ABSTRACTS

IBIA 2021 virtual event: a global conference and meeting of minds for adult and pediatric brain injury professionals

3 Spontaneous Migration of a Falling Bullet in the Cerebellum Reveals the Importance of Intraoperative Skull X-Ray

Ali Hammed\textsuperscript{a}, Moufid Mahfoud, Alaa Sulaiman\textsuperscript{a}, Salah Hammed\textsuperscript{b}

\textsuperscript{a}Tishreen University Hospital, Syrian Arab Republic; Latakia, Tishreen University Hospital, Syrian Arab Republic, \textsuperscript{b}Faculty of medicine, Aleppo, Syria

ABSTRACT

Craniocerebral gunshot wounds (CGSWs) are the most lethal types of the cranial traumas and they are usually mortal. Falling bullets or gravitational bullets are the ones that move under the effect of the gravitational force after the muzzle force diminished. CGSWs constitute a major clinical challenge for neurosurgeons dealing with trauma in both the military and civil experience. We report the case of a 21-year-old man with a falling bullet wound to the head-falling bullet wound to the head. In his physical examination, there was a single-entry wound situated on the left side of the parietal bone, about 2 cm left of the midline. Brain tissue was seen through the open wound. In the first neurological examination, the patient was confused and GCS at the time of admission was 14. Pupils were equally reactive, and his vitals were stable. Cranial computerized tomography (CT) revealed a bone defect of 0.5 cm in the left parietal region and a metallic object located between left occipital bone and inferior side of left cerebellar hemisphere. The patient underwent a left unilateral retrosegmoid craniectomy. Intraoperative skull X-ray was obtained and it revealed that the bullet had migrated upward inside the left cerebellar hemisphere and the bullet was removed. The decision of surgical treatment of a bullet injury is difficult if it is in close proximity to vital structures, removal of the bullet may cause significant neurological damage; however, migration can lead to a worsening of the neurological status of the patient.

4 Using PPI (Public and Patient Involvement) in Neurorehabilitation Service Research Prioritization

Lorraine Crawley\textsuperscript{c}, Grainne McGettrick\textsuperscript{b}, Kevin Hughes\textsuperscript{c}, Leanne Brennan\textsuperscript{a}

\textsuperscript{a}Acquired Brain Injury Ireland, Limerick, Ireland, \textsuperscript{b}Acquired Brain Injury Ireland, Dublin, Ireland, \textsuperscript{c}Acquired Brain Injury Ireland, Clare, Ireland, \textsuperscript{d}Acquired Brain Injury Ireland, Sligo, Ireland

ABSTRACT

Objective: A Research Prioritization Exercise (RPE) was conducted to determine research focus for the coming years in an adult neurorehabilitation service. As best practice guidelines in health research highlight that Public and Patient Involvement (PPI) should be a key component, particular emphasis was placed on including the perspectives of clients and family members in the RPE.

Design: Due to COVID-19 restrictions, the planned focus groups with clients and family members were altered to telephone and zoom contact and questionnaires were distributed through an online system.

Method: Following a literature review and scoping, a research prioritization questionnaire to all stakeholders was designed with input from clients on the content. The results were analyzed with client and family member involvement.

Results: The following research priority themes were agreed from 259 responses: ‘Effective rehabilitation,’ ‘Access to services and the rehabilitation pathway,’ ‘The impact of brain injury’ and ‘The facts and figures.’ Clients and families suggested the themes were interlinked. The involvement of clients throughout the research process, rather than as solely ‘research participants,’ was highlighted as crucial.

Conclusions: The themes now form the core part of our research work for this strategic phase of our service. Our clients and their families are at the center of these priorities. Researchers will have to provide evidence of their PPI plan to our Ethics Committee and we will examine how we can support our clients in this process of being more prominent stakeholders in service research.

5 Concussion in Women’s Flat-Track Roller Derby

Melissa Stockbridge\textsuperscript{c}, Zafer Keser\textsuperscript{a}, Rochelle Newman\textsuperscript{b}

\textsuperscript{a}Johns Hopkins University School of Medicine, Baltimore, United States, \textsuperscript{b}University of Maryland, College Park, United States

ABSTRACT

Concussions are common among women’s flat-track roller derby players, a unique and under-studied sport, but little has been done to assess how common they are, how impactful they are on players’ cognition and communication, and what players can do to manage injury risk. The purpose of this research was to provide a thorough and updated look into concussion incidence and experience by players of roller derby.
Six hundred sixty-five adult roller derby players from 25 countries responded to a comprehensive online study by providing medical histories and completing cognitive and linguistic tasks targeting memory, attention, word-finding, and discourse: multiple variations of the n-back task, letter fluency, category fluency, picture naming, and expository language sampling. Participants also responded to a battery of psychometric assessment tools targeting risk-factors for poor injury recovery (negative bias, social support, mental toughness) and players' thoughts and feelings in response to injury: the Big Five Inventory 2 negative emotionality items, Multidimensional Scale of Perceived Social Support, Brief Resilience Scale, Sports Mental Toughness Questionnaire, Injustice Experience Questionnaire, and an adaptation of the Revised Illness Perception Questionnaire referencing concussion. Per 1000 athletes, 790.98 concussions were reported. Current players reported an average of 2.2 concussions over 4.6 years of play, while former players reported 5.8 concussions over 5.8 years of play, a significant difference (Levene’s F = 14.14, p < 0.001; t(154.94) = 3.72, p < 0.001). Between four and five concussions, the relative incidence of concussion for current and past players noticeably shifted. Twenty-three percent of the past players had five or more concussions, in contrast with 8.5% of current players. These data provide insight into the common narrative shared by roller derby players, that many retire due to injury.

We found no evidence that players’ position, full-contact scrimmages, or flooring impacted number of concussions. However, in a model that significantly predicted an individual player’s number of concussions (R² = 0.07, F(5, 569) = 7.85, p < 0.001), neurological history (of greater severity than concussion; t = 3.16, = 0.002, β = 1.38) and uncorrected visual disturbance (t = 3.58, p < 0.001, β = 1.28) were more influential predictors of an individual’s number of concussions during roller derby than years of participation (t = 1.99, p = 0.05, β = 0.05) or age (t = 2.02, p = 0.04, β = 0.02), though all four contributed significantly.

Although players described lingering somatic symptoms, there was no evidence that their concussion histories significantly impacted their attention, working memory, or language at the single word level or in written samples when controlling for differences in age and education. This supports the narrative in the literature that concussions are fundamentally mild in nature with deficits not observed in single skill or discourse-based tasks among individuals with either recent concussions or a concussion history.

6 Brain Injury: Voices of a Silent Epidemic

Cindy Daniel†, Andrew Palumbo†

†National Concussion Management Center, Lexington, United States

ABSTRACT

Long-term outcomes from brain injury are difficult to predict and more challenging to fully understand. We see athletes who have been concussed, soldiers coming back from war with brain injuries, even political figures who have sustained brain injuries through assault who have lived to tell their stories. Even though traumatic brain injuries now receive unprecedented attention in popular media, the common perception of recovery still tends to gloss over the longer-term struggles that many face. What can we do to help others really understand what they are going through and to encourage successful reintegration?

The video guides viewers on a journey about the brain injury – its causes and effects on people who are injured and those around them. This video was designed to help laypersons understand the impairments and changes in abilities that occur following brain injury. Viewers are guided through primary functions of the brain by active professionals in the field, supported by personal testimonials from survivors of brain injury regarding daily challenges and successes they face.

Individuals who view this video gain a better understanding and perspective regarding what individuals with brain injury experience by seeing and feeling their brain injuries through their personal experiences. The professional narration assures clear scientific and clinical grounding, something that is often absent from such intimate examinations. The video has also been recognized for its potential to teach a number of professions, such as clinicians, caregivers, attorneys and policymakers.

Many survivors of brain injury can appear to be completely uninjured in their day-to-day lives, but the fact remains that altered brains often result in persistent hidden challenges that can have adverse and dramatic daily effects. Just as advances in neurology have improved the survival rate of those who sustain a brain injury, increased awareness and understanding of these injuries by laypersons and professionals will help improved recovery and reintegration of brain injury survivors. By exploring the cases presented in this video and tying them back to today’s understanding of the brain, this silent epidemic is given a new voice that can speak to people unfamiliar to brain injury.

7 Emergency Preparedness and Ensuring the Safety of Persons with Brain Injuries

Cindy Daniel†

†National Concussion Management Center, Lexington, United States

ABSTRACT

The most lethal part of an emergency is the lack of preparedness in dealing with it: people are caught off guard, becoming confused, frightened, and disoriented; and these challenges are even more pronounced for those with disabilities – particularly hidden ones such as brain injuries. This has become apparent in recent natural disasters when thousands of evacuated people simply fall through the cracks. After critical analysis of what goes wrong, and under new legislation mandating precise procedures, we now have more refined means of guiding people through emergency situations, the efficacy of which can be seen in more recent disasters.
For example, the major failings in dealing with Hurricane Katrina were lack of communication, education, and resources for dealing with large-scale chaos. Notably, emergency service providers were simply ill-prepared for handling the volume of shocked people. As the result of responsive education and protocols put in place to solve these problems, we are now seeing fewer casualties in disaster scenarios.

The key indicators of this process improvement are that supplies are being made accessible more quickly, emergency workers are better prepared to guide citizens out efficiently, and increased trust in preparedness protocols and evacuation processes has yielded more collected attitudes through disaster scenarios.

We can be better prepared for future emergencies by distilling the lessons learned over the last decade into these four steps of prevention:

- Why do not we prepare?
- Understanding people with disabilities
- Accommodating people with disabilities in an emergency
- Preparing for an emergency

It is possible for us all to have a clearer understanding of why we should prepare before an emergency hit and what to do when that happens. This also dramatically improves aid to persons with disabilities, especially persons with brain injuries. The following questions can help us be better prepared:

- Do you have a “go kit” ready?
- Do you have an emergency plan, or know where to go if you are evacuated?
- Hospitals and shelters: Is your facility fully accessible to people with disabilities in a disaster?
- Service providers: Do you have the means of providing accessible transportation in an emergency?

8 Post-Covid growth in Neuro-rehabilitation Services in Ireland- Covid-19 as a Potential Catalyst for Change in the Field of Neuro-rehabilitation for those with an Acquired Brain Injury

Kevin Hughes

Acquired Brain Injury Ireland, O’Meara House, Ballinacurra Rd, Ireland

ABSTRACT

Acquired Brain Injury (ABI) consists of any trauma to the brain. While the world has been dealing with the Covid-19 pandemic, the prevalence of ABI is a pandemic of a silent nature which is nonetheless an emerging health burden. Global estimates suggest that traumatic brain injury (injury caused by an external force) affects 10 million people annually (Hyder et al., 2007). In light of Covid-19, those working in the field of Neuro-rehabilitation had to adapt in order to provide vital support and continued rehabilitation for those with ABI. Many services switched to a Tele-Rehabilitation (TR) strategy to allow rehab to continue remotely while maintaining physical distancing. TR has been widely utilized in countries such as the United States, and Australia, and has a strong evidence base for its efficacy. This presentation will use case studies to explore the adaptation of TR by an ABI Neuro-rehabilitation service, and discuss how we can use this time as an opportunity to reconceptualize the way we structure neuro-rehabilitation in Ireland to combat service shortages, and in doing so improve outcomes for our clients.

9 Evaluating a Compassion Focused Therapy Group for Adults with Acquired Brain Injury

Lorraine Crawley\textsuperscript{a}, Louise Peoples\textsuperscript{b}

\textsuperscript{a}Acquired Brain Injury Ireland, Limerick, Ireland, \textsuperscript{b}Headway, Limerick, Ireland

ABSTRACT

Objective: Evaluate the effectiveness of a Compassion Focused Therapy (CFT) group for adults with Acquired Brain Injury in the context of coping with stressors. Design: The original quantitative (pre/post questionnaires) design was altered due to COVID-19 restrictions ending the group prematurely at session 7 of 10. Contact with the group continued by e-mail for the next 3 months. Qualitative interviews were then carried out 6 months later and questions on the altered ending were included. Method: Out of the eight participants who started the group, six consented to take part in the qualitative interview which due to COVID-19 restrictions were completed remotely. An interview protocol focusing on eight key areas (including session content, group experience and impact of COVID-19 restrictions on session completion) was utilized. The content of the interviews were analyzed using interpretative phenomenological analysis. Results: Three core themes emerged from the interviews, namely the usefulness of the compassion focused model to address stress, the importance of group cohesion and the timing of the intervention. A preference was expressed for face-to-face group work rather than through technology options. Conclusions: Participants successfully transferred strategies discussed during the group to daily life and reported increased coping with stress as a result. The feedback provides encouragement for continued provision of this type of therapeutic group to clients when COVID-19 restrictions ease. The positive impact of attending a CFT group adds to the growing body of research in this area.

10 Prevalence, Predictors, and Outcomes of Traumatic Brain Injury in Young Offenders

Hope Kent\textsuperscript{a}, Huw Williams\textsuperscript{a}, Lee Hogarth\textsuperscript{a}

\textsuperscript{a}University Of Exeter, Exeter, United Kingdom

ABSTRACT

Violent crime is a multifaceted problem, and recent literature has begun to elucidate the role of traumatic brain injury (TBI) in offending behavior. TBI is a silent epidemic among young offenders and has been linked to problems with impulsive
aggressive behavior, social communication, and information processing which increase vulnerability to repeated contact with the criminal justice system. We examined the self-reported prevalence, predictors, and outcomes of traumatic brain injury in a sample of 96 male young offenders aged 16–18. Of this sample, 74% had experienced a lifetime head injury, and 46% had experienced a head injury leading to a loss of consciousness (LOC). This is significantly higher than in the general population, where it is estimated that 8–12% of people have had a head injury leading to LOC. Ninety percent of participants had a history of at least one violent offence. Frequency of these violent offences was predicted by the severity ‘dosage’ of lifetime TBI. Post-concussion symptoms (PCS), including forgetfulness, confusion, and concentration, significantly mediated the relationship between TBI and violent offending. Furthermore, poor parental supervision during childhood and adolescence was significantly associated with both more severe head injuries, and with higher levels of self-reported aggression. This research has implications for the early identification and intervention for vulnerability factors to violent crime. Parenting interventions could reduce incidence of severe TBI and improve outcomes following TBI. Screening for cognitive PCS could reveal those most at-risk of violent offending and provide insight into both the mechanism by which TBI influences violent crime. Collectively, more effective screening, early identification, and early intervention, can help to rehabilitate this highly vulnerable group and protect against the criminalization of neurological disabilities, fostering an ecology of support around at-risk young people.

Psychological distress is defined as a state of emotional suffering associated with stressors and demands that are difficult to cope with in daily life. The relationship between grief and psychological distress is variable, however what is clear is that where unresolved grief exists a person or system may be significantly impeded. In family systems that have experienced a life altering event such as a brain injury, unresolved grief is predetermined and may delay or prohibit recovery. The ambiguity of the loss makes it difficult to grieve because there is no closure and the loss is ongoing. Families can be become frozen in their grief and disruption can ensue, often resulting in an emotionally painful, confusing and unresolved mourning process. Unlike death there is no official verification of loss and thus no finality with rituals of support. Research has shown that people are often criticized for not finding closure and left on their own to cope, isolated and trapped between hope and despair, with lingering grief that is often unfairly diagnosed as personal or family pathology. This presentation will explore ambiguous loss and will seek to find meaning in the experiences of individuals and families affected by a brain injury. The objective of the presentation is to inform the reader of how individuals and families can be supported in the grieving process. The clinician will argue that there is a deficit in services and further research needs be undertaken to secure funding so that supplementary support services can be evolved. A recommendation will be made for the development of an educational handbook for professionals working in brain injury services. The handbook will provide a detailed working model on how to address unresolved grief and enhance quality of life of both the individual with the neuro-rehabilitation need and their family members.

11 Finding Meaning in Ambiguous Loss: The Correlated Loss following a Traumatic Brain Injury and the Impact on Individuals and Families

Danielle Manning*

*Acquired Brain Injury Ireland, Ennis, Ireland

ABSTRACT

Brain injury is a silent epidemic and is one of the leading causes of death and disability worldwide. In Ireland, it is estimated that 11,000 people are hospitalized each year due to a brain injury. In many cases individuals with a brain injury are left with a permanent disability as a consequence of cognitive impairments, adverse personality changes and emotional and communication difficulties. Such impairments can affect their capacity to work, drive and live independently. The outcome for individuals effected by a brain injury is difficult to determine. In some cases individuals may require long-term care due to ongoing disabilities. Research has shown that the burden of care is often placed on family members who subsequently assume the role of caregiver. As a consequence this can result in alteration in family roles, relational dysfunction, unmet family needs and psychological distress.

12 Concussion in Children Under the Age of 6

Cara Zukewich*

*Saskatchewan Prevention Institute, Saskatoon, Canada

ABSTRACT

There is rapid growth and development of the brain during early childhood. The brain is vulnerable during this time. The functioning of the brain can be affected by a concussion. Children’s developing brains are very sensitive to this type of injury. It can take longer for children’s brains to heal after a concussion compared to adults, meaning that their symptoms can last longer. It is important for parents and caregivers to recognize the signs and symptoms of a concussion, learn how to prevent a concussion, and know what to do if their child gets a concussion.

Information will be shared about the following:

0 Where and when does a concussion happen?
0 What are the symptoms of a concussion?
0 Treatment
0 Prevention
0 Outcomes
0 Tools and Resources
13 The Gendered Legitimacy Deficits of MTBI

Marley Olson*

*University Of Colorado Boulder, Boulder, United States

ABSTRACT

Traumatic brain injury (TBI) is a pressing public health issue. It is a major cause of long-term disability across the world with an estimated 10 million people per year being affected (Hyder et al. 2007). One of the known risk factors for TBI is sex and gender. Findings of sex and gender differences in traumatic brain injury research first appeared in the literature over twenty years ago. Today, the lay public and the medical community still remain largely uninformed of the special challenges faced by women with concussion and traumatic brain injury. Gender is an especially important social determinant of concussion and traumatic brain injury as there are epidemiological differences between men and women that cannot be fully explained by sex, suggesting that there is something social and systematic about the observed disease patterns: gender. The gender gap in concussion can be understood through the processes of medicalization and gender that operate interactively to manifest head injury as a “men’s” condition. Women as patients do not fit the cultural frameworks that construct the imagined concussion sufferer. Despite the fact that men in war or on the football field are the culturally dominant images of concussion and traumatic brain injury, women are more likely to sustain a concussion, report more and extended symptoms, and have worse recovery outcomes than men. The prevalence of women’s concussion and traumatic brain injuries has widely been ignored. This ultimately affects the diagnosing of and treatment of women’s concussions and traumatic brain injuries. This chasm in gendered concussion epidemiology offers a rich context in which to examine how social processes, such as the gender system, intersect with medicine to create a dissonance between the legitimacy of a diagnosis and the legitimacy of some patients – a dissonance that produces disparate sequelae in men’s and women’s illness experiences of concussion and traumatic brain injury that cannot be understated.

In my presentation, “The Gendered Legitimacy Deficits of Mild Traumatic Brain Injury,” I draw on qualitative research using interviews and focus groups to address the legitimacy deficits women uniquely face as mild traumatic brain injury (mTBI) patients, and how this may affect their recoveries. I discuss the social systems that produce masculinized politics of concussion and traumatic brain injury. I show how these politics differently shape men and women mTBI patients’ experiences to create more or less access to health-care resources, thereby affecting their prognoses. I offer a theory of the contested sick role to explain my research finding that women report significantly more legitimacy deficits throughout the disease process. In doing so, I move the conversation beyond the effects of sex in mTBI prognosis to consider how gender – as a social system – impacts mTBI epidemiology.

14 The Impact Spectrum of Head Injuries on the Sport of Hockey

Caleb Neal*

*Community Healthcare Network, New York, United States

ABSTRACT

Sports concussions have become a more prevalent issue in the past several years, as more research is done the consequences of head injuries, including their long-term effects, are becoming clearer. The Center for Disease Control and Prevention (CDC) estimates there are between 1.6 and 3.8 million sports and recreation-related concussions per year, in fact that there are over 4 million concussions (including non-sports related) in total each year. The most widely accepted definition for a concussion is provided by the consensus statement on concussion in sport at the 4th International Conference on Concussion in Sport in Zurich, which states “a concussion is a brain injury and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces.” Concussions are caused by the rapid movement (linear front-to-back, side-to-side) or rotational (angular) movement of the brain inside the skull, resulting in damage and disruption to the brain cell function, causing brain trauma. The word “concussion” comes from the Latin “concussus,” which means to shake violently.

Concussions are typically caused by a blow to the head, neck, or, face, or by a blow elsewhere that transmits a force to the head, typically resulting in a rapid onset of short-lived neurological impairments, and may even result in neuropathological changes. Sports-related concussions (SRCs) are concussions that are specifically sustained during a sporting event. The sport with the highest incidence of concussions is actually biking, but the highest team sports are football and hockey. The literature shows concussions result in a wide range of graded cognitive, somatic, and neurological symptoms, with the most reported symptom being headaches. Age, gender, and post-concussion activity levels have all been shown to be modifying factors of symptoms and neurocognitive function.

For this literature review, various academic sources (such as PubMed and the National Center for Biotechnical Information) were used to find medical journal articles and other sources on concussions. After researching the science of concussions, the next part of the research was dedicated to looking at the incidence of head injuries in the NHL. This included looking up NHL Concussion Protocol, new rules, hockey equipment and their effect on concussions, and the mechanisms of concussion in the sport of hockey. Finally, after looking at head injuries in hockey, the last part of the research for this review centered around long-term effects of concussions. There is a specific focus on incidence of depression, suicide, and Chronic Traumatic Encephalopathy (CTE) in retired athletes. Another primary focus of this literature review was to look at the relationship between hockey and head injuries.
15 Assessment of Potential Concussions in Elite Male Hurling: Are Players Receiving an Appropriate Standard of Care?

Mario P. Rotundo, Darek Sokol-Randella, Gregory Tierney, Conor Deasy, Michael Cusimano

School of Medicine, University College Cork, Cork City, Ireland, School of Biomedical Sciences, University of Leeds, Leeds, United Kingdom, Cork University Hospital Emergency Department, Cork City, Ireland, University of Toronto, Toronto, Canada

ABSTRACT

Background: Hurling is a fast-paced contact sport that places players at risk of concussion. Given the consequences of repeated concussions, it is imperative that sideline management guidelines are followed.

Hypothesis/Purpose: To determine if Potential Concussive Events (PCEs) in elite Hurling are assessed in accordance with league guidelines. The secondary objective is to investigate the effectiveness of current concussion training programs.

Methods: Video analysis was used to identify PCEs throughout the 2018 and 2019 inter-county Hurling seasons and championships. Assessment, return to play decisions, and signs of concussion were evaluated based on previously validated methodology.

Results: A total of 183 PCEs were identified over 82 matches. PCEs were frequently assessed (86.3%, n = 158), but most assessments were under 1 minute in duration (81.0%, n = 128). Thirteen (7.1%) players were removed following a PCE. Forty-three (23.5%) PCEs resulted in one or more signs of concussion, of which 10 (23.3%) were removed from play. There was no difference in rate of assessment, duration of assessment, or rate of return to play between 2018 and 2019.

Conclusion: In elite Hurling, suspected concussions frequently elicit brief assessment and rarely result in removal from play. Affirmative action is needed to ensure that standardized concussion assessment occurs in the Gaelic Games.

16 Characteristics and Assessment of Potential Concussive Events in the UEFA Champions League

Darek Sokol-Randella, Mario P. Rotundo, Claire Denley, Matthew Aranha, Antoin Stanton, Michel Attia, Abdulhakim Jilani, Conor Deasy, Michael Cusimano

University College Cork, Cork City, Ireland, Cork University Hospital, University College Cork, Cork City, Ireland, Injury Prevention, University of Toronto, Toronto, Canada

ABSTRACT

Background: Athletes involved in elite sports such as Association Football (AF) are at a high risk of sustaining Sport-Related Concussion (SRC). The current study investigates the characteristics of potential concussions in AF, as well as the quality of subsequent assessment with respect to the International Football Association Board (IFAB) and International Conference on Concussion in Sport (ICCS) recommendations.

Study Design: Descriptive Epidemiology Study

Methodology: Trained reviewers identified potential concussive events (PCEs) throughout 121 matches of the 2019/2020 Men’s UEFA Champions League (CL) tournament, using a standardized observation protocol. Each PCE was analyzed for visible signs of concussion and circumstantial factors, as well as assessment incidence, duration, and return-to-play decision.

Results: Over 121 matches, 202 PCE incidents were identified. Sixteen incidents involved two PCEs, producing a total of 218 PCEs (1.80 per match, 54.59 per 1000 match hours). Of the 218 PCEs, 107 (53.0%) occurred in an aerial battle. PCEs most commonly occurred in the center region of the pitch (45.41%, n = 99). The mandibular region was found to be the most frequently affected region of the head (30.7%, n = 67), with arm/elbow to head (38.1%, n = 83) being the most common mechanism. Strikes to the frontal region were most likely to produce one or more signs of concussion (34.5%, n = 10), followed by the temporal region (30.4%, n = 14).

Of the 218 PCEs, 54 (24.8%) were assessed by medical personnel, often on the sideline (83.3%, n = 45). However, 73.3% (n = 33) of sideline assessments were under 1 minute in length. Fifty (22.9%) players sustaining a PCE displayed one or more signs of concussion. Of these, 23 (46.0%) were assessed by medical personnel. One (2.0%) was permanently removed from play.

Conclusion: PCEs frequently result from aerial duels and are most commonly associated with arm/elbow strikes. The mandibular region is most frequently affected. The findings from this study provide initial guidance for the development of player protection strategies to reduce the incidence and severity of SRC in the CL.

Players suffering a PCE are occasionally assessed, often on the sideline. However, assessments rarely last longer than a minute. Players are seldom removed from play, even when visible signs of concussion are present. Improved adherence to IFAB and ICCS concussion guidelines is needed.

17 The 2019 Neuro-rehabilitation Implementation Framework in Ireland: Challenges for Implementation and the Implications for People with Brain Injuries

Grainne McGettrick, Karen Foley, Sara Burke, Sarah Barry, Manjula Manikandan

Acquired Brain Injury Ireland, Dun Laoghaire, Dublin, Ireland, Trinity College Dublin, Dublin, Ireland, Royal College of Surgeons, Dublin, Ireland

ABSTRACT

In 2019, 8 years after the publication of Ireland’s first neuro-rehabilitation strategy, an implementation framework was published. This paper describes and assesses the Irish health
18 Exploring the Use of Technology in our Community Rehabilitation Service during the Pandemic

Karen Foley, Grainne McGettrick

A Acquired Brain Injury Ireland, Dun Laoghaire, Dublin, Ireland

ABSTRACT

In March 2020 with the onset of the Covid-19 pandemic, Acquired Brain Injury Ireland as a specialist community rehabilitation service provider, moved from a face-to-face to a largely tele-rehabilitation model of service in the community. Our services are inter-disciplinary led with highly trained Rehabilitation Assistants working on a one-to-one basis with the client to implement the Individualised Rehabilitation Plan. Due to successive national lockdowns, social distancing measures and the health and safety risk posed by the pandemic, this model of service, largely provided in the person’s home was on longer possible. Therefore, we quickly adapted to provide our range of interventions using a variety of online platforms and methods of engagement. Almost a year into the pandemic we conducted a survey of our clients which aims to provide a snapshot of how they are experiencing their usage of technology during the COVID-19 pandemic. The survey was administered using Survey Monkey software in February 2021 during our third National Level 5 lockdown. A total of nine questions were asked, eight multiple choice, one open-ended where respondents were invited to submit their ideas for the future use of technology in their rehabilitation.

There were 134 respondents in total, all ABI Ireland clients currently using our services. Overall, clients’ use of technology during the pandemic has been largely positive. In the main, they had access to the necessary equipment and broadband services that they needed to get on-line. Many continue to require on-going support to engage. The respondents provided ratings on how useful or not technology usage was during the pandemic and how easy/difficult they found using technology for rehabilitation. The research explored the advantages and disadvantages of using technology and respondents were asked to rate their future preferences. Finally, the research explores respondents’ ideas for the future in relation to using technology. The responses were wide and varied with training in tech for cited, as well as information on the most appropriate apps/online resources. More creative solutions are required for those with sensory, visual and hearing impairments. It is clear from our findings that, despite the drawbacks, technology has an important role in the future delivery of rehabilitation programs and that clients want to have a combination of in-person and tech responses available to them. Many respondents used the opportunity to point out that nothing takes the place of human contact.

19 Which Factors Contribute to Upper Limb Associated Reactions During Walking in People with Acquired Brain Injury?

Michelle Kahn\textsuperscript{a,b}, Ross Clark\textsuperscript{b}, Benjamin Mentiplay\textsuperscript{c}, Kelly Bower\textsuperscript{d}, John Olver\textsuperscript{a,e}, Prof Gavin Williams\textsuperscript{a,d}

\textsuperscript{a}Epworth Healthcare, Melbourne, Australia, \textsuperscript{b}University of the Sunshine Coast, Sunshine Coast, Australia, \textsuperscript{c}La Trobe University, Melbourne, Australia, \textsuperscript{d}The University of Melbourne, Melbourne, Australia, \textsuperscript{e}Epworth-Monash Rehabilitation Unit, Melbourne, Australia

ABSTRACT

Aim: To determine which potential contributing factors are associated with expression of upper-limb associated reactions during walking.

Design: Cross-sectional observational study.

Method: Forty-two participants with a brain injury and upper-limb associated reaction during walking underwent three-dimensional motion analysis. A composite score outcome measure quantified upper limb kinematic deviation compared to healthy controls. Clinical assessment included: upper and lower limb hypertonicity, spasticity and strength, balance, dynamic walking stability, arm and leg function, anxiety, arm pain/discomfort, and fear of falling. Pearson correlation coefficients ($r$) were calculated to quantify the extent of associations between these outcomes. For those that were not normally distributed, Spearman correlation coefficients ($p$) were used. For impairments where there was the ability to dichotomize the group into two independent samples. Further analyses were performed to determine if the feature had an impact on AR presentation with t-test calculations and Cohen’s ‘$d$’ effect size (ES) quantifying the statistical difference and magnitude difference in associated reaction between the two groups. Additionally, Chi-squared analyses explored the relationship between hypertonicity and spasticity of each of the upper limb muscles and the AR at the corresponding upper limb joint axis.

Results: Significant, moderate-to-strong correlations ($r = 0.42–0.74$, $p < 0.05$) existed between upper limb associated reactions and hypertonicity and spasticity of the upper limb muscles and
the knee extensors. Significant, moderate correlations \( r = 0.42-0.59, p < 0.05 \) existed for balance, dynamic stability, upper limb strength, and arm function. Participants who had shoulder internal rotator, elbow, forearm, and finger flexor hypertonicity; elbow and finger flexor spasticity; knee extensor spasticity; and, reduced dynamic stability had a more severe AR \( p < 0.05 \); effect sizes \( \geq 0.80 \). Associated reactions were also present without these features. For example, an elbow joint axis AR was present in 21% of participants without elbow flexor hypertonicity and 33% without elbow flexor spasticity.

Conclusion: Associated reactions are complex and multifactorial. Upper limb muscle hypertonicity and spasticity were prevalent and should be prioritized for assessment however, associated reactions were present in the absence of these features. Hypertonia and spasticity should be differentiated in their relationships to associated reactions. Knee extensor hypertonia and spasticity, postural stability, upper limb strength, and arm function may also be important factors to consider for associated reactions during walking.

20 Defining the Kinematics and Measuring Upper Limb Associated Reactions During Walking in People with Acquired Brain Injury

Michelle Kahn\(^{a,b} \), Gavin Williams\(^{a,c} \), Benjamin Mentiplay\(^d \), Kelly Bower\(^e \), John Olver\(^{a,c} \), A/Prof Ross Clark\(^b \)

\(^a\)Epworth Healthcare, Melbourne, Australia, \(^b\)University of the Sunshine Coast, Sunshine Coast, VIC, \(^c\)University of Melbourne, Melbourne, Australia, \(^d\)La Trobe University, Melbourne, Australia, \(^e\)Epworth-Monash Rehabilitation Unit, Melbourne, Australia

**ABSTRACT**

Aim: To use three-dimensional motion analysis during walking to:

1. Define upper limb associated reaction kinematics
2. Devise composite score outcome measures to quantify associated reactions

**Design:** Cross-sectional observational study.

**Method:** Forty-two participants with a brain injury and hemiplegic upper limb associated reaction during walking and 36 healthy controls underwent three-dimensional motion analysis. The mean, standard deviation, peak and total joint range-of-motion were calculated for each axis across the gait cycle. Associated reaction kinematics were evaluated first on a group level with analysis of covariance quantifying the between-group differences. Second, associated reaction kinematics were evaluated on an individual participant level with calculation of the percentage of participants with brain injury classified as abnormal for each outcome variable. Abnormality was defined as \( \pm 1.96 \) standard deviation of the healthy control mean. Composite score outcome measures were devised for the for the affected upper limb to quantify the associated reaction kinematic abnormality with evaluation of their validity, test–retest reliability, and responsiveness.

**Results:** Significant between-group differences existed for all elbow and shoulder abduction outcome variables \( p < 0.01 \), most shoulder flexion variables, forearm rotation standard deviation and range-of-motion and wrist flexion range-of-motion. Associated reactions most frequently affected elbow flexion and shoulder abduction axes. The elbow was most prevalently affected \( 38/42, 90\% \), but abnormality at the shoulder \( 32/42, 76\% \), forearm \( 20/42, 48\% \) and wrist joints \( 10/42, 24\% \) were common. Very-strong correlations existed within the composite scores \( r > 0.98 \). All scores had very-strong test–retest reliability \( (ICCs > 0.81) \) and provided different information regarding the effort-dependent change in associated reactions.

Conclusion: All upper-limb joints are commonly implicated in associated reactions and therefore warrant inclusion in clinical assessment. Composite scores combined kinematic data to yield a summary score of associated reaction abnormality. Composite scores comprehensively assessed the whole upper-limb associated reaction, accurately classified abnormality, and quantified severity with very-strong clinimetrics.

21 Ecological Validity for Upper Limb Associated Reaction Testing

Michelle Kahn\(^{a,b} \), Gavin Williams\(^{a,c} \), Benjamin Mentiplay\(^d \), Kelly Bower\(^e \), John Olver\(^{a,c} \), Ross Clark\(^b \)

\(^a\)Epworth Healthcare, Melbourne, Australia, \(^b\)University of the Sunshine Coast, Sunshine Coast, VIC, \(^c\)University of Melbourne, Melbourne, Australia, \(^d\)The University of Melbourne, Melbourne, Australia, \(^e\)La Trobe University, Melbourne, Australia, \(^e\)Epworth-Monash Rehabilitation Unit, Melbourne, Australia

**ABSTRACT**

Aim:

1. To evaluate relationships between stationary and dynamic-associated reaction tests in people with acquired brain injury
2. To evaluate the relationship between surface electromyography and kinematics for in associated reactions
3. To evaluate the test–retest reliability of these assessments

**Design:** Cross-sectional observational study.

**Method:** Participants underwent associated reaction testing with seated contralateral maximal voluntary isometric contraction tests and walking (self-selected and fast speeds). For seated tests, measures included biceps surface electromyography and elbow goniometry. For walking tests, measures included biceps surface electromyography and three-dimensional motion analysis kinematics. Pearson’s correlations evaluated the relationships. A subgroup of chronic participants (\( > 1 \) year post injury) were reassessed one-week later for reliability.

**Results:** For biceps brachii sEMG during seated and walking tests, there was a strong \( r = 0.65 \) and moderate \( r = 0.53 \) relationship at self-selected and fast walk, respectively. A low-to-moderate relationship existed between biceps brachii sEMG...
and kinematics during walking, and between seated and walking measures of ARs \( r = 0.23 \) to 0.53. All tests had strong-to-very strong test–retest reliability (intra-class correlation coefficients > 0.78).

Conclusion: Seated tests (measured by goniometry and biceps surface electromyography) correlate only weak-to-moderately to associated reaction walking kinematics, and moderately-to-strongly with biceps surface electromyography during walking. Moderate relationships existed between surface electromyography and kinematics, indicating they may provide different information for associated reactions. Seated maximal force associated reaction tests do not reflect their functional occurrence, suggesting questionable ecological validity. Kinematics provide an objective measure of the visual appearance of associated reactions. Reliable and portable surface electromyography is now available and may provide complimentary information to assist in differentiating contributing factors to associated reactions.

### 22 Comparing the Accuracy of Subjective Assessment to Criterion-reference Three-dimensional Motion Analysis for Upper Limb Associated Reaction Assessment During Walking in People with Acquired Brain Injury

Michelle Kahn\(^{a,b}\), Gavin Williams\(^{c,d}\), Benjamin Mentiplay\(^{a}\), Kelly Bower\(^{a}\), John Olver\(^{a,c}\), Ross Clark\(^{b}\)

\(^{a}\)Epworth Healthcare, Melbourne, Australia, \(^{b}\)University of the Sunshine Coast, Sunshine Coast, Australia, \(^{c}\)University of Melbourne, Melbourne, Australia, \(^{d}\)La Trobe University, Melbourne, Australia, \(^{e}\)Epworth-Monash Rehabilitation Unit, Melbourne, Australia

**ABSTRACT**

**Aim:** To compare the accuracy of subjective upper-limb associated reaction rating during walking using the International Classification of Functioning, Disability and Health Framework Qualifiers Scale compared to kinematics from criterion-reference three-dimensional motion analysis.

**Design:** Cross-sectional observational study.

**Method:** Forty-one participants with a brain injury and an upper-limb associated reaction during walking underwent three-dimensional motion analysis at their self-selected walking speed with kinematic deviation scores quantifying abnormality in the whole upper limb and each joint axis. Three experienced neurological physiotherapists viewed video recordings of the participants’ walking trials and applied the Qualifiers Scale to subjectively rate the global associated reaction severity and severity at each upper limb joint on a 5-point scale. The comparative accuracy was calculated via quantifying relationships (Fisher’s exact test), percentage agreement, sensitivity, and specificity.

**Results:** The Qualifiers Scale had limited accuracy compared to three-dimensional motion analysis upper limb assessment. The wrist severity score was the only outcome demonstrating a significant relationship to the corresponding kinematic deviation score (\( p < 0.05 \)). Four out of seven outcomes had ≤ 58% agreement in abnormality classification. None of the outcomes had high sensitivity and specificity. The sensitivity was relatively low for all outcomes (0.32–0.73) and specificity relatively high (>0.80) for four of the seven outcomes.

Conclusion: The Qualifiers scale tended to under classify abnormality compared to three-dimensional motion analysis with false negatives likely. The Qualifiers scale cannot be confidently implemented in clinical practice. There appears to be a disconnect between 3DMA and subjective rating of ARs. Objective associated reaction assessment is required.

### 23 Sisu To a New You: Transformation After Brain Injury

Kelly Thune\(^{a}\)

\(^{a}\)Kelly Education Consulting, Fayetteville, United States

**ABSTRACT**

Participants will learn through a series of purposeful reflective questions, research-based strategies, and relevant stories how they can use the Finnish cultural context of sisu (a noun and a verb translating to having perseverance, integrity, and tenacity) to face significant adversity. Tenants include learning the history of the word sisu, confronting challenges, reflection as a tool, exercise and training, finding enjoyment while in discomfort, becoming reason and learning informed, developing connections and relationships, and restoring balance, purpose, and goal-setting.

Kelly has used her credentials and expertise in education and curriculum writing to develop a weekly plan including a daily sisu building focus to overcome adversity from brain injury or any hardship including the isolation that many are feeling from Covid-19. Her book/plan has saved lives.

For more information, visit: sisutoanewyou.com

### 24 Effectiveness of Pharmacotherapy for Depression after Adult Traumatic Brain Injury: An Umbrella Review

Amelia Hicks\(^{a}\), Fiona Clay\(^{b}\), Amelia James\(^{a}\), Malcolm Hopwood\(^{c,e}\), Jennie Ponsford\(^{a}\)

\(^{a}\)Monash-Epworth Rehabilitation Research Centre, Monash Institute of Cognitive and Clinical Neurosciences, School of Psychological Sciences, Monash University, Melbourne, Australia, \(^{b}\)Department of Forensic Medicine, Monash University, Southbank, Australia, \(^{c}\)Department of Psychiatry, University of Melbourne, Melbourne, Australia, \(^{e}\)Professoral Psychiatry Unit, Albert Road Clinic, Department of Psychiatry, University of Melbourne, Melbourne, Australia

**ABSTRACT**

Objectives: Symptoms of depression are common following traumatic brain injury (TBI), impacting survivors’ ability to return to work, participate in leisure activities, and placing strain on relationships. Depression symptoms post TBI are often managed with pharmacotherapy, however, there is little research evidence to guide clinical practice. There have been a number of recent systematic reviews examining
pharmacotherapy for post TBI depression. These reviews have offered little conclusive insight, with only a small subset endorsing pharmacological intervention over placebo. These reviews differ in their conduct, quality and reporting, and often have discordant results and conclusions. The aim of this umbrella review was to synthesize systematic reviews and meta-analyses of the effectiveness of pharmacotherapy for the management of post TBI depression in adults.

Methods: Eligible reviews examined any pharmacotherapy against any comparators, for the treatment of depression in adults who had sustained TBI. Seven databases were searched, with additional searching of online journals, ResearchGate, Google Scholar and the TRIP Medical Database to identify published and unpublished systematic reviews and meta-analyses in English up to May 2020. Evidence quality was assessed using Joanna Briggs Institute Critical Appraisal Instruments.

Results: Twenty-two systematic reviews published between 2004 and 2020 were included in the umbrella review, of which ten reviews contained a meta-analysis. Six drug classes (MAOIs, TCAs, SSRI s, SNRIs, stimulants and anti-convulsants) and 10 individual drugs were examined across the 22 reviews. There was insufficient high quality and methodologically rigorous evidence to recommend prescribing any specific drug or drug class for post TBI depression. The findings do show, however, that depression post TBI is responsive to pharmacotherapy in at least some individuals. Lack of significant findings may have been contributed to by placebo effects, small pooled samples, the outcome measures used, short treatment duration, low methodological quality and low severity of depression at baseline.

Conclusions: While the evidence base develops for specific drugs, this umbrella review suggests that a trial of anti-depressants may be sensible with careful monitoring of harms, objective assessment of depressive symptoms, and discontinuation if no benefit is observed. The selection of which anti-depressant to prescribe should be made considering the likelihood of responsiveness to the treatment and vulnerability to the adverse events associated with that drug for each individual. To progress the evidence base, primary studies should use a control-comparison design, TBI appropriate measures of depression and include a follow-up post intervention cessation. Measurement and reporting of harms in both primary studies and systematic reviews is critical to understand the tolerability of commonly used drugs in this population.

25 Does Ongoing Cognitive Decline Occur Decades After a Moderate to Severe Traumatic Brain Injury? A Prospective Controlled Study

Amelia Hicksa, Gershon Spitza, Chris Rowe b, Caroline Roberts a, Dean McKenzie c, Jennie Ponsford a

aMonash-Epworth Rehabilitation Research Centre, Turner Institute for Brain and Mental Health, School of Psychological Sciences, Monash University, Melbourne, Australia, bDepartment of Molecular Imaging and Therapy, Austin Health, Heidelberg and Florey Department of Neuroscience and Mental Health, University of Melbourne, Melbourne, Australia, cResearch Development and Governance Unit, Epworth HealthCare Melbourne, Australia and Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, Australia

ABSTRACT

Objectives: This prospective controlled study examined long-term trajectories of neuropsychological performance in individuals with traumatic brain injury (TBI) compared to healthy controls, and the impact of IQ, age at injury, time since injury, and injury severity on change over time.

Methods: Fifty-three individuals with moderate-to-severe TBI (60.37% male; M 59.77 yrs), and 26 controls (53.85% female; M 63.96 yrs) were recruited and studied prospectively (M 12.72 yrs between assessments). Participants completed measures of premorbid IQ (Weschler Test of Adult Reading), processing speed (Digit Symbol Coding Test), memory (Rav Auditory Verbal Learning Test) and executive function (Trail Making Test Part B), at a mean of 10.62 yrs (Initial) and 23.91 yrs (Follow-Up) post injury.

Results: Individuals with TBI did not show a significantly greater decline in neuropsychological performance over time compared with demographically similar controls. There was no association between change over time with IQ, time since injury or injury severity. Being older at injury had a greater adverse impact on executive function outcomes at the follow-up time point.

Conclusions: In this small sample, a single moderate-to-severe TBI was not associated with ongoing cognitive decline up to three decades post injury. Changes in cognitive function were similar between the groups and likely reflect healthy aging.

26 Stakeholder perspectives on navigating the pediatric concussion experience: Exploring the Needs for Improved Communication Across the Care Continuum

Douglas Gomez a, Ann Glang a, Juliet Haarbauer-Krupa b, Gerard Gioia a, Rachel Bull c, David Wright d, Alex Hall d, Harold Simon e, Jonathan Ratcliff f

aUniversity Of Oregon, Dept. of Psychology, Eugene, United States, bCenters for Disease Control and Prevention, Atlanta, United States, cChildren’s National Hospital, Rockville, United States, dEmory University School of Medicine, Atlanta, United States

ABSTRACT

Children receive care for concussion in a variety of settings depending on the level of acuity and time since the initial injury. Settings can include emergency departments, intensive care units, inpatient rehabilitation programs, primary care offices, outpatient rehabilitation services, and the educational system (Arbogast et al., 2017). The transition from medical care to school services is also characterized by substantial variability (Centers for Disease Control and Prevention, 2018; Ennis et al., 2017). Returning to school and accessing services in the educational system are a unique transition for children. The majority of research to date has described the transition
process from hospital to school for hospitalized children (Glang et al., 2008). It has been shown that the return to school process is critical to positive outcomes and that a successful return to school requires integration between entities, specifically the hospital, parents, and the school (Dettmer et al., 2014). Children who receive systematic transition services as part of their medical care are more likely to be identified for specialized support services at school and their parents report greater satisfaction with school support. It is important for the healthcare and school systems to communicate so that medical providers can offer information to schools about the injury diagnosis and child’s health (Gioia, 2014). Currently, the CDC supports a project to better understand clinical decision support that includes an examination of discharge instructions for school-aged children (ages 6–17 years), from medical providers. As part of this project the team conducted focus groups with stakeholders who received this information, including parents, educational personnel, school nurses, and athletic trainers. The focus groups inquired about the type of information received from medical providers at the time of injury diagnosis.

Data from focus groups were analyzed using a thematic analysis approach. The transcribed data were entered into a qualitative data analysis application (Dedoose, Version 8.0.35). Consistent with Braun and Clarke (2006), researchers used an inductive (bottom-up) coding process, described semantic themes from a realist epistemology, and provided a rich description of the data set. The analysis began with an intensive review of transcripts to organize and code the data across stakeholder groups and settings. This analysis was iterative and though codes were generated initially, the next step of the analysis involved the creation of overarching themes, for example, communication from health-care providers, which were derived from the relationships between the initial codes. Themes were then discussed and augmented by the primary research group to arrive at formal titles and definitions for each theme.

The purpose of this session is to present the themes from these focus groups to better understand how to improve communication from medical providers about concussion and the process of returning to school.

27 Transition in Acquired Brain Injury Youth (TrABI-Y): Preliminary Results from a Systematic Literature Review

Jérôme Gauvin-Lepageab, Laurence Leblancab, Véronique Poupart-Monettec, Julie Farthingab, Shana Bissonnetteab, Louise Koclasd, Magdalena Jaworskia, Josee Larochelled, Anne-Sophie St-Pierre-Clémente

aResearch Center of the Sainte-Justine University Hospital, Montreal, Canada, bFaculty of Nursing, University of Montreal, Montreal, Canada, cMontreal Children’s Hospital, Montreal, Canada, dSainte-Justine University Hospital, Montreal, Canada, eMarie-Enfant Rehabilitation Centre, Montreal, Canada

ABSTRACT

Objective: Acquired Brain Injury (ABI) in pediatrics refers to children born with a neurological deficit, which will lead to a chronic neurological disorder. As advances in medical pediatric health progress, we are seeing these ABI youth transitioning into adult health-care services while also going through different life events. Despite the growing number of young adult patients, access to transition programs to facilitate the transition process is still limited and evidence on the effectiveness of these programs is inconclusive. The purpose of this systematic review is to review the state of current knowledge regarding transition programs available for youth with ABI.

Methods: The databases Medline, All EBM Reviews, PsycINFO, and CINAHL were searched for this review. Two articles were finally selected by the authors, out of 3824 articles. These selected articles are currently appraising with the Mixed Methods Appraisal Tool (MMAT).

Results: A synthesis of the findings will be drafted to identify the effectiveness of available transition programs as well as predictors, factors, and determinants involved in the transition process.

Conclusions: This systematic review will allow a better understanding of the current state of knowledge regarding transitions of care and life processes of ABI youth. Therefore, it will allow clinicians and researchers to better identify the effectiveness of available transition programs for this population. These results could further be used as a guide for national and international decision makers interested in proposing innovative and integrated solutions for the transitions of care and life processes for the ABI youth population.

28 Traumatic Brain Injury in Adolescence and the Family Resilience Process: A Case Study

Jérôme Gauvin-Lepageab

aResearch Center of the Sainte-Justine University Hospital, Montreal, Canada, bFaculty of Nursing, University of Montreal, Montreal, Canada

ABSTRACT

Objective: The aim of this study was to better understand the family resilience process following a severe traumatic brain injury during adolescence.

Methods: Inspired by the humanistic model of nursing care as a disciplinary perspective, this study used a qualitative and inductive case study design.

Results: The data analysis yielded six themes as well as four sub-themes that illustrate this family’s resilience process. The most important factors that emerged were (a) family characteristics (i.e., a fighter personality, cultural and spiritual beliefs, presence of hope, keeping a sense of humor), (b) support of family members, (c) support of friends, (d) practicing sports and leisure activities, (e) back-to-school support, and (f) feeling helpful to the adolescent. Conclusions: This study provides interesting avenues with
regard to the implementation of strategies to foster the resilience process in families during particularly difficult situations in their lives, such as a traumatic brain injury during adolescence.

29 Social Participation of Children and Adolescents with Acquired Brain Injury: A Scoping Review

Jérôme Gauvin-Lepage\textsuperscript{a,b}, Alexandra Lapierre\textsuperscript{b}, Shana Bissonnette\textsuperscript{a,b}

\textsuperscript{a}Research Center of the Sainte-Justine University Hospital, Montreal, Canada, \textsuperscript{b}Faculty of Nursing, University of Montreal, Montreal, Canada

**ABSTRACT**

Objective: Given that adequate social participation significantly improves quality of life, it should be a part of all intervention programs aimed at rehabilitation. In the case of acquired brain injuries, impairments in social functioning are common given the neuropsychological resources involved in social interactions. This is especially true in pediatric and adolescent populations, as injuries to developing brains pose a unique set of negative outcomes. This review aimed to synthesize the current research literature focusing on social participation of children and adolescents with acquired brain injury.

Methods: A scoping review was conducted in accordance with the Joanna Briggs Institute guidelines. Four databases were systematically searched for studies published between 2000 and 2018. Results: 477 potentially relevant articles were identified, and 17 met the inclusion criteria. Most of these articles concluded that acquired brain injuries negatively affect participation in social activities on many levels such as frequency, diversity, and intensity. Moreover, there exist many predictors of social participation outcomes, such as age at injury, gender/sex, pre-injury status, severity of injury, and family environment. Despite these findings, only two studies focusing on interventions were found, and both showed limited results according to social participation measures.

Conclusions: This review highlights the current gap in interventional research that aims to support social participation of children and adolescents with acquired brain injury.

30 Social Participation and Quality of Life of Children Suffering from a Neurotrauma: The Development of an Innovative Interdisciplinary Research Program

Jérôme Gauvin-Lepage\textsuperscript{a,b}

\textsuperscript{a}Research Center of the Sainte-Justine University Hospital, Montreal, Canada, \textsuperscript{b}Faculty of Nursing, University of Montreal, Montreal, Canada

**ABSTRACT**

Background: Since neurotraumatic injuries (NTI), such as traumatic brain injuries, sequelae of stroke and meningitis, and brain tumors, are one of the main causes of physical disability in youth, they represent a major health problem in Canada. In fact, nearly 20,000 Canadian youth have experienced an acute or chronic condition following NTI that required rehabilitative care. The vast majority of these injuries are traumatic in nature, therefore unexpected, sudden, and permanent. Depending on their level of severity, NTIs can have a significant impact on the activities of daily living of youth. In fact, youth and their families must learn to live with physical, neurological, and emotional disabilities that will affect their functioning and their family dynamics for many years, if not their entire lives. Thus, NTI is a complex health situation resulting in the progressive onset of disabilities as well as medical and social problems that significantly influence the social participation and quality of life of youth with NTI and their families. In turn, the transition of these youth, through the stages of their care and their lives, is ultimately affected.

Methods: The general goal of this research program is to promote the social participation and quality of life of youth with NTI, particularly at the intensive functional rehabilitation and social integration stages, through the empirical deployment of interprofessional interventions with a humanist approach and to assess their contributions to an optimal care and life transition trajectory.

Results: The objective of Axis I is to assess the preliminary effects (by a mixed pre-experimental longitudinal prospective pilot design) of the Pediatric Physical Rehabilitation Intervention Protocol for Optimal Social Participation (PRO-REA) and of the Personalized Support for Community Integration Program (PRO-COM) on (i) the social participation and (ii) quality of life of youth with NTI at the intensive functional rehabilitation and social integration stages. The objective of Axis II is to qualitatively validate (through a descriptive qualitative design) a model of trajectory of transition that youth with NTI and their families face. The objective of Axis III is preliminary and aims to explore the effect of adapted physical activity on the social participation of youth with NTI.

Conclusions: This new knowledge will allow an optimal resumption of the activities of daily living of youth with NTI in order to improve their well-being. This research program will therefore highlight the advantages of a care approach centered on the life plan of youth with NTI and their families, in addition to better equipping health professionals, particularly with regard to their knowledge, in order to promote the social participation and quality of life of youth with a view to the most harmonious transitions.

31 Traumatic Brain Injury, Physical Health, Mental Health, and Hair Cortisol among Colombian Women Victims of Intimate Partner Violence

Nathalia Quiroz Molinares\textsuperscript{a}, Concepción Blasco-Ros\textsuperscript{b}

\textsuperscript{a}Universidad De La Costa, Barranquilla, Colombia, \textsuperscript{b}Universidad De Valencia, Valencia, España

**ABSTRACT**

Intimate Partner Violence (IPV) refers to behaviors intended to exert power and control over another individual, including physical, sexual, verbal, emotional, and financial abuse.
It is a public health problem, as well as a violation of human rights (Ballan & Freyer, 2012). The purpose of this work was to assess the impact of IPV-related Traumatic Brain Injuries (TBI) on mental health, physical health, and hair cortisol levels in women who have suffered IPV. For this matter, 44 women who suffered physical violence in the city of Barranquilla, Colombia were assessed. We found a high prevalence of TBI, high levels of hair cortisol, however, we did not find a relationship between TBI, physical health, mental health, and cortisol. These results have important social and clinical implications. At the social level, this research highlights the need to propose public policies related to increasing the scope of care in victim care centers, since as has been shown, women survivors of intimate partner violence not only suffer from psychological sequelae but also the high incidence of TBI in this population should be taken into account. Finally, at the clinical level, the need to carry out routine evaluations of possible traumatic brain injury in this population is highlighted, as well as to design rehabilitation programs according to their needs.

Results: The benchmark audits 32 areas of practice when caring for a patient with an E.V.D. We achieved an overall score of 86%. The following issues were identified as a result of the audit:

- Lack of written patient information leaflets.
- Daily prescription of E.V.D. Drain.
- Use of appropriate adhesive dressing at E.V.D. site.
- Possible site infection not correctly documented.

Conclusion: The audit results whilst positive overall, highlighted areas that require improvement in practice. The following points were identified as areas to focus on:

- Patient information: As a group we developed a patient information leaflet for patients with an E.V.D.
- E.V.D site infection & dressing: This area has been identified for further review to ensure evidence-based policy change.
- Daily medical prescription: A change in prescription practice is currently being reviewed by the Beaumont neurosurgical teams

32 Beaumont Hospital Neuroscience Benchmarking Group & EVD Audit

Ciara O'Rourke, Deirdre Nolan

aBeaumont Hospital, Beaumont, Ireland

ABSTRACT

Introduction: Beaumont Hospital is the National Neurosurgical Centre in Ireland. In an aim to provide the highest possible standard of care to our patients we linked with centers in the UK to Benchmark, review and standardize our nursing practices. As part of the National Neuroscience Benchmarking Group (NNBG) Beaumont Hospital were involved in the creation of benchmarks. The Beaumont Neuro Benchmarking Group was established in 2020 in order to advance local policy.

Objectives: To work within the professional guidance and standards set out by Beaumont Hospital Ethics Committee. To improve clinical effectiveness and minimize risk by the development of standards & guidelines. To develop and work collaboratively with interdisciplinary and external contributors. To develop the research potential of all members of the Neuro Benchmarking Group. To initiate and implement change based on evidence derived from research.

The first benchmark undertaken by the group was Cerebral Spinal Fluid (C.S.F.) Management in conjunction with External Venticle Drain’s (E.V.D.).

Methodology: We audited three areas, two neurosurgical wards and one neuro I.C.U. setting. Our aim was to capture information on twelve patients with an E.V.D. (an average of four per area). We agreed a timeframe of 3 months to capture data. The standardised CSF management audit tool provided by the NNNBG was selected to collect the data.

33 Safe Transfer of Spontaneous Sub Arachnoid Hemorrhage (SAH) Patients to Beaumont Hospital

Deirdre Nolan, Paula Corr

aBeaumont Hospital, Dublin, Ireland

ABSTRACT

Background: Beaumont Hospital is the National neurosurgical centre and we accept patients from all around the country. Over a 4-year period (February 2016 – February 2020) we accepted 889 patients with a diagnosis of SAH. We found that the patient referral and handover information was lacking in content and understanding so we decided to audit the next 30 transfers, focusing on both verbal handover and written documentation.

We listened at the morning handover to the information given to the Neurosurgical on call team. We looked closely at the written transfer information in the patient chart and spoke with nurses and doctors to ascertain the quality of the verbal hand over they had received.

Following the NICE guidelines for suspected SAH, patients should have an immediate CT or CTA and if the CT is negative then a Lumbar Puncture for Xanthochromia should be done 12 hours post ictus.

If positive, immediate referral to a neuroscience centre, Neurological observations and start Nimodipine 60 mgs 4 hourly. Our findings were that 100% had a CT done but only 87% had documented Neurological observations and 73% had been started on Nimodipine, despite advice from the on-call team in Beaumont. We also found that not all patients were transferred with either a nurse or doctor.
Conclusion: To improve these shortcomings we have developed an Algorithm for health care professionals dealing with spontaneous SAH, to guide them in the initial care and requirements for referral and safe transfer.

34 Autonomic Dysfunction Following Mild Head Injury

Subir Dey

aArmed Forces Medical College, Pune, India

ABSTRACT

Objectives: To study the pattern and trend of clinical features, natural history, clinical management, and rehabilitation implications of dysautonomia after traumatic brain injury,

Methods: Retrospective data from their case records on 20 patients with dysautonomia and same number sex and Glasgow coma scale score matched controls. The groups were compared on injury details, CT findings, physiological indices, and evidence of infections over the first 28 days after injury, clinical progress, and rehabilitation outcome.

Results: Dysautonomia group were significantly worse than the control group on all variables studied except duration of stay in intensive care, the rate of clinically significant infections found, and changes in functional independence measure (FIM) scores.

Conclusions: Dysautonomia is a distinct clinical syndrome, associated with severe diffuse axonal injury and preadmission hypoxia. It is associated with a poorer functional outcome; however, both the controls and patients with dysautonomia show a similar magnitude of improvement as measured by changes in FIM scores. It is argued that delayed recognition and treatment of dysautonomia results in a preventable increase in morbidity.

35 Outcomes of Resuscitative Endovascular Balloon Occlusion of the Aorta (REBOA) Utilization in Trauma Patients with and Without Traumatic Brain Injuries: A National Analysis of the American College of Surgeons Trauma Quality Improvement Program Data Set

Brendon Sen-crowe

aKendall Regional Medical Center, Miami, United States

ABSTRACT

Background: Hemorrhage remains a leading cause of death among trauma patients. Resuscitative endovascular balloon occlusion of the aorta has grown in popularity as an efficient, less invasive alternative to managing patients with noncompressible hemorrhage. The aim of this study to investigate the clinical outcomes of resuscitative endovascular balloon occlusion of the aorta use in adult civilian trauma patients with and without concomitant traumatic brain injury.

Methods: This a secondary analysis of the American College of Surgeons Trauma Quality Improvement Program database from the years 2015 to 2017 of adult trauma patients with and without traumatic brain injury and who had a resuscitative endovascular balloon occlusion of the aorta. Patients who were deceased on arrival, required resuscitative thoracotomy, or had missing information regarding traumatic brain injury status were excluded. Multivariable risk adjustment was performed. The primary outcome was inpatient mortality.

Results: Of 2,352,542 patients, 199 met the criteria for inclusion in the final analysis. Resuscitative endovascular balloon occlusion of the aorta + traumatic brain injury patients were significantly more likely to have a lower Glasgow Coma Scale ≤8 (82.4% vs 54.4%, P < .001) and systolic blood pressure (89 ± 37.4 vs 107.2 ± 39.7; P = .002), and higher injury severity score >25 (83.5% vs 65.8%, P = .01) compared with resuscitative endovascular balloon occlusion of the aorta/non-traumatic brain injury patients. No differences in odds of inpatient mortality (62.4% vs 50.9%, P = .11) or complications (17.7% vs 11.4%, P = .21) were observed between groups. Subgroup analysis based on mechanism of injury, trauma center level, teaching hospital status, and pelvic fracture status also did not show any differences in mortality.

Conclusion: Inpatient mortality with resuscitative endovascular balloon occlusion of the aorta use does not differ between patients with or without concomitant traumatic brain injury, despite those with traumatic brain injury having significantly higher injury severity and more severe hypotension on intake.

36 3D-Printed External Cranial Protection Following Decompressive Craniectomy After Brain Injury: An Exploratory Clinical Trial

Karen Chua, Rathi Ratha Krishnan, Jia Min Yen, Tegan Kate Plunkett, Yan Ming Soh, Chien Joo Lim, Catherine Chia, Jun Cong Looi, Suan Gek Ng, Jai d

aTan Tock Seng Hospital Rehabilitation Centre, Singapore, bClinical Research and Innovation Office, Tan Tock Seng Hospital, Singapore, cAuMed Pte Ltd, Singapore, dDepartment of Neurosurgery, National Neuroscience Institute, TTSH Campus, Singapore

ABSTRACT

Objectives: 3D-printed (3DP) customized temporary cranial protection solutions following decompressive craniectomy (DC) are currently not widely practiced. A pilot trial of a 3DP customized head protection prototype device (HPPD) on 10 subjects was conducted during the subacute rehabilitation phase.

Materials and Methods: Subjects > 30 days post-DC with stable cranial flaps and healed wounds were enrolled. HPPD were uniquely designed based on individuals’ CT scan, where the base conformed to the surface of the individual’s skin covering the cranial defect, and the lateral surface three-dimensionally mirrored, the contralateral healthy head. Each HPPD was fabricated using the fused deposition modeling method. These HPPD were then fitted on subjects using a progressive wearing schedule and monitored over 1, 2, 4, 6 and 8 follow-up (FU) weeks. Outcomes during FU included; reported wearing time/day (hours), subjective pain, discomfort, pruritus,
dislodgment, cosmesis ratings; and observed wound changes. The primary outcome was safety and tolerability without pain or wound changes within 30 minutes of HPPD fitting.

Results: In all, 10 enrolled subjects received 12 HPPDs [5/10 male, mean (SD) age 46 (14) years, mean (SD) duration post-DC 110 days (76)] and all subjects tolerated 30 minutes of initial HPPD fitting without wound changes. The mean (SD) HPPD mass was 61.2 g (SD 19.88). During 8 weeks of FU, no HPPD-related skin dehiscence was observed, while 20% (2/10) had transient skin imprints, and 80% (8/10) reported self-limiting pressure and pruritus.

Discussion: Findings from this exploratory study demonstrated preliminary feasibility and safety for a customized 3DP HPPD for temporary post-DC head protection over 8 weeks of follow-up. Monitoring and regular rest breaks during HPPD wear were important to prevent skin complications.

Conclusion: This study suggests the potential for wider 3DP technology applications to provide cranial protection for this vulnerable population.

37 Evidence to Support the Use of S-Adenosylmethionine for Treatment of Post-Concussive Sequelae in the Military

Sofia Matta\textsuperscript{a}, Danny Schieffler\textsuperscript{b,c}

\textsuperscript{a}Naval Hospital Camp Pendleton, Santa Monica, United States, \textsuperscript{b}New Jersey City University, Jersey City, United States, \textsuperscript{c}New York University, New York, United States

ABSTRACT
Introduction: Since the year 2000, over 413,000 service members have sustained TBI and may present with post-concussive sequelae including headaches, fatigue, irritability, cognitive problems, depression, insomnia and chronic pain. While the focus of the paper is on military TBI, the usefulness of SAMe would extend to both civilian and military populations. This narrative review examines the preclinical and clinical literature of S-adenosylmethionine’s (SAMe) metabolism and alterations seen in disease states such as Major Depressive Disorder, treatment-resistant depression, pain disorders including fibromyalgia and osteoarthritis, fatigue, cognition and memory, dementia, use in pregnancy and peripartum, children, adolescents and adults, to the elderly with and without dementia, stroke, neurodegeneration and aging, and other disorders in order to highlight its potential benefit in post-concussive sequelae after traumatic brain injury (TBI).

Materials and Methods: A MEDLINE/PubMed and Cochrane Database search was conducted between 5/03/2018 and 7/30/2019 by combining search terms for S-adenosylmethionine (SAMe) with terms for relevant disease states including (depression, brain injury, dementia, Alzheimer’s Disease, Parkinson’s Disease, cognition, fatigue, and pain). This search retrieved a total of 676 references. Four hundred and thirty-nine were excluded for being over a 10-year publication date, except where clinically relevant. After additional removal of repeated articles, the number of articles totaled 197. An additional 59 articles were excluded: 10 not in English, 4 duplicates, 4 not original investigations and 41 outside the scope of this article. The remaining 138 articles were used in this review and included 25 clinical, 46 preclinical, 63 reviews and 4 case reports.

Results: This narrative review examined the preclinical and clinical literature of SAMe’s metabolism and alterations seen in Major Depressive Disorder, pain disorders, fatigue, cognition and memory, dementia, and other disorders to highlight the potential benefit of SAMe in post-concussive sequelae in mTBI. The literature showed potential for improvement, safety and tolerability in these symptom clusters commonly seen in military mTBI.

Conclusion: There is evidence of a potential benefit of SAMe as an intervention to help with symptoms across the range of post-concussive sequelae and syndromes commonly seen in military mTBI. Since the discovery of SAMe in 1952, this pleiotropic molecule has shown the significance of its involvement in several metabolic cascades in such disparate systems as epigenetics, bioenergetics, DNA methylation, neurotransmitter systems and potential usefulness in military TBI. Significant limitations include the disparate presentations seen in patients with mild TBI, those with post-concussive syndrome, as well as those with comorbid depression and PTSD. Also, over-the-counter medications are not regulated and SAMe products may vary widely in price and quality. Furthermore, this narrative review serves as the rationale for future open label and double-blind placebo-controlled trials in military mTBI and SAMe.

38 “You Can’t Fix Your Brain”: A Qualitative Study Exploring the Experiences of Children with Concussion and Their Parents

Alyson Campbell\textsuperscript{a}, Vickie Plourde\textsuperscript{b}, Lisa Hartling\textsuperscript{a}, Shannon Scott\textsuperscript{a}

\textsuperscript{a}University Of Alberta, Edmonton, Canada, \textsuperscript{b}Universite de Moncton, Moncton, Canada

ABSTRACT
Background: Recovery from a concussion can be emotionally draining for children and their families. Few studies to date have qualitatively explored the concussion experience from child or youth perspectives coupled with the experiences of parents. Our study is unique in that we explore the concussion experience from onset of injury through recovery from two unique perspectives: parents, and children/ youth themselves. Furthermore, few studies have explored the information needs and preferences of parents and children who sustain concussions, which our study explores in depth.

Purpose: To explore the in-depth experiences, information needs and preferences of children who have had a concussion and their parents who have cared for them.

Design: Qualitative description.
ABSTRACTS

Methods: Semi-structured qualitative interviews were conducted via Zoom with children aged 5 years and older who have had a concussion and parents who have cared for a child with a concussion. Interviews were audio-recorded and transcribed.

Results: Fourteen interviews were conducted with children and parents who have experience with concussion. Six major themes emerged: 1) mechanism of injury and concussion symptoms experienced by children, 2) healthcare experience reported by parents, 3) parent concerns and emotions of child’s concussion, 4) child thoughts, feelings and questions about their concussion, 5) concussions affect more than just your head and 6) health information seeking and preferences related to concussion. Children/youth and their parents have unique experiences, information needs and preferences regarding concussion.

Practice Implications: This is valuable information in developing resources about childhood concussion that parents and children will find useful and relevant. This research has direct relevance to health-care professionals who may encounter children with concussion in their daily practice so they can ensure the needs of children and families are being met. Our findings will be used to create the content for an innovative knowledge translation tool about pediatric concussion.

39 Combining Music Therapy Techniques with Physical Therapy in an Individual Following Brain Injury: A Case Study in the Use of Both Patterned Sensory Enhancement and Rhythmic Auditory Stimulation

Heather McLeana, Nicole Spurgeonb, Michelle Melicostac

aKennedy Krieger Institute, Baltimore, United States
bSpurgeon B.A., Baltimore, United States
cBaltimore, Maryland, United States

ABSTRACT

Objective: This was a case study of a patient with a complex medical history admitted to an inpatient pediatric rehabilitation hospital following an acquired brain injury looking at the use of Patterned Sensory Enhancement (PSE) and then progressing to Rhythmic Auditory Stimulation (RAS) for gross motor functional recovery. Both PSE and RAS have been shown to be beneficial in adults with varying diagnoses as well as children with spastic diplegic CP. The premise of this study was to assess the benefit of each in an individual with a pediatric brain injury. PSE is a neurologic music therapy technique that uses rhythmic, melodic, harmonic, and dynamic-acoustical elements of music to provide temporal, spatial, and force cues for movements which reflect functional exercises and activities of daily living. Rhythmic-auditory stimulation (RAS) is defined as a therapeutic application of pulsed rhythmic or musical stimulation in order to improve gait or gait-related aspects of movement.

Interventions: PSE was utilized in Physical Therapy sessions for improvement in sit-to-stand transfers and RAS was utilized for gait progression. For PSE trials, the patient completed sit-to-stand initially without music to achieve baseline time and allow Physical Therapist (PT) and Board-Certified Music Therapist (MT) to assess movement patterns. Timed sit to stand was then performed with PSE music provided. For RAS trials, the patient performed a 10-meter-walk test without music for a baseline and then completed the same timed test with RAS musical accompaniment. Sessions were completed as a co-treatment with MT and PT.

Results: This patient showed improvements for functional transfers as well as gait during a 10 m-walk test with the addition of PSE and RAS, respectively. During PSE, baseline timed sit-to-stand was 4.05 seconds; with PSE times decreased to 2.51 seconds and 1.98 seconds. During RAS, baseline 10-meter-walk test was 14.91 seconds; with RAS, times decreased to 11.33 seconds and 10.02 seconds using a strummed chord pattern, and 8.55 seconds, using a broken chord pattern at a slightly faster tempo.

Conclusions: This case study demonstrates that both PSE and RAS are beneficial for this individual with an ABI and are promising modalities in the gross motor functional recovery during pediatric inpatient rehabilitation admissions following brain injury. This also reinforces music’s role as a “force cue.” Future studies should address the following: increased sample size, repetition of techniques over multiple days, use of varied tempos, patterns, and timing with MT, and longer-term monitoring of impact.

40 New Findings from a Patient-Reported Outcomes Brain Injury Data Warehouse

CEO/Founder Lynne Becker

aPower of Patients, LLC, Boston, United States

ABSTRACT

INTRO: Increasing attention is beginning to be focused on traumatic brain injuries (TBI). However, there is still a significant lack of research causing substantial knowledge gaps for providers, payers, and most importantly the patients. Research designs that do not include injury pathways and patient-reported outcome metrics may be missing unique data elements that could assist with the development of more personalized diagnostics and therapeutics.

PROBLEM DEFINITION: Silos-of-care combined with a lack of standard of care plans are likely culprits that contribute to the poor management of patients with TBI and PCS. Clinical trials are necessary to establish best practices and standards to improve patient outcomes, but these results are years, perhaps decades away. Is it possible that patient-reported outcomes can be used to accelerate patient recovery and personalize targeted therapeutics?

VARIABLES: Power of Patients has created a patient-reported outcomes symptom and trigger tracking data warehouse. Each patient creates a personalized dashboard, selecting their symptoms, and triggers to track and specify goals that are most important to them. Data collected is structured, unstructured, and augmented by proprietary algorithms.

RESULTS: Power of Patients will discuss initial findings for 378 patients that range in age from 14 to 81 with 608 uniquely reported symptoms and over 27,000 logged events.
Demographic data, distributions, will be stratified by gender, injury type, loss of consciousness, time since injury, symptoms, and social determinants of health.

**41 A Highly Verbal Graham Cracker: The Emotional Experience of Three Years of Persistent Concussion Symptoms (Lived Experience)**

Allison Moir-Smith

*a* None – This is a Lived Experience Presentation, Manchester, United States

**ABSTRACT**

I will tell three vivid stories about the emotional experience of living with persistent concussion symptoms for 3 years:

Crushing depression and suicidal ideation.

Isolation and rage at the world.

Social anxiety and loss of self.

This is compelling because I am a therapist, I am married to a therapist, and was in therapy during my PCS. And yet, I couldn’t express – or let myself know – the depths of my terror and sadness.

Told by someone with emotional fluency from my 20 years’ experience as a therapist and storytelling skills from my 35 years as a writer, this presentation will be accessible, a little bit funny, and told with props!

Hat, sunglasses, blanket over my head, and artwork – a progression of my healing process, from adult coloring books used in cognitive rehabilitation to early (and ugly) watercolors, to the colorful, jubilant acrylics I paint, sell and share today as I work to raise concussion awareness through my art.

You can hear a casual version of my story at the McGill University Support Group (Google “Concussion Chats Allison”).

In the roundtable discussion after my 25-min casual talk, the 20-something McGill students reflect on how my 50-something stories offered them new insights into their own lived experiences. This reflects the universality of the emotional experience of PCS, even across generations.

My hope is that this presentation will give clinicians a deeper, more empathic understanding of the anguish their PCS patients live in, so that they can support not only their physical returns to life, but their emotional returns to life as well.

**43 Getting Back to school After ABI: What do Young People, Parents and Teachers Tell us About What is a Challenge, and What they Need?**

Emily Bennett*a, Emily Talbots, Alison Fletcherab, Louise Robinsona

*a* Nottingham Children’s Hospital, Nottingham, United Kingdom, bThe Children’s Trust, Tadworth, United Kingdom

**ABSTRACT**

Background/Aims: Childhood acquired brain injury (ABI) has a prevalence rate higher than any other neurodevelopmental disorder (McGuire et al, 1998; McKinlay et al, 2008). However, recent evidence has indicated that educational professionals have a limited understanding of childhood ABI and its impact on education (Linden et al, 2013; Howe and Ball, 2017). As a result, children and young people (CYP) with an ABI may not receive the level of support they require at school; ultimately effecting their developmental and educational outcomes.

**44 Acquired Brain Injury in Childhood: The Knowledge, Experience and Training Needs of Special Educational Needs Coordinators in UK Schools**

Emily Bennetta, Emma Woolb, Shirley Thomasb

*a* Nottingham Children’s Hospital, Nottingham, United Kingdom, bNorthampton University, Northampton, United Kingdom

**ABSTRACT**

Background: Returning to education after an Acquired Brain Injury (ABI) can be extremely stressful for a child/young person and their family. Teachers and special educational needs coordinators (SENCOs), also report to finding the process challenging; often having had little, if any, training about ABI before this point. While there is much that can be done to support the return, there has been limited exploration of the experiences and views of children/young people, their parents and teachers about what can both help and hinder the process. Methods: A service evaluation was completed to explore the views of children and young people with ABI, their parents and teachers about the process of returning to education (RtE), and the support they received from health-care professionals at a regional centre in the UK. Questionnaires (n = 59) were sent to parents of patients treated for an ABI in the last two years. Teachers or SENCOs were also asked to complete questionnaires. The evaluation focused on core themes around the process of RtE and the level of support required and received by the child/young person, the nature and utility of assistance received from different professionals and services, participation and integration in school life on return, and the key challenges and positives experienced.

Results: 31 parents (response rate = 51%), 17 educators and 14 YP completed the survey. The returned questionnaires provide an overview of the RtE process for families and educational professionals. Results highlight the significant levels of anxiety and ongoing challenges for all involved and the vital role played by health-care professionals who bring a wealth of experience and insight to the process. Important themes are raised regarding the positive steps and support which can be taken to improve the RtE process.

Conclusions: Young people, their parents, and teachers offer crucial insight into the challenges of the return to education process. Their feedback highlights important factors for service development and reminds professionals of the key components of an effective return.
Within UK schools, support for CYP with additional needs is overseen by the Special Educational Needs Coordinator (SENCo). The aim of this study was to explore whether these professionals have knowledge of childhood ABI, and have received training on how to effectively support CYP with ABI in school.

Methods: 54 SENCos took part in this research. SENCos were asked to complete a survey to establish their knowledge of, and misconceptions about childhood ABI; their experience of working with childhood ABI; their opportunities for training about childhood ABI; and their perspectives on how knowledge of childhood ABI and training for teachers could be improved.

Results: SENCos who took part in this research showed limited knowledge of childhood ABI. This was reflected in the number of misconceptions held about childhood ABI and the proportion of SENCos highlighting significant gaps in training about ABI. Qualitative analysis of survey responses identified five core areas that SENCos wanted more training on. This research also identified an additional issue regarding access to funding for children with an ABI; 20% of participants stating said it was ‘difficult’ and 40% ‘extremely difficult’ to obtain funding for a child with ABI.

Conclusions: Findings of this research show a clear need for more training on childhood ABI across schools. At present, a majority of SENCos are not receiving training and when they are offered training, this is often delayed. It is also apparent that gaining funding to meet a CYP’s new needs can be a challenge for SENCos, perhaps due to their limited knowledge of the condition and the lack of awareness of ABI in the wider education and Local Education Authority systems. The study highlights a need for funding for CYP with an ABI must be made more accessible. However, more research is needed to determine what the barriers to funding are.

**46 Characteristics and Assessment of Potential Concussive Events in the English Premier League**

Pádraig O’Connell², Mario Pasquale Rotundo³, Pádraig O’Connell¹, Antón Stanton⁴, Faruk Alagic⁵, Benjamin Neillipovitz⁶, Ciara O’Donoghue⁷, Mickel Attia⁸, Thilashma Naidoo⁹, Abdulhakim Jilani⁹, Conor Deasy¹⁰, Michael D. Cusimano⁵

¹University College Cork, Cork, Ireland, ²Cork University Hospital, Emergency Department, Cork, Ireland, ³St. Michael’s Hospital, Division of Neurosurgery, University of Toronto, Toronto, Canada

**ABSTRACT**

Background: Sports-related Concussion (SRC) in the English Premier League (EPL) has not been well described. Despite its high prevalence, accurate diagnosis and management of potential concussions in a gameplay setting remains challenging. Aim: The objective of this study is to investigate the contextual factors of suspected concussions in elite Football and the quality of subsequent medical assessment with reference to the International Football Association Board (IFAB) recommendations.

Study Design: Descriptive Epidemiology Study

Methodology: Trained reviewers identified potential concussive events (PCEs) throughout 60 matches of the 2019/2020 Men’s EPL season, using a standardized observation protocol. Each PCE was analyzed for visible signs of concussion and circumstantial factors, as well as assessment incidence, duration, and return-to-play decision.

Results: Over 60 matches, 62 PCE incidents were identified. Five incidents involved two PCEs, producing a total of 67 PCEs (1.03 per match, 33.83 per 1000 match hours). Of the 62 PCE incidents, 31 (50.0%) occurred in an aerial battle. PCEs most commonly occurred in the center region of the pitch (41.8%, n = 28), and most frequently affected the mandibular region of the head (34.3%, n = 23). Ball-to-head (17.9%, n = 12) and head-to-head contact (14.9%, n = 10) were the most common mechanisms of injury. Ball to head contacts were significantly associated with one or more signs of concussion (p < 0.01).

Of the 67 PCEs, 32 (47.8%) were assessed by medical personnel, almost always on the sideline (93.8%, n = 30). However, 86.7% (n = 26) of sideline assessments were under 1 minute in length. Thirty (44.8%) players sustaining a PCE displayed one or more signs of concussion. Of these, 20 (29.9%) were assessed by medical personnel. Only 1 (3.3%) player was permanently removed from play.

Conclusion: The current study highlights high-risk situations and impacts that may elucidate targets for injury prevention strategies. PCEs are occasionally assessed, frequently on the sideline. However, assessments are typically less than a minute in duration and rarely result in permanent removal from play, despite the presence of visible signs of concussion. Improved adherence to international recommendations is needed.

**47 Comparison of Self-Reported Lifetime Concussions and Mild Traumatic Brain Injuries Among Adults**

Jill Daugherty*, Kelly Sarmiento*, Matthew Breiding*

*Centers for Disease Control and Prevention, Atlanta, United States

**ABSTRACT**

Objectives: Self-report surveys provide an opportunity to obtain more comprehensive estimates of the burden of traumatic brain injury (TBI) in the United States. However, public understanding of various terms (e.g., mild TBI, concussion) could impact estimates of mild TBI (mTBI) and concussion that are derived from self-report. To better understand this issue, this presentation examines a question wording experiment within a large national survey, comparing the percentage of adults who self-reported having had a concussion with those who self-reported an mTBI in their lifetime.

Methods: Self-report data were collected from 4,053 respondents in the summer wave (“SummerStyles”) of Porter Novelli’s 2020 U.S. ConsumerStyles survey. Respondents were randomized to be asked about lifetime experience with concussion or mTBI via a question that defined what
a concussion or mTBI was and described common symptoms. Respondents were then asked several follow-up questions related to their most serious injury.

Results: Approximately 25.5% of respondents reported sustaining a concussion in their lifetime, while 17.2% reported sustaining an mTBI. The circumstances of the self-reported injuries, such as location and mechanism of injury, were generally similar regardless of whether the respondents reported a concussion or mTBI. However, a greater percentage of individuals who reported a concussion (91.1%) reported receiving a diagnosis for their injury than those who reported an mTBI (69.9%). Symptoms experienced as a result of the injury were generally similar across questions, but a larger percentage of those with a concussion (24.9%) reported being bothered by light or noise than those with an mTBI (17.9%) while the reverse was true for sadness (4.1% vs. 9.6%).

Conclusions: A greater percentage of respondents in this study reported a lifetime history of concussion than a lifetime history of mTBI. Previous studies found the provision of a concussion definition as part of a concussion survey question did not impact concussion self-report; however, these results suggest that the overarching terminology used can impact self-reporting. Additional research is needed to determine whether providing a definition for mTBI prior to asking about mTBI would result in similar or different levels of reporting.

52 How Does the Meaning of Traumatic Brain Injury Change for Older Adults Across the First-Year Post-Injury?

Wonkyung Junga, Mia Vogelb, Karl Cristie Figuraciona, Hilaire Thompsona

aUniversity Of Washington, Seattle, United States, bWashington University in St. Louis, St. Louis, United States

ABSTRACT

Background/Objectives: The incidence of traumatic brain injury (TBI) among older adults is growing; however, little is known about the trajectory of their recovery after TBI and how older adults integrate the experience of injury into their lives. With the increasing aging population, it is now imperative to identify factors that influence overall quality of life and wellbeing to better address recovery after geriatric TBI. The aim of this study was to explore and elucidate how the meaning of TBI changes over the first-year post-injury for older adults.

Methods: A phenomenological study was conducted with adults, aged 65 and over, who were diagnosed with mild-moderate TBI. To obtain longitudinal perspectives, participants were interviewed at 1-week and 1-, 3-, 6-, and 12-months post-injury. During each interview, each participant was asked questions pertaining to symptoms, function, support, and the meaning of TBI. All transcripts were reviewed in full and themes were coded by two trained qualitative researchers in NVIVO. Tables were constructed to first evaluate cross-sectional themes and patterns related to the meaning of TBI to the individual, then compared longitudinally.

Results: Thirteen individuals (five men, eight women) participated in the study over 12 months. Based on 57 interviews, five different themes regarding the meaning of TBI were identified: gratitude for being alive, suffering from current vulnerability, slowing down and being more careful, a chance for reflecting on life, and a meaningless event. Overall, most participants’ perceived meaning of their TBI remained consistent over the year post-injury. A few participants expressed negative feelings about their TBI at the baseline interview and gradually accepted changes caused by the injury while having time to reflect on their lives.

Conclusions: The rich interviews provided a deep understanding of several different patterns in perceived meaning of TBI among older adults. These findings can be used as a foundation for future research as well as a resource for individualized intervention among older adults who have sustained a TBI.

53 Mothers with Acquired Brain Injury: Identifying the Gaps

Philomena Butlera

aUniversity College Dublin, Belfield, Ireland

ABSTRACT

Currently there is a gap in the knowledge base about the impact of Acquired Brain Injury (ABI) on mothers and the family unit (Gan et al. 2006). While there is a greater proportion of males with ABI than females (Colantonio, 2016), the importance of recognizing sex and gender differences in health-care is essential in order to avoid inequities in healthcare provision (Celik et al. 2011). A systematic literature search of the databases CINAHL, Pubmed and PsycINFO, using the terms ‘head injury’, ‘brain injury’, ‘stroke’, TBI, ‘impact’, ‘consequence’, ‘sequelae’, ‘family’, ‘relationship’, together with handsearching bibliographies, yielded 65 articles that focused on the impact of ABI on families. The extraordinarily low numbers of studies where a mother had an ABI was striking. Only four studies focused solely on mothers with ABI, while four other studies related to parenting and ABI either mention mothers incidentally or make recommendations that mothers should be researched in more depth. The limited research that is available on maternal ABI tends to focus on child welfare concerns (Alcorn, 2019; Ducharme and Davidson, 2004). The two themes that emerge from the existing literature are as follows: the safety and welfare of children and associated risks of mothers with ABI; and the emotional and behavioral consequences for children of mothers with ABI. Both Alcorn’s (2019) and Ducharme and Davidson’s (2004) case studies investigate the relationship between a mother and her children when she has an ABI and examine how parenting education sessions can assist in supporting this relationship in order to ensure the children’s safety. While both studies offer interesting insights into how the mother–child relationship can be affected when the mother has a brain injury, both mothers had their brain injuries as children, and thus had their impairments before becoming mothers. These studies suggest that
mothers and children are dealing with specific pre-existing impairments caused by ABI rather than the shock and trauma of the event leading to the ABI, the potential loss of identity, and role change. These studies look at one aspect of parental brain injury, with no reference to the diverse range of challenges that could be experienced by other families. Some of the literature on parental ABI makes a distinction between fathers and mothers (Pessar et al. 1993; Verghaeghe 2005). These studies explore the impact of parental ABI on emotional and behavioral reactions in children, with some authors arguing that children of fathers with ABI present more acting out behaviors than those of mothers who have an ABI. Increasing the knowledge base in relation to mothers with ABI is necessary to develop a greater understanding of the complexities and needs of this diverse group, thereby ensuring the delivery of a more person-centered service.

54 New Modern Technology in Pediatric Neurorehabilitation: PowerVR program for Remediation of Social Deficits in Children with Neurological Disorders

Marianne Saard\textsuperscript{a,b}, Alina Rostsinskaja\textsuperscript{a}, Kirsi Sepp\textsuperscript{b}, Christen Kööp\textsuperscript{b}, Anneli Kolk\textsuperscript{a,b}

\textsuperscript{a}University of Tartu, Tartu, Estonia, \textsuperscript{b}Children’s Clinic of Tartu University Hospital, Tartu, Estonia

\textbf{ABSTRACT}

Introduction: Social deficit (SD) is often present in children with neurological disorders (ND), but evidence-based intervention methods remain undeveloped. Modern interactive technologies represent attractive approach to train difficult real-world situations in safe environments. Aim was to implement combined technological platform -PowerVR- consisting of multitouch-multiuser tabletops (MMT) and virtual reality (VR) to enhance social competence in children with ND.

Methods: The new PowerVR rehabilitation program incorporates both, individual and paired intervention sessions for children with SD. Sixty-four children with ND (epilepsy, traumatic brain injury, tics, stroke) aged 7–13 years and 16 healthy age-matched controls participated in baseline assessments. Intervention started with pre-training evaluations. Interactive applications were implemented for paired trainings on MMT: Snowflake on Multitouch-Tabletop and NoProblem on DiamondTouch Tabletop (two age-matched patients trained together). Ten VR social metaphors (created by authors) and NeuroVR (VirtualisVR rehabilitation program) on HTC Vive VR device were used. In NeuroVR, children reacted to changing colors of balls with hand movements; seeing their opposite hand in VR while practicing with the other hand etc. Simultaneous monitoring of vital signs [heart rate (HR), blood pressure] during individual training with social metaphors was implemented.

Results: After the paired interventions, children’s cooperation, communication and metacognitive skills improved significantly (up to 50% increase in FOS subscales). In VR environment, children practiced in various socially and emotionally challenging situations. Most difficult social metaphor based on HR changes was in cinema. Individual trainings on VR with social metaphors improved social attention, communication, emotional attitude, gestural behaviors, and decreased social anxiety (by Sentence Completion Task, Spence Anxiety Scale). In NeuroVR, using techniques like Mirror/Ball and Electric Track, children practiced fine motor skills, hand-eye cooperation, coordination, attention. Mirror/Ball and Electric Track techniques were especially promising in children with stroke.

Conclusion: Children with ND need combined novel technological rehabilitation methods, like PowerVR program, which allows extensive training of various impaired functions, while being motivating and ensuring good compliance. Advantages of using VR are flexibility, safe environment and precise performance measurement. Rehabilitation based on our combined method trains children’s social skills individualy and decreases social anxiety, in addition to developing cooperation skills in paired trainings.

55 Social Deficit Profiles in Children with Neurological Disorders Assessed by Structured Model of Neurorehab

Marianne Saard\textsuperscript{a,b}, Alina Rostsinskaja\textsuperscript{a}, Kirsi Sepp\textsuperscript{b}, Christen Kööp\textsuperscript{b}, Anneli Kolk\textsuperscript{a,b} \textsuperscript{a}University Of Tartu, Tartu, Estonia, \textsuperscript{b}Children’s Clinic of Tartu University Hospital, Tartu, Estonia

\textbf{ABSTRACT}

Introduction: Children with neurological disorders (ND) often present with social competence (SC) deficits. Developing evidence-based paediatric interventions require the assessment of children’s social profiles, which reveal specific social components that need to be targeted in remediation. Aim was to evaluate the SC profiles of children with ND prior to rehabilitation using the Structured Model of Neurorehab.

Methods: We have previously presented the Structured Model of Neurorehab (Kolk et al., 2019) with assessment and intervention tools for socio-cognitive deficit. So far, 64 children with ND (epilepsy, traumatic brain injury, tic disorder, stroke) (44 boys/20 girls) aged 7–13 years and 16 healthy age-matched controls have participated in baseline assessments based on the evaluation tools from the structured model.

Results: At baseline (B), children with ND had noticeably higher deficits in executive functions on BRIEF parents’ questionnaire (M = 117, SD = 23.59) compared to healthy controls (M = 22, SD = 18.36). Most impaired components of SC were emotion recognition, Theory of Mind (ToM) abilities, low cooperation and verbal/non-verbal communication skills, and pragmatics (Friendship Observation Scale scores ~25-50% out of 100). In Sentence Completion Task children reported lack of friends, behavioral problems, bullying, and social anxiety. In Spence Anxiety Scale, 52% of children with ND reported physical injury fears, 38% obsessive-compulsive behavior, 33% social anxiety, 33% symptoms of generalized anxiety, 29% panic disorder, and 29% revealed separation anxiety. Tests under the Social domain of NEPSY-II battery showed impairments in Affect Recognition (B = 7, SD = 5.01) and lower results in Verbal ToM (B = 8, SD = 3.06) and Contextual
ToM (B = 8, SD = 3.15). ToM Stories test showed lower understanding of Intentional Lying (B = 7, SD = 2.20) and Sarcasm (B = 6, SD = 2.20).

Conclusion: Evaluation tools based on our theoretical structured model for socio-cognitive deficit rehabilitation have effectively described the social profiles of children with ND. These children showed various impaired components in SC and often expressed anxieties. Children with ND need novel multicomponent neurorehabilitation methods, which target the individual specific impaired SC components. Assessment based on evidence-based models, which structurally allow detection of impaired sub-functions, is important to be used prior to the rehabilitation process and after the training period as well, to evaluate the primary and long-term effects of rehabilitation.

56 Benefits of Modern Technology in Paediatric Pain Management: Virtual Reality Videos and Holograms for Reducing Fear and Anxiety Before and During Hospital Procedures

Anneli Kolka, Marianne Saard, Alina Rostsinska, Kirs Sepp, Christen Kööp

Abstract

Introduction: In recent years treatment of pain has made new strides. Digital distractions provide pain and distress reduction for children undergoing painful or uncomfortable hospital procedures (Gates et al, 2020). Using novel technology (virtual reality, social robots) has shown promise in pain management. Hologram technology provides an innovative approach as a distraction technique. To our knowledge, holograms have not been used as distractions in hospital settings for children before.

Methods: 14 children aged 5 months to 7 years undergoing painful hospital procedures, such as intravenous cannulation and blood draws, were presented with seven different playful holographic videos with HYPERVSN 3D device during procedures. Face, Legs, Activity, Cry, Consolability scale (FLACC, 1997) was used to measure children’s distress during procedures before and after initiating hologram distractions.

Results: In assessing the effectiveness, we found positive changes on the FLACC scale. At first assessment, 64% of children presented with moderate discomfort, 22% with mild, 7% with severe and 7% with none. Nurses evaluated children’s distress by facial expressions, verbal and non-verbal communication. After being presented with holograms, children demonstrated positive effects in increased comfort and cooperation during procedures. At second assessment with FLACC scale, no children showed severe pain levels, only 7% presented with moderate and 43% with mild discomfort levels. Remarkable 50% of children showed no signs of distress. Distraction technique was effective for children of different ages, especially for smaller children aged 10–13 months (reported by nurses). In addition, procedures like measuring blood pressure and botox therapy were easier to be conducted using the supplementing hologram method.

Conclusion: For the first time, novel hologram technology was utilized and revealed as effective distraction technique in children for pain and distress reduction during common painful and uncomfortable hospital procedures. We believe that looking at holograms, in addition to distraction, may improve children’s emotional state and perception of control over pain. We encourage health-care professionals to implement modern exciting hologram devices in hospital settings.

62 TBI Knowledge of Professionals Working with Justice-Involved Youth

Jessica Riccardi, Samantha Vogel, Angela Ciccia

ABSTRACT

Justice-involved youth (JIYs) are three to four times more likely to have experienced a traumatic brain injury (TBI) than children in the general population. Between 30% and 80% of JIYs are estimated to have experienced one or more TBIs. Childhood TBI is associated with higher rates of ADHD/hyperactivity/inattention, conduct/mood disorders, and speech-language and learning difficulties. These difficulties pose challenges for rehabilitation and community re-entry post-incarceration. Although this population is known to have higher rates of previous TBIs, the history of TBI often goes un-identified and is not considered in long-term planning for JIYs. Professionals working with JIYs play a critical role in identifying and providing supports and services related to TBI. The aim of this study was to better understand the knowledge of TBI of professionals working with JIYs, a research priority identified by the National Conference of State Legislatures (2019). Fifty employees of an urban juvenile court system completed an online survey about their TBI knowledge. Respondents scored an average of 77.31% correct, yet statistically significant patterns emerged in item responses. Items with the lowest percent correct responses (10–66%) included topics related to mechanism of injury for teens and JIYs and functional difficulties after TBI, including memory and aggression. Experience working with a JIY with a TBI was the only factor related to higher knowledge scores (p = 0.040), and professionals with greater years of experience were more likely to have worked with a JIY with a TBI (p = 0.036). Self-rating of knowledge of TBI was associated with level of education (p = 0.035), yet neither of these factors were significantly associated with higher knowledge scores. These results provide foundational evidence on TBI knowledge of professionals working with JIYs to inform future TBI-related trainings and education provided to professionals working with JIYs. Educational content should focus on the functional difficulties associated with TBI in JIYs, including memory and aggression. The high prevalence of TBI in this population, and subsequently the high likelihood of having worked with a JIY with
a TBI, should also be addressed. Additional implications for trainings, practices, and policies related to JIYs with TBI will be discussed during the presentation.

**66 Recovery of Consciousness and Predictors of Early Functional Outcomes for Pediatric Patients with Disorders of Consciousness (DOC) During Inpatient Rehabilitation**

Robyn Howarth, Joshua Vova, Laura Blackwell

*Children’s Health-care of Atlanta, Atlanta, United States*

**ABSTRACT**

Objective: Disorders of consciousness (DOC) may occur following a traumatic brain injury (TBI), including coma, state of unresponsive wakefulness or vegetative state (VS), and minimally conscious state (MCS). Diagnostic criteria have been previously established, primarily with adults. The aims of the current study are to examine recovery of consciousness among pediatric patients with DOC following TBI who require inpatient rehabilitation and to investigate predictors of early recovery in this setting.

Participants & Methods: 26 patients were identified with DOC (VS or MCS) who received inpatient rehabilitation following a severe TBI (42.3% female; mean age = 8.9 ± 6.4 years). Severity of injury was determined by Glasgow Coma Scale (GCS) score. Level of responsiveness was assessed using the Coma Recovery Scale, Revised (CRS-R). Functional status was assessed using the Developmental Functional Quotient (DFQ) for the Functional Independence Measure for Children (WeeFIM).

Results: Average length of stay was 40.7 days (range = 19–113). At admission, 14 patients (53.8%) were in VS and 12 patients (46.2%) were in MCS. Mean admission CRS-R score was 7.8 (SD = 4.2) and discharge CRS-R score was 14.9 (SD = 7.7). 65.4% emerged from a MCS during inpatient rehabilitation. Patients who presented in VS were less likely to emerge by discharge (36% in VS emerged versus 92% in MCS). There was a trend for those who emerged to have a longer LOS (45 versus 32 days) and to admit sooner to inpatient rehabilitation (52 versus 34 days). At admission, there was no difference in WeeFIM scores between those who emerged and those who did not emerge. There was a significant difference in WeeFIM change scores from admission to discharge (.84 versus 20.97). Other demographic and clinical variables were not found to be associated with recovery of consciousness.

Conclusions: Previous research investigating the recovery of consciousness during inpatient rehabilitation in pediatric DOC is limited. Results of the current study revealed that a majority of patients admitted in DOC emerged from a MCS. Patients who did not emerge tended to be further out from injury at admission and have a shorter LOS. Current findings emphasize the importance of serial monitoring during rehabilitation to help impact care strategies.

**67 Utility of Serial Cognitive Assessments to Inform Treatment of Pediatric Patients Diagnosed with Anti-NMDA Receptor Encephalitis (NMDARE)**

Robyn Howarth, Laura Blackwell, Grace Gombolay

*Children’s Health-care of Atlanta, Atlanta, United States, Emory School of Medicine, Atlanta, United States*

**ABSTRACT**

Objective: Anti-NMDA receptor encephalitis (NMDARE) is a recently described auto-immune disorder triggered by the presence of antibodies targeting the NMDA receptor. Clinical presentation includes psychiatric symptoms and neurologic decline, including a decreased level of consciousness. Objective assessments for monitoring cognitive status are limited in NMDARE and needed to assess treatment response. The Cognitive and Linguistic Scale (CALS) is a 20-item measure designed for serial assessment of cognitive-linguistic recovery following acquired brain injury during inpatient rehabilitation. Scores range from 20 to 100. The primary aim of the current study is to examine the utility of the CALS to serially assess cognitive status and to inform treatment for patients with NMDARE during inpatient rehabilitation.

Participants & Methods: 18 pediatric patients were identified with a confirmed diagnosis of NMDARE between the ages of 3–18 years (mean age at symptom onset = 10.5 ± 4.2) who required intensive inpatient rehabilitation following acute care hospitalization. Functional status was assessed using the Developmental Functional Quotient (DFQ) for the Functional Independence Measure for Children (WeeFIM). Cognitive-linguistic skills were serially assessed using the CALS at admission and discharge.

Results: A majority of patients were female (61%) and non-Caucasian (72%). Average time to initiate immunotherapy from symptom onset was 21 days (range = 2–51). Mean length of stay on the inpatient rehabilitation unit was 32 days (range = 14–108). Average admission CALS score was 43.4 (SD = 17.7), with 50% of patients presenting with decreased levels of consciousness (CALS ≤ 35). Mean discharge CALS score was 74.1 (SD = 21.8). Most patients demonstrated notable improvements in WeeFIM and CALS scores between admission and discharge; however, a subset of patients (17%) displayed a decreased level of consciousness at discharge, deemed low responders. Younger age, seizures, and higher number of treatments received were associated with worse functional outcomes at discharge.

Conclusions: The clinical course and treatment response in pediatric NMDARE is highly variable, particularly early in the disease course. Pediatric patients diagnosed with NMDARE may demonstrate a notable decline in functional skills that warrants inpatient rehabilitation. Current findings suggest that the CALS may be one objective measure to help monitor cognitive status and response to treatment in NMDARE within the inpatient setting.
68 What do You Want to do with Your Rehabilitation? Introduction of a Life Skills Coach on an Inpatient Brain Injury Rehab Unit

Brenna Buchanan\textsuperscript{a}, Nicholas Joachimides\textsuperscript{a}

\textsuperscript{a}Holland Bloorview Kids Rehabilitation Hospital, Toronto, Canada

\textbf{ABSTRACT}

Pediatric Brain Injury Rehabilitation has traditionally been delivered by a team of Physicians, Nurses, Occupational Therapists, and Physiotherapists etc. The main focus of the team has been on restoring function of the upper and lower limbs, while enhancing cognitive function. Holland Bloorview Canada’s Largest Pediatric Rehabilitation Hospital introduced the role of a Life Skills Coach to the inpatient team, a role that is well established in the outpatient setting. There is a scattering of literature which highlights that children who are hospitalized often lose a sense of control and fall behind their peers with independence, decision-making and socially. A Life Skills Coach brings a unique patient focused approach which can assist patients to gain a sense of autonomy and bring an enhanced meaning to their rehabilitation experience, as well as focusing on skills to support readiness for transition to home. Patients at Holland Bloorview have identified skills such as resuming daily routines, time management, job interview coaching, and basic chores such as folding laundry, and making snacks. In addition, the Life Skills Coach can develop strategies with the patient to enhance cognitive goals such as self-advocacy, speaking about disability disclosure, friendship skills and bullying. Life Skills Coaching is transforming pediatric inpatient rehabilitation with the early introduction of the concept of real-world rehabilitation. The feedback from families and patients has been very positive, and success stories will be highlighted in this poster.

70 Using a Cognitive Orthosis to Support Meal Preparation Following a Severe Traumatic Brain Injury: A Single-case Study

Mireille Gagnon-Roy\textsuperscript{ab}, Nathalie Bier\textsuperscript{ac}, Sylvain Giroux\textsuperscript{de}, Mélanie Couture\textsuperscript{fg}, Hélène Pigot\textsuperscript{bde}, Guylaine Le Dorze\textsuperscript{bhi}, Nadia Gosselin\textsuperscript{bhi}, Sareh Zarshenas\textsuperscript{bhi}, Charlotte Hendryckx\textsuperscript{bhi}, Carolina Bottari\textsuperscript{ab}

\textsuperscript{a}School of Rehabilitation, Université de Montréal, Montreal, Canada, \textsuperscript{b}Centre for Interdisciplinary Research in Rehabilitation of Greater Montreal (CRIR), Institut universitaire sur la réadaptation en déficience physique de Montréal du CIUSSS du Centre-Sud-de-l’Île-de-Montréal, Montreal, Canada, \textsuperscript{c}Centre de recherche de l’Institut Universitaire de Gériatrie de Montréal (CRIUGM), Montreal, Canada, \textsuperscript{d}DOMUS Laboratory, Department of Computer Science, Faculty of Science, Université de Sherbrooke, Sherbrooke, Canada, \textsuperscript{e}Centre de recherche sur le vieillissement-Research Center on Aging, CSSS-IUGS, Sherbrooke, Canada, \textsuperscript{f}Centre for Research and Expertise in Social Gerontology (CREGÉS), Montreal, Canada, \textsuperscript{g}Department of psychology, Université de Sherbrooke, Sherbrooke, Canada, \textsuperscript{h}School of Speech-Language Pathology and Audiology, Université de Montréal, Montreal, Canada, \textsuperscript{i}Center for Advanced Research in Sleep Medicine (CARSIM), Montreal, Canada, \textsuperscript{j}Department of psychology, Université de Montréal, Montreal, Canada

\textbf{ABSTRACT}

Introduction: Meal preparation is a complex occupation involving various cognitive abilities (e.g. planning, problem-solving, multitasking) and sub-tasks (e.g. choosing a meal to prepare, grocery shopping, ensuring safety when cooking). Cognitive deficits due to a moderate-to-severe traumatic brain injury (TBI) may interfere with the completion of this activity. To address this issue, we developed an assistive technology for cognition, the Cognitive Orthosis for coOKing (COOK), using a research action design approach in partnership with an alternative residential resource for people living with severe TBI. The current study aimed to evaluate the feasibility and usability of using COOK within the home of a person living alone.

Methodology: Participants: A 35-year-old man with a severe chronic TBI (17 years post-injury) and his mother.

Design: A single-case experimental study following an ABC with multiple baselines design, where A represented the baseline phase, B represented the learning phase with COOK and C represented the follow-up. Each phase encompassed three evaluation time points, including 1) a weekly daily journal, 2) the observation of a meal preparation task and 3) a control task (i.e., obtaining information). Interviews were also completed with the participant with TBI and his mother several times during the study to explore their experience with COOK.

Analyses: Quantitative analysis (Tau-U) and qualitative thematic analysis.

Results: Following seven learning sessions (including four in a laboratory setting), the participant could use COOK independently at home. His meal preparation performance improved over time, as he required less assistance and was more efficient at follow-up compared to baseline (both Tau = -1, p = .0495). However, the number of meals he prepared using the stove did not change significantly. This finding could be explained by the presence of technical issues (e.g. inability to activate the stove when desired). When confronted with technical issues, the participant usually tried to correct the problem by himself (therefore disconnecting a sensor one time, which was corrected only a few days later) or found alternatives that didn’t involve using COOK (e.g., go to the restaurant, prepare a simple meal without the stove), and only called the research team as a last resort as he did not want to disturb. Nonetheless, the participant and his mother found COOK very helpful in improving the participant’s motivation and confidence to cook independently while increasing his meal preparation skills.

Conclusion: Despite technical issues and the absence of improvement in the number of meals prepared per week using the stove, COOK is a promising technology to support people with a severe TBI during meal preparation. Further
research is needed to 1) advance technology features and 2) assess usability and integration of COOK in daily life by people with various profiles and living contexts.

**71 Perinatal Neurotrauma: Complicated Childbirth and Brain Impact**

Lisa Kurth*

*University of Colorado School of Medicine, Developmental Pediatrics, Fort Collins, United States

**ABSTRACT**

Pediatric traumatic brain injury may consider expanding to include perinatal events, including complicated childbirth, which demonstrate evidence-based influence for child neurodevelopmental trajectory. Epidemiological studies link specific intrapartum complexities presenting during labor and delivery with rising child neuropsychiatric outcomes, justifying the Perinatal Neurotrauma concept. Specifically, overlapping, interacting factors involving early exposures combined with elevated maternal gestational BMI, confer a disruptive cascade of neural events which may risk lifelong impairments for children. Rising neuropsychiatric conditions including ADHD and Autism, have unconfirmed etiologies, yet complicated childbirth associations. Concomitant cognitive dysregulation, emotional dysregulation, social and academic issues often persist into adulthood. While a genetic etiology has been considered, it is unlikely genetics alone trigger these outcomes. Plausibly, events introduced during most sensitive developmental periods may adversely impact the malleable fetal brain with risky downstream effects, disrupting child neurodevelopment. Birth complications typically involve well-respected measures aimed at expediting childbirth. One first-line, synthetic uterine contractant effectively expedites >50% of all U.S. childbirths, despite its poorly understood fetal impact. Exponential increases in exogenous uterine stimulation and dosage inconsistencies amplify concerns regarding consequential child outcomes. Labor duration, dosages and duration are important algorithms to disentangle since these are all modifiable factors. Established repercussions of this early environmental exposure include fetal distress, low Apgar scores, uterine hyperactivity, FHR abnormalities, NICU admissions and ischemia/asphyxia/hypoxia. Putative neuropathophysiologic models include fetal intolerance to prolonged dosages, labor impact; epigenetic triggering, oxytocin receptor hyperstimulation and/or receptor oversaturation. Other considerations include neuroinflammation; hypertonic uterine contraction pressure imposing neuropathophysiological alterations and diffuse axonal injury. Plausibly, disharmonious compounds, GABA downregulation; blood–brain barrier breach and/or placental permeability may also compromise fetal neuroprotective integrity. Additionally, the underexplored neuropathophysiological interpretation of pharmacokinetics involving synthetic properties may play a key role in brain impact. Interestingly, maternal BMI/adiposity, a modifiable gestational health factor, increases odds for medically assisted childbirth owing to diminished uterine contractility in obese mothers. The shared effects of maternal BMI with chemically expended labor, and its two-fold impact on offspring brain development is under-investigated and should not be marginalized since its potential future contribution to the study of pediatric traumatic brain injury is imperative. While a signature, underlying, neuropathogenic mechanism(s) linking childbirth agents and maternal gestational BMI to pediatric brain injury lacks confirmation, studies associate these factors directly to child neuropsychiatric phenotypes, with mixed evidence. Logically, the vulnerable fetal brain’s reaction to early, overlapping events and exposures is important to better understand. It is timely to appreciate that a constellation of perinatal factors may risk future functional and behavioral impairments for children. The Perinatal Neurotrauma concept refers to early vulnerabilities which may destabilize and/or disrupt fetal brain development, warranting aggressive research and inclusion in the burgeoning field of pediatric brain injury as a critical child public health issue.

**72 Perceptions Regarding Children’s Safety and When Is a Good Age to Start Playing Tackle Football**

Dana Waltzman*, Kelly Sarmiento*, Jill Daugherty*

*Centers For Disease Control and Prevention, Atlanta, United States

**ABSTRACT**

Objectives: In the United States, approximately 2 million youth play American football. It is not only one of the most commonly played sports in the United States among youth, but is also one of the most watched sports on television, with millions of fans nationwide. Despite its popularity, American football is associated with the largest number of emergency department visits for sports- and recreation-related traumatic brain injury (including concussions) among youth. Tackling is responsible for almost two-thirds of these injuries. Contact restrictions and modifying tackling techniques may reduce head impacts, and thus concussion risk. To this end, some groups recommend implementing age restrictions; eliminating tackling for football players under high-school age. As American football is part of the lives of many Americans, an examination of public readiness to support age restrictions warrants investigation.

Methods: Self-report data were collected from 4,053 respondents in the summer wave (“SummerStyles”) of Porter Novelli’s 2020 U.S. Consumer Styles survey. Respondents were asked questions about whether they would support enforcing specific age limits, concerns about safety, the benefits and dangers of playing tackle football, and past tackle football history.
Results: This highest percentages of respondents reported middle (11–13 years of age) or high school (14–18 years of age) as a good age for kids to start playing tackle football, 32.8% and 27.8%, respectively. However, a substantial proportion (19.8%) of respondents also reported that there was no good age for kids to play tackle football. Women, those with a higher education, and individuals who were not a fan of or did not play football were more likely to endorse this option. Respondents endorsed the primary benefits of kids playing football as keeping physically active (65.1%) and teaching good skills for life (55.4%), while the primary reason not to play was due to concussions or other brain injuries (83.3%) or other kinds of injuries (66.1%). However, most respondents (86.5%) were somewhat or very concerned about children’s safety when playing tackle football. Again, females, those with more education, and those who were not a fan of or did not play football were more likely to be very concerned about kids’ safety in tackle football.

Conclusions: Despite acknowledgement of some benefits to playing football, respondents overall expressed concern about player safety and endorsed age restrictions on tackling. Future research that explores the culture of football and its impact on implementation football safety measures may be beneficial.

Disclaimer: The findings and conclusions in this manuscript are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

79 Implementation of Lean in a Neuro Rehabilitation Facility using the BRAIN Framework

Joe Walters

On With Life, Inc., Ankeny, United States

ABSTRACT

On With Life, a provider of neuro rehabilitation services started its Lean journey in early 2020. The implementation of Lean has been used to redesign key processes and create a focus on being a sustainable provider of brain injury and neurological rehabilitation services. This presentation will be a case study of the journey over the last year and highlight the development of the BRAIN framework, discussion of what Lean is, strategies for implementation and insights from two Lean Kaizen events. The BRAIN framework is comprised of five steps that can be used to analyze a process, regardless of size for opportunities to reduce wastes. The framework incorporates the concepts of Lean in an easy-to-use format relatable to On With Life’s mission. Using this framework, the On With Life team has identified many of the eight forms of waste in current processes and developed solutions to allow staff to work more efficiently and effectively.

The first Kaizen event involved reviewing the admission process to an inpatient post-acute rehab unit. As length of stays have decreased and frequency of admissions increased, the inefficiencies and lack of coordination in the current admissions process became unsustainable. A multidisciplinary team used the BRAIN framework in a four-day Kaizen event and determined three major areas to address. Solutions from the event included a revision of admission documentation workflows, more focused intake acceptance decision process and development of an electronic Bed Board for easier room assignment.

A second Kaizen event was conducted in late 2020 to redesign intake and documentation processes in On With Life’s outpatient clinics. As the outpatient program has grown, non-standard processes using a mix of paper and electronic documentation have resulted in disruptions to treatment. Program leadership’s ability to track and analyze the performance of outcomes was also limited due to intensive efforts to gather data for outcomes. Using BRAIN during a second four-day Kaizen event allowed the team to completely redesign the outpatient program processes. As a result, all outpatient documentation and workflows are now managed electronically, which has reduced missed pre-authorizations, increased use of existing EHR functionality and automated tracking and reporting of program outcomes using a self-service reporting tool.

The case study of On With Life’s journey will also include perspective and insights from participants in both Kaizen events. It will highlight challenges of using BRAIN along with learnings of how it helped team members perform their jobs better and change their thinking about additional areas that could be improved. It will also provide ideas on how other organizations can get started in improving processes for their own programs.

93 Concussion Practice Patterns Among Speech-Language Pathologists

Mary Ann Williams-Butler, Robert Cantu

aEmerson Hospital, Concord, United States

ABSTRACT

Concussion, defined as a traumatic brain injury (TBI) caused by biomechanical forces, results in a complex pathophysiologic process including metabolic, physiological and microstructural injury, often causing diffuse insult to multiple areas of the brain. This can contribute to a constellation of signs/symptoms as the brain attempts to regain homeostasis. Symptoms can be classified in four main categories: somatic, cognitive, affect, and sleep. These concussion symptoms can be best served by an interdisciplinary team to address the numerous and complex factors influencing the recovery trajectory. As more is understood about the neuropathological changes and resultant cognitive communication deficits secondary to concussion, the role of the speech-language pathologist (SLP) on the interdisciplinary concussion care team becomes essential. The SLP can, within their scope of practice, provide assessment, diagnosis, and treatment of these cognitive communication deficits that can negatively impact daily functioning and social interactions. Without a consistent body of evidence to support specific practice recommendations, SLPs must rely on knowledge of other neurological populations to care for people with concussion. Identifying the current state of practice for SLPs is critical to enable future development in concussion care.
The goals of this study were to:

1. Identify current SLP practice patterns related to assessment and treatment with adults and pediatrics diagnosed with concussion
2. Clarify definitions of common terms used in cognitive retraining, and
3. Establish areas of growth in clinical practice and research.

An online 10 question survey was compiled to collect data on current assessment and practice components utilized by SLPs in outpatient concussion clinics across the US. The questions were established based on existing literature regarding cognitive-communication, SLP scope of TBI practice endorsed by the American Speech Hearing Association (ASHA), and prevailing practices for treatment of concussion. Data were analyzed using descriptive statistics. Results revealed patient education and symptom management were regular components of cognitive retraining with concussion. A smaller percentage included cognitive endurance building in their treatment approach. Further analysis identified variations in how SLPs defined the terms: patient education, symptom management, and cognitive endurance building. The study also revealed discrepancies for what SLPs identified as a diagnostic tool. One-quarter of respondents relied on screening tools as their primary source of assessment. Screening tools are not designed as a full diagnostic battery and can therefore underestimate the complex cognitive weaknesses typically associated with concussion.

The research continues to identify the uniqueness of those diagnosed with concussion and their vulnerability to comorbidities (PTSD, anxiety, depression, ADHD) which can further impact the recovery trajectory. It is therefore crucial those involved in providing concussion care have a strong knowledge base to support the differential diagnosis and therapeutic plan in order to optimize outcomes.

94 Long-Term Changes in Social Adaptive Abilities Following Early Mild Traumatic Brain Injury

Fanny Dégeilh\textsuperscript{a}, Annie Bernier\textsuperscript{b}, Miriam Beauchamp\textsuperscript{b,c}

\textsuperscript{a}Department of Child and Adolescent Psychiatry, Psychosomatics, and Psychotherapy, LMU University Hospital Munich, Ludwig-Maximilians-Universität, Munich, Germany, \textsuperscript{b}Department of Psychology, University of Montreal, Montreal, Canada, \textsuperscript{c}Saint-Justine Research Center, Montreal, Canada

\textbf{ABSTRACT}

Introduction: Social problems may be among the most debilitating consequences of TBI (Yeates et al., 2007). We previously reported that early mild TBI (mTBI, sustained before the age of 6 years) disrupts the expected developmental progression of children’s social adaptive abilities over 18 months post-injury (Dégeilh et al., 2018), suggesting that young children may experience a slowing in the acquisition of social adaptive abilities compared to their typically developing peers. The present study aimed to explore whether this slowing in the acquisition of social adaptive abilities persists in the longterm.

Method: Parents of 81 children with mTBI (38 girls) and 60 with orthopedic injuries (OI; 34 girls) sustained between 1.5 and 5 years completed the social skills sub-scale of the Adaptive Behavior Assessment Scale-II at baseline (retrospective assessment of preinjury functioning) and at 6, 18, 30, and 60 months post-injury. Growth curve analysis (Mirman, 2014) was performed to explore group effects on the time course of social adaptive abilities captured with a third-order (cubic) natural polynomial.

Results: There was no effect of group at pre-injury (estimates: OI = 100.9, mTBI = 101.4; p = .83), but there was a marginal or significant effect of group on all time terms (Estimates - OI: time = 0.08, time2 = −0.03, time3 = 0.003; Estimates - mTBI: time = −0.03 [p = .058], time2 = 0.01 [p = .048], time3 = −0.0002 [p = .048]). For OI, social adaptive abilities increased by 0.40 point per month from 0 to 18 months post-injury and then progressively decreased by −0.08 point per month until 60 months post-injury. For mTBI, social adaptive abilities remained at the pre-injury level for the first 6 months, then slowly increased by 0.15 point per month until 30 months post-injury, and finally decreased by −0.14 point per month until 60 months post-injury.

Conclusions: These findings suggest that early mTBI may disrupt the expected developmental progression of children’s social adaptive behavior. The developmental profile of social abilities in children with mTBI appears to follow the same overall pattern as other children of the same age, but with a delayed onset after a 6-month period of stagnation and a slower improvement rate.

95 TEAm Pilot Study on screening for Pediatric mTBI in Emergency Departments

Alex Hall\textsuperscript{a}, Timothy Moran\textsuperscript{a}, Juliet Haarbauer-Krupa\textsuperscript{b}, Rachel Bull\textsuperscript{a}, David Wright\textsuperscript{a}, Jonathan Ratcliffe\textsuperscript{a}

\textsuperscript{a}Emory University School of Medicine, Atlanta, United States, \textsuperscript{b}CDC, Atlanta, United States

\textbf{ABSTRACT}

Children have the highest rate of emergency department (ED) visits for traumatic brain injury (TBI) of all age groups. An injury of any severity to the developing brain can disrupt a child’s developmental trajectory and may result in restrictions in school classwork requirements and participation in activities such as sports and extracurricular clubs and projects. As a result of a TBI of any severity, children may experience changes in their health, thinking, and behavior that affect learning, self-regulation, and social participation, all of which are important in becoming a productive adult. Unlike other developmental health conditions in children that are diagnosed at birth, TBI is an acquired condition that can occur anytime during childhood with the potential for a sudden alteration in development.
Emergency physicians are often the initial, and only, clinical providers for patients who have sustained a mild traumatic brain injury (mTBI). Previous research on adults over age 18 suggests that 30–50% of the mild TBIs presenting to the ED go undiagnosed. A recent study found that a screening instrument integrated in ED triage observed 38,621 individuals at high-risk for mTBI, and only 50% of those were subsequently diagnosed with mTBI. In the current study, the primary objective was to determine if these findings were consistent in a pediatric population by evaluating the frequency of a documented mTBI evaluation, initial diagnosis, discharge plans, and parent education among children identified as being high-risk for mTBI according to an integrated screening instrument at triage.

At a pediatric level 1 trauma center, triage nurses screened children using two simple questions: did an injury occur, and was the mechanism consistent with mTBI. If the two questions were positive, a third question was asked: was there a period of altered mental status. Patients were considered at high-risk for mTBI if all responses were positive. Data were abstracted from the electronic medical record. Triage screening results, patient characteristics, clinician characteristics and documentation, and disposition features were analyzed. Patient characteristics included age, sex, race, primary language, payor type, and disposition (i.e., admission, discharge to home). Clinician characteristics and documentation included practice location (i.e., ED physician, urgent care physician, pediatrician), mTBI evaluation (i.e., medical, history and physical), diagnoses (i.e., concussion, non-specific head injury), and delivery of discharge education.

This session will describe pilot study findings and implications for health-care provider diagnosis and care management of children who experience a concussion and present to the ED.

96 Use of Neuromuscular Electrical Stimulation for the Treatment of Moderate-Severe Oropharyngeal Dysphagia Post Traumatic Brain Injury: A Case Series

Hannah Loughnane

Galway University Hospitals, Saolta Hospital Group, Newcastle, Ireland

ABSTRACT

Introduction: Aetiology of dysphagia includes stroke, traumatic brain injury (TBI), progressive neurological disease, head and neck cancer, and trauma to the aerodigestive tract. Incidence rates of dysphagia secondary to TBI are as high 93%. Dysphagia secondary to TBI can be impacted by factors including cognitive-communication, behavioral, neurological, and mechanical issues (Howle et al, 2014). Treatment of dysphagia depends on symptoms and severity, traditionally using exercises to improve muscle function (Logemann, 2006). Research specific to dysphagia rehabilitation post TBI is lacking, with dysphagia research often involving heterogeneous patient groups (Howle et al, 2014). Transcutaneous neuromuscular electrical stimulation (NMES) is usually completed in conjunction with traditional swallowing therapy. NMES aims to increase the effectiveness of swallowing therapy by strengthening the swallowing muscles and stimulating sensory pathways to help with motor cortex re-organisation and relearning (Powell et al, 2017). Ampcare is one commercially available NMES system. Most evidence for NMES in treatment of dysphagia is in stroke populations.

Research Aims: We sought to examine use of NMES in conjunction with traditional therapy with patients with moderate-severe oropharyngeal dysphagia secondary to TBI.

Methods: Case series of four male patients (aged 20–65 years) with moderate-severe dysphagia secondary to TBI who were referred to inpatient Speech and Language Therapy (SLT) in the acute-stage post brain injury. Three patients were nil per oral prior to commencing treatment; two of these were receiving full nutrition and hydration via PEG, one via nasogastric tube.

All patients completed traditional dysphagia rehabilitation exercises between sessions, targeting laryngeal elevation and base of tongue strengthening. All patients completed a 20 treatment session block of NMES as per Ampcare Effective Swallow Protocol (30 minute session up to 5 times weekly). Modified Barium Swallow Study was completed pre and post treatment to guide and evaluate treatment and outcomes.

Results: Post-treatment MBS showed improvement of 2–4 points on Dysphagia Outcome Severity Scale (DOSS) in all patients. All patients resumed full oral intake post intervention. Increases in Functional Oral Intake Scale (FOIS) for all patients were also noted (2–4 points). Physiologically, improvements were noted in bolus control, bolus transit time, oropharyngeal residue, swallow reflex trigger and airway protection.

Discussion: Use of NMES in dysphagia rehabilitation is an emerging area of practice in SLT. Limited evidence to date focuses specifically on patients post-stroke. As per this case series, NMES may be a useful therapy approach for patients with moderate-severe oropharyngeal dysphagia post TBI. Although they presented with a variety of physical and cognitive deficits, all patients were able to engage in intensive sessions. They reported benefits to structured rehab program (as per Ampcare protocol) and were motivated to engage in traditional rehabilitation exercises between SLT-led sessions. All were successfully weaned from non-oral feeding.

97 Social-Legal Narratives in Adults with and without Traumatic Brain Injury

Joseph Wszalek, Macayla Church, Lyn Turkstra

University of Wisconsin–Madison, Madison, United States, McMaster University, Hamilton, Canada

ABSTRACT

Objective: To characterize social-legal narrative production in adults with and without traumatic brain injury.

Participants: 19 adults with moderate-to-severe TBI (11 women) and 21 adults without TBI (13 women).

Methods: Participants completed an open-ended, semi-structured interview in which they were prompted to describe their knowledge of laws and legal systems. The resulting narratives were coded for microlinguistic and macrolinguistic elements of language production.
Results: Participants with TBI produced narratives with more microlinguistic errors (number [t(38) = -4.17, BH-adjusted p = .001] and rate [t(38) = -5.13, BH-adjusted p < .001] of paragrammatic errors; percentage [t(38) = 6.04, BH-adjusted p < .001] of incomplete sentences) and with more macrolinguistic errors (number [t(38) = -2.63, BH-adjusted p = .047] and rate [t(38) = -2.59, BH-adjusted p = .048] of local cohesion errors; number [t(38) = -6.78, BH-adjusted p < .001] and rate [t(38) = -6.58, BH-adjusted p < .001] of global cohesion errors; number [t(38) = -4.11, BH-adjusted p = .001] and rate [t(38) = -5.86, BH-adjusted p < .001] of lexical information units). When controlling for working memory and speed-of-processing—cognitive measures we previously identified as predictors of performance on tasks of legal-language and legal-rule comprehension—the group effects for number and rate of paragrammatic errors, number and rate of global cohesion errors, and number and rate of lexical information units all persisted, but there were no effects of the cognitive measures on micro- or macrolinguistic elements.

Conclusion: Adults with TBI produced social-legal narratives with poorer linguistic quality than their uninjured peers. These findings replicate findings from studies investigating non-social-legal narratives in adults with and without TBI and add to a growing corpus of empirical findings that link TBI to poorer outcomes on tasks of social-legal communication. Although additional experiments are required to better elucidate cognitive measures associated with this poorer-quality narrative production, the results identify areas of potential risk for individuals with TBI who must use narrative speech to navigate legal contexts.

98 Chiropractic Treatment of a Post-Concussion Syndrome Secondary to Volleyball Injury in a 14-Year-Old Female: A Case Report

Marilyn Holbeck

*Sacro Occipital Technique Organization – USA, Fairfax, United States

ABSTRACT

Objective/Clinical Features: A 14-year-old female was struck in the frontal bone (glabella) by a volleyball with significant impact on March 2012 from an inferior to superior direction, while she was twisting her body towards the left. She was seen by both a pediatrician and neuro-pediatrician and was told to take Tylenol, and rest (watch and wait). She presented to this office in July 2012, approximately 4-months post-trauma, with no memory of the volleyball game, decreased visual fields, dizziness, nausea, extreme fatigue, and headaches since impact along with focal in occipital and glabella regions. Due to her symptomatology she had been unable to attend school since the March 2012 accident.

Intervention/Outcomes: The patient was treated with chiropractic sacro occipital technique (SOT) category two supine block (two wedges) placement for pelvic torsion and associated sacroiliac joint hypermobility syndrome, cervical staircase adjustments (non high velocity low amplitude) without only slow gentle small arc twisting or rotation, and parietal sagittal suture cranial release techniques. The day following the first treatment she was able to return to school for the first time since the injury and she reported that the pain in her occipital region had subsided. She was seen for three more visits with the focus on cranial adjusting of the craniofacial region and by August 2012, one month later, she was symptom free. Until she was treated at this office her symptoms had remained stable without any improvement. Following the first treatment there was consistent improvement noted which continued after each subsequent office visit.

Discussion: The temporal nature of her symptoms, from the time of the trauma, are consistent with her having suffered a post-concussion syndrome with associated brain trauma. Of significance is that her symptoms had not changed for four months until receiving her first chiropractic treatment, which suggests a possible correlation between the care rendered and the patient’s presentation post-treatment. While regression to the mean, placebo or ideomotor effects, or coincidence might be a consideration, her lasting effects since the injury and immediate response to treatment is compelling. With any single subject case report, it is always difficult to generalize the findings to the population at large, however there may be a subset of patients that are unresponsive to medication and watching and waiting that might find conservative SOT chiropractic care a viable option.

Conclusion: Based on the finding of this case report SOT and cranial treatment for the care of post-concussion syndromes in athletes warrants further study. Ideally interdisciplinary conservative care facilities would be optimal to treat patients with these methods, particularly when they are unresponsive to medication and more aggressive options are not a reasonable option.

99 Chiropractic Care of Professional Ice Hockey Player Suffering from Multiple Concussions: A Case Report

Thomas Bloink

*Sacro Occipital Technique Organization, Santa Monica, United States

ABSTRACT

Introduction: The field of chiropractic is becoming more involved in the assessment and treatment of sports-related concussion. As the studies emerge, chiropractors involved in treating athletes for sport-related concussion are using the most recent SCAT assessment tools as they are being developed.

Case Presentation: A 21-year-old male professional hockey player suffered a concussion on May-2017 when he was checked into the boards during a playoff hockey game. He was on the disabled list until early November-2017. Upon his return, he played five games before having another substantial head impact on resulting in an additional concussion. At his initial presentation on January-2018 he reported constant headaches, which were intermittent in intensity, ranging from increased head pressure to severe pain. His headache was localized to the frontal bone, bilateral sphenoid wings,
and glabella. He also stated that he felt he was chronically clenching his jaw. After the initial head trauma, a SCAT concussion checklist suggested a significant brain injury associated with headache, photophobia, photophobia, impaired memory at the time of the head injury, intermittent brain fog, forgetfulness, fatigue, intermittent mood swings, and continuing for over nine-months afterwards. He was referred to this office by his team due to his inability to practice/play hockey due to suspected unresolved post-concussion syndrome.

Methods: The patient pO2 values were 95% at rest and while on a stationary bicycle would decrease to the lower 90s. Sacro occipital technique (SOT) analysis and cranial assessment revealed multiple cranial, craniofacial, and temporomandibular joint (TMJ)-related imbalances. Treatment involved treatment to the spine and cranial bone functional imbalance and associated cranial/dental co-treatment included lower occlusal splint therapy to control clenching and the translation of occlusal forces affecting his head. Dental treatment frequency was one visit per week for 3 weeks in a row immediately preceded by cranial treatment at this clinic.

Results: The patient was treated for 10-visits over four-weeks at which point he returned to regular play again. His oxygen saturation improved, registering with activity at 99%. His entire original presenting symptoms had resolved by the fourth week of care, and he scored a goal and had two assists in his first game back.

Conclusion: This case discusses care of a professional ice hockey player suffering multiple concussions and having limited ability to return to play hockey for 9 months due to cognitive issues, headaches, and reduced pO2 values when physically stressed. Chiropractic care with cranial interventions along with dental/chiropractic co-management of his TMJ dysfunction with a dental appliance appeared to create a significant change, and he returned to the ice within 4 weeks of care. Based on the finding in this case report, further research into chiropractic cranial care to facilitate recovery from sports-related post-concussion syndromes might be warranted.

100 Post Concussion Syndrome, Temporomandibular Joint Disorders, and Chiropractic Dental Co-treatment: A Case Report

Thomas Bloink*a

aSacro Occipital Technique Organization, Santa Monica, United States

ABSTRACT
Introduction: This case report describes a patient who had head trauma with subsequent post-concussion syndrome symptoms that persisted for five-months. Since treatment regimens for concussions and post-concussions are still being formulated, low-risk interventions, such as chiropractic, may offer a safe therapeutic approach to supplement care.

Case History: On September 13, 2013, the patient, a 21-year-old female student, stood up abruptly, felt lightheaded, fell down forward into a desk hitting her head on the desk and then on the floor. She was momentarily unconscious and awoke on the floor with significant head pain. Emergency services arrived, immobilized the patient, and transported her to the emergency room where she was examined and released.

Over the ensuing months she began to feel lightheaded and nauseous when exercising. These symptoms progressively worsened until she had to stop all exercise activities. Her symptoms progressed to include anterolateral headaches, aggravated by all cognitive activities (e.g., studying, phone use, etc.), causing her to significantly reduce her physical and cognitive activities. After finishing the college semester (December 12, 2013) she stayed in bed for much of the rest of the month. She noted some slight recovery yet still significantly decreased all physical (e.g., driving, walking, etc.) and cognitive (college education) activities.

Evaluation noted photophobia, contrast sensitivity, and convergence insufficiency. Pelvis assessment noted pelvic torsion associated with sacroiliac joint imbalance and dysfunction.

Treatment: Sacro occipital technique (SOT) pelvic block (wedges) were used to balance and stabilize the patient’s sacroiliac joint. SOT cranial and craniodental procedures were implemented with a referral to a dentist specialist in temporomandibular joint disorders (TMD). Following chiropractic treatment the dentist performed an evaluation and delivered an equilibrated mandibular occlusal splint on February 27, 2014. She was followed up on March 6, 2014 for another post-treatment splint equilibration and was seen for a total of nine-treatments at this clinic.

Results: As of March 18, 2014 the patient was completely pain-free without symptoms of lightheadedness, brain fog, or nausea. She was able to exercise, lift lightweights, and able to run five-miles. This was a significant improvement given her symptoms and lack of function were consistent since her accident and prior to instituting care at this clinic.

Conclusion: Further research is needed to determine whether a subset of post-concussion or head trauma patients may have TMD that limits their ability to fully recover function and recover from head trauma. Collaborative efforts between emergency room doctors, chiropractors, and dentists (with TMD care training) treating post-concussion patients, may lead to improved patient outcomes.

101 Women and Caregiving for Brain Injury: The Lived Experiences

Cynthia O’Donoghue*a, Cara Meixnera

aJames Madison University, Harrisonburg, United States

ABSTRACT
Background: At present, there exist limited popular or empirical studies informing what women experience as caregivers to individuals with brain injury. This is particularly troublesome since the literature indicates that a majority of caregiving is provided by mothers, partners, sisters, and
103 A Cluster Randomized Trial to Reduce Missed Abusive Head Trauma in Pediatric Intensive Care Settings

Kent Hymel

ABSTRACT

Background: To minimize missed or unrecognized cases of pediatric abusive head trauma (AHT), PediBIRN investigators derived and validated a 4-variable clinical decision rule (CDR) that recommends thorough abuse evaluations for young, acutely head-injured, “higher risk” patients who present with any one or more of its 4 predictor variables. Applied perfectly, the “PediBIRN-4” performs with 96% sensitivity.

Objective: To estimate the PediBIRN-4’s actual impact on abuse evaluations and missed AHT in pediatric intensive care unit (PICU) settings.

Methods: A cluster randomized trial. Participants were 8 PICUs in US academic medical centers; 90 PICU and child abuse physicians; and their consecutive acutely head-injured patients <3 years (n = 183 and n = 237, intervention vs. control). PICUs were stratified by patient volumes, pair matched, and randomized equally to intervention or control conditions. Randomization was concealed from the biostatistician assessing outcomes. Cluster level, physician-directed interventions included initial and booster training, access to an AHT probability calculator, and local information sessions. Outcomes included higher risk patients evaluated thoroughly for abuse (with skeletal survey and retinal exam), potential cases of missed AHT (patients lacking either evaluation), and rendered subordinate to an economy-driven model (Fins, 2015) and caste systems spawn an array of access barriers (Wilkerson, 2020).

Drawn from the researchers’ work with survivors, caregivers, and providers, this contribution turns incisively to neuroethics, examining frameworks that spotlight the above-referenced challenges and present possibilities for systems-level change (Meixner & O’Donoghue, 2020). Three models (i.e., teleological, care ethics, and pragmatism) are applied to authentic scenarios that feature issues such as exclusion hierarchies, implicit discrimination, stigmatization, and dehumanization. A teleological approach brings to the fore “a methodology for understanding the disjointed, siled systems of rehabilitative care and asserts proper goals for care” (Meixner & O’Donoghue, 2020, p. 74). To examine problems teleologically is to critique a traditional, rationalist approach in favor of one that is adaptive, person-centered, and biopsychosocial. Relatedly, a care ethics model, rooted in the work of disability scholar Rogers (2016), examines schemes of caring that are humanizing, interdependent, equitable, and safe. Finally, there is pragmatism, which looks beyond abstraction to deal “with the problems of humanity, as well as pointing the way toward progressive practices and policies … not only for [disabled persons], but for a society that is also impaired as a result of its own construction of disability” (Keith & Keith, 2013, p. xii).
ABSTRACT

Objective: Hemianopia following occipital stroke is believed to be mainly due to local damage at or near the lesion site. Yet, MRI studies suggest functional connectivity network (FCN) reorganization also in distant brain regions. Because it is unclear if reorganization is adaptive or maladaptive, compensating or aggravating vision loss, we characterized FCNs electrophysiologically to explore the role of local and global brain plasticity and correlated reorganization with visual performance.

Methods: Resting-state EEG was recorded in chronic, unilateral stroke patients and healthy age-matched controls (n = 24 each). The correlation of oscillating EEG activity was calculated with the imaginary part of coherence between pairs of interested regions, and FCN graph theory metrics (degree, strength, clustering coefficient) were correlated with stimulus detection and reaction time.

Results: Stroke brains showed altered FCNs in the alpha- and beta-band in numerous occipital, temporal and frontal brain structures. On a global level, FCN had a less efficient network organization while on the local-level node networks reorganized especially in the intact hemisphere. Here, the occipital network was 58% more rigid (with a more “regular” network structure) while the temporal network was 32% more efficient (showing greater “small-worldness”), both of which correlate with worse or better visual processing, respectively.

Conclusions: Occipital stroke is associated with both local and global FCN reorganization. While reorganization towards a more “regular” network structure in intact visual cortex is maladaptive, responsible for perceptual deficits in the intact visual field, reorganization in intact temporal brain regions is presumably adaptive, possibly supporting enhanced peripheral movement perception.

105 Evaluating the Relationship Between Executive Functioning, Spoken Discourse, and Life Participation Outcomes of Persons with Aphasia

Manaswita Dutta\textsuperscript{a}, Laura Murray, Brielle Stark

\textsuperscript{a}Rush University, Chicago, United States

ABSTRACT

Background: Previous research suggests a strong relationship between executive functioning (EF) and linguistic ability in individuals with or without brain injury (Marini et al., 2011). This association, however, has been insufficiently studied in persons with aphasia (PWA), despite frequent reports of them demonstrating EF and spoken discourse difficulties (Andreotta et al., 2012; Murray, 2017). Furthermore, few studies have examined the role of such cognitive-linguistic difficulties on aphasia-related quality of life (QOL).

Aims: The specific aims of the current study were to examine in PWA: (1) the integrity of EF skills; (2) the quality of spoken discourse productions; and (3) the relationship between their EF and spoken discourse abilities with life participation/psychosocial outcomes.

Method: Twenty-two PWA (WAB-R AQ mean = 74.4; SD = 17) and 24 healthy controls (HC; MoCA mean = 27; SD = 1) completed a comprehensive battery of verbal and nonverbal EF tests and retold the Bear and the Fly story. Additionally, PWA and their caregivers completed the Sydney Psychological Reintegration Scale-2 and the Assessment of Living with Aphasia to evaluate life participation/psychosocial functioning.

Results and Discussion: Confirming prior research (e.g., Baldo et al., 2015; Nicholas & Connor, 2017), we found that PWA demonstrated significantly poorer scores and slower performances than HC on most verbal and nonverbal EF measures (all \(p < .03\)). Individual-level analysis revealed significant variability in performances within the aphasia group indicating that most but not all PWA demonstrated EF deficits. Our results did not reveal a consistent relationship between aphasia severity or type and EF task performances.

In line with Armstrong (2000) and Boyle (2009), PWA produced significantly fewer correct information units, more word retrieval and grammatical errors, a smaller proportion of nouns, and less lexically diverse language output than HC (all \(p < .03\)). Like Andreetta et al. (2012), PWA demonstrated significantly fewer main concepts, reduced organization, and less efficient language use compared to HC (all \(p < .01\)). Similar to Cruice et al. (2010), PWA had greater difficulty with life participation, community integration, and experienced more frequent environmental barriers.

Impairments in initiation, planning, organization, cognitive flexibility, and self-monitoring were significantly related to compromised narrative performance (Marini et al., 2011).
Further, poor life participation/psychosocial outcomes were linked to cognitive flexibility and self-monitoring difficulties (Owensworth & Shum, 2008). Spoken discourse abilities were found to be more sensitive and better predictors of QOL than discrete language impairments (Elbourn et al., 2019).

Conclusion: Our findings indicate that PWA demonstrate verbal and nonverbal EF and micro-and macrolinguistic spoken discourse difficulties, which can present as barriers to social communication and reintegration, thus negatively impacting their QOL. It is important to evaluate EF, spoken discourse, and patient-reported outcomes in clinical practice to improve rehabilitation success and QOL of PWA.

106 Brain Regulation of Voice Development in Childhood and Puberty, A Review

Mette Pedersen

aMedical Centre, Copenhagen, Denmark

ABSTRACT

Our aim with this systematic review was to get further knowledge of the biological background of the normal human voice production. The search included genetics and brain development related to voice production as well as hormones. Only 18 papers were found in a search made by the library of the Royal English Society of Medicine, we supplemented the systematic search with references, found in papers that did have interesting information even if no voice production measures were found. Voice analysis included the quantitative GAT (glottal analysis tools), OCT (optical coherence tomography) and deep learning research on the vocal folds. The sexual hormones were discussed, as well as the genetic development of voice production, regulated from the hypothalamus probably related to growth hormone. The primitive integrating voice production centre placed in the motor cortex located over the hand in the homunculus is discussed. Two signal processing brain functions for voice production of voluntary and involuntary processing have different developmental aspects. Updated results of fMRI brain studies are referred to as well as results of tissue examinations. All these findings are important in the future. Advanced quantitative voice production analysis based on huge amounts of sound information can be combined with artificial intelligence methods to treat voice production deficiencies. In this way developmental disorders of voice production could be diagnosed and treated better.

107 Piloting A Bespoke Memory Toolkit: Intervention for Children Following Traumatic Brain Injury

Fiona Snyder, Tara Murphy, Frédérique Liégeois

aChailey Clinical Services, North Chailey, United Kingdom, bGreat Ormond Street Hospital NHS Foundation Trust, London, United Kingdom, cUniversity College London Great Ormond Street Institute of Child Health, London, United Kingdom

ABSTRACT

Traumatic brain injury (TBI) in children causes significant long-term difficulties in cognition and behavior. Despite this, there is little research on clinical interventions, reflecting the complexity of studying the impact of TBI to a developing brain, and in children with widely varying home and school environments. The paediatric neurocognitive interventions (PNI) model offers a multi-level framework for planning clinical interventions, taking into account developmental and environmental factors. This pilot study aimed to evaluate the efficacy of clinical interventions for children with memory difficulties following TBI, using the PNI model to identify intervention targets and draw upon the support available in the child’s system. Five children (8–15 years old) with TBI and reported memory problems were randomised to two groups in a multiple-baseline design. A six-week, one hour per week, intervention for memory impairment was delivered to all children. Interventions included psychoeducation, mnemonic strategies and environmental adjustments. Participants were evaluated at three, two-monthly time points. Group A received the intervention between Time 1 and 2, whereas Group B received the intervention between Time 2 and 3. There was no significant effect of the intervention on memory performance, measured using The Rivermead Behavioral Memory Test for Children (RBMT-C). However, there were significant gains in quality-of-life measures and individualised goals post-intervention. Results provide preliminary evidence that, whilst memory itself cannot be readily remediated, the everyday difficulties experienced by children with TBI and their families can be improved through brief clinical interventions.

108 Psychological Interventions for Children with Traumatic Brain Injury: A Systematic Review

Fiona Snyder, Tara Murphy, Frédérique Liégeois

aChailey Clinical Services, North Chailey, United Kingdom, bGreat Ormond Street Hospital NHS Foundation Trust, London, United Kingdom, cUniversity College London Great Ormond Street Institute of Child Health, University College London, London, United Kingdom

ABSTRACT

The cognitive and psychosocial difficulties following paediatric traumatic brain injury (TBI) are well documented. In contrast, there is a lack of understanding and guidance regarding the effectiveness of psychological interventions for this group of children. This review aims to summarise the current literature on psychological interventions for children with TBI. A search using the PubMed and PsycINFO databases was completed. In total, 10 intervention studies met inclusion criteria: six targeted cognitive difficulties (in memory, attention and executive skills) and four targeted psychosocial difficulties (in behavior and emotional wellbeing). Studies were evaluated using both methodological quality ratings and effect size calculations. Three papers were rated as high quality, six were moderate quality and one was low quality. Across studies, significant
improvements in outcome measures, with moderate to large effect sizes, provided converging evidence for the cognitive remediation and alleviation of psychosocial difficulties in children with TBI, following intervention. The cognitive intervention studies reviewed indicated increased effectiveness when a metacognitive component was included in training tasks. The psychosocial intervention studies reviewed also indicated that the inclusion of a metacognitive component, as well as psychoeducation increased efficacy.

109 Traumatic Brain Injury Treatment for Transgender Individuals: A Systematic Review

Maya Navarro\textsuperscript{a,b}, Sara Bond\textsuperscript{a,b}, Mason Wolf\textsuperscript{a,b}, Sukthi Gunda\textsuperscript{a,b}, Lisa Abe\textsuperscript{a,b}

\textsuperscript{a}New York University, New York, United States, \textsuperscript{b}Polygeia Global Health Think Tank, New York, United States

\textbf{ABSTRACT}

Background/Objectives: As research on transgender populations has significantly increased within the past decade, there has been an increased emphasis on making necessary accommodations for these communities within health-care settings. Although trans populations are more likely to suffer from traumatic brain injuries (TBIs) than cisgender populations, the treatment of TBIs within this group has not received due consideration. Therefore, our primary objectives in this systematic review were: (1) to investigate the unique needs of trans people in TBI treatment and recovery; and (2) to determine if the quality-of-care trans populations receive is adequate considering established cisgender-center care methods.

Methods: A total of 6 databases were searched until April 2021 to compile a systematic review and qualitative analysis that focused on the two aforementioned primary objectives. As the direct intersection of trans healthcare and TBIs has been sparsely studied, the inclusion criteria for the peer-reviewed literature published since 1996 was broadened to include either a focus on trans populations, TBIs, or documented cases of trans discrimination in healthcare.

Results: 24 articles were identified to focus on TBIs in trans and LGBTQIA+ populations, their health-care needs, or the established standard of care. Articles included ranged from case studies, cross-sectional studies, scoping and systematic literature reviews, surveys, or commentaries. Multiple studies (n = 3) that were included had a disproportionately low amount of trans-identifying research participants. While little research was found on the direct overlap of trans populations and TBI recovery, there was a consensus in all articles that trans populations need unique accommodations during TBI recovery to mitigate complications brought on by hormone therapies or negative mental health outcomes associated with gender role dissonance. Studies specifically focusing on trans care in both a normal health-care setting and TBI recovery (n = 7) established that trans populations feel like they do not receive adequate care, and there is a negative stigma in seeking treatment.

Conclusions: Significant disparities in TBI treatment quality received by trans populations as opposed to their cisgender counterparts reflect a lack of inclusive research and disappointing support for trans populations in health-care settings at large. Small sample sizes, limited representation in larger studies, and a dearth of trans-specific studies have resulted in an alarming lack of data and poor provider knowledge. Best practices are not established, patient autonomy is low, and trans patients have fewer unique health resources than other groups. Medical providers should have trans needs woven into all domains of their formal training, and should periodically consult trans medical professionals and engage with the community themselves to keep abreast of a rapidly evolving sector. More trans-specific research and provider training is needed to better support this community.

110 Brain Monitoring in Neurorehabilitation

Vera Nenedovic\textsuperscript{a}, Shawn Pear\textsuperscript{a}, Lindsey Cabral\textsuperscript{a}, Peter Runney\textsuperscript{b}

\textsuperscript{a}Holland Bloorview Kids Rehab, Toronto, Canada

\textbf{ABSTRACT}

Purpose: To quantify recovery after brain injury to better direct treatment and predict outcome, by calculating the phase synchrony of patients’ electroencephalography recordings.

Methods: A pilot study of ten children, 5–17 years, who sustained a brain injury from trauma, stroke, tumors, or infection, had electroencephalography (EEG) recorded weekly from admission to discharge. An eight-channel, dry electrode, wireless EEG was used (Cognionics\textsuperscript{\textregistered}). Matlab algorithms calculated the phase synchrony for each channel pair. The phase synchrony, an index between 0 and 1, reflects the degree of connectivity between electrodes. The phase synchrony was averaged for each 30 second recording. The Kings Outcome Scale for Childhood Head Injury (KOSCHI) was evaluated on admission and at discharge.

Results: The global EEG phase synchrony increased in 8 of the 10 patients, correlating with an increase in the KOSCHI from admission to discharge. One patient showed no change in phase synchrony or KOSCHI. One patient demonstrated a decrease in the EEG phase synchrony, during the rehab course and this correlated with a change in clinical status due to hydrocephalus.

Conclusion: In this pilot study the phase synchrony of EEG recordings is a promising novel biomarker of brain recovery that warrants further investigation.

113 Spontaneous Magnetic Brain Activity in Chronic Disorders of Consciousness Following Severe Traumatic Brain Injury Caused by Car Accidents

Yuka Ikeyama\textsuperscript{a}, Hirohito Yano\textsuperscript{a,c}, Mikari Sawada\textsuperscript{d}, Yoshitaka Asano\textsuperscript{b}, Maki Okada\textsuperscript{d}, Jun Matsumoto-miyazaki\textsuperscript{a}, Etsuko Owashi\textsuperscript{a}, Kazufumi Ohmura\textsuperscript{a}, Hiroaki Takei\textsuperscript{b}, Kazuhiro Miwa\textsuperscript{b}, Takeshi Ito\textsuperscript{b}, Kazutoshi Yokoyama\textsuperscript{b}, Morio Kumagai\textsuperscript{b}, Jun Shinoda\textsuperscript{a,c}
ABSTRACT

Objectives: Visualization of brain activities in patients with chronic disorders of consciousness is required owing to difficulty in observation of their responses or intentions. This study focused on obtaining overviews of brain activity in the resting state from spontaneous magnetoencephalography (MEG) data by mapping dominant areas of various frequency bands on the whole cerebral cortex. In addition, the distributions of the maps were compared between vegetative state (VS) and minimally conscious state (MCS).

Methods: Nine patients (eight men, one woman; mean age: 43.0 ± 16.2 years; duration after injury: 21.2 ± 11.1 months; VS 4, MCS 5) were retrospectively analyzed.

Acquired MEG data were recorded with eyes-closed for 5 minutes under pass-band 0.1–330 Hz and sampling frequency of 1 kHz. In the 300 seconds recording time, the middle 100 seconds period was analyzed using Brainstorm, a software working based on Matlab.

After pre-processing (consisting of checking quality of the power spectrum density, Notch filter, Band-pass filter), the power maps were created by estimating the average power of the target period for six frequency bands, namely δ (2–4 Hz), θ (5–7 Hz), α (8–12 Hz), β (15–29 Hz), low-γ (30–59 Hz), and high-γ (60–90 Hz). The power maps were displayed in individual cortex images abstracted from the T1 magnetic resonance image with rainbow colors from blue to red and the maximum set as the median absolute power value among all patients in the frequency band.

Then, the more active areas (yellow and red regions) were visually scored as 0 (<10% red or <50% yellow), 0.5 (>10% and <50% red or >50% yellow), and 1 (>80% red) per 1 lobe of each view from four directions (bottom, right, left, top). The total full score was 20 per 1 patient. Patients’ scores (added scores in each direction and the total scores of the four directions) were collected, and differences between the VS and the MCS groups were evaluated.

Results: In the slow waves, the scores of the δ wave at the bottom of the brain were slightly higher in VS than in MCS (p-value = 0.149, Mann–Whitney test). Among fast waves, the total scores of the α wave were marginally lower in VS than in MCS (p-value = 0.186, t-test). Both γ waves showed higher scores at the bottom of the brain in MCS than in VS (p-value = 0.056, p-value = 0.089, respectively, t-test).

Conclusions: In the present study, the difference in the brain activity between VS and MCS tended to appear at the bottom of the brain. It was speculated that the comparison of dominant frequency bands at the bottom of the brain could be useful in the estimation of the status of disorders of consciousness caused by severe traumatic brain injury following car accidents.

115 Using a Multifaceted Clinical Concussion Assessment Battery for Adults with Persistent Concussion Symptoms

Kelsey Bryk, Scott Passalugo, Thomas Buckley

aUniversity of Manitoba, Winnipeg, Canada, bBoston Children’s Hospital, Boston, United States, cUniversity of Delaware, Newark, USA

ABSTRACT

Background: A multifaceted battery of post-concussion assessments has been established and utilized in clinical and research settings to acutely assess symptoms, cognitive function, balance, clinical reaction time, and oculomotor function. These have been helpful for acute assessments; however, it remains unclear if they are useful in an adult population with persistent concussion symptoms (PCS). It is estimated that 15–40% of mTBI patients will experience symptoms that persist beyond the normal 10–14-day clinical recovery timeline. The purpose of this study was to identify neurocognitive deficits using a multifaceted clinical post-concussion assessment battery in adults with PCS.

Methods: A sample of 15 adults with PCS (11 females; age: 43.9 ± 11.8 years) and 24 healthy control subjects (16 females; age: 42.1 ± 10.3 years) were recruited. PCS patients sustained a diagnosed mild traumatic brain injury (mTBI) at least 3 months prior to testing; control subjects could not have sustained an mTBI in the last 12 months or have a history of PCS. Participants completed the Rivermead Post-Concussion Symptoms Questionnaire (RPSQ) and the following clinical assessments: Clinical Reaction Time (CRT), King-Devick (KD) Test, and the Vestibular Ocular Motor Screening (VOMS) assessment which includes a measure of near point convergence (NPC); an NPC greater than 5 cm is considered abnormal. A symptom increase of >2 indicates VOMS failure. Independent samples t-test were performed on all dependent variables to compare PCS patients and controls; an alpha level was set a priori at .05.

Results: PCS patients reported a significantly worse number (p < .001) and severity (p < .001) of symptoms on the RPSQ. PCS patients also demonstrated significantly slower average CRT (PCS: 238.3 ± 47.3 msec, CI: 212.1–264.5; Controls: 208.3 ± 18.0 msec, CI: 200.7–215.9; p = .035), longer KD time to completion (PCS: 74.8 ± 51.1 sec, CI: 46.5–103.1; Controls: 46.7 ± 9.0 sec, CI: 42.8–50.5; p = .010), and significantly greater NPC on the VOMS (PCS: 16.8 ± 13.7 cm, CI: 9.3–24.4; Controls: 5.2 ± 8.9 cm, CI: 1.5–9.0; p = .001) than healthy control participants with medium to strong effect sizes (0.385–0.530). Additionally, 10 of 15 (66.7%) PCS patients had an abnormal average NPC of greater than 5 cm, whereas 8 of 24 (33.3%) of healthy controls had an abnormal average NPC of greater than 5 cm. Twelve of 15 PCS patients failed VOMS, whereas no control subject failed VOMS (p < .001).

Conclusion: While PCS research has tended to focus on symptoms that patients experience, limited research has examined cognitive impairments in these patients using objective assessments. Our results suggest that patients with PCS have
persistent and subtle cognitive impairments that can be assessed using commonly used clinical post-concussion assessments. Therefore, while measurements of symptoms are typically used to distinguish adults with PCS from healthy individuals, cognitive assessments may also assist in further identifying and quantifying subtle deficits.

116 Practice-Based Evidence. How Well do We Collect Routine Clinical Data and What do Rehab Practitioners Think about the Process? A Service Evaluation

Peter Tucker\textsuperscript{a}, Emma Brooks, Sophie Gosling

\textsuperscript{a}Recolo UK Ltd, Bath, United Kingdom

\textbf{ABSTRACT}

Background: The international collaboration of the Common Data Elements (CDE) group recommend best outcome measures for research in paediatric ABI population (McCaulay et al., 2012). Routinely collected clinical data on children can be flawed, uncertain, proximate and sparse ‘FUPS’ (Wolpert & Rutter, 2018).

Recolo UK Ltd provides community-based neuropsychological rehabilitation for children, young people and young adults. Associates collect data from their assessments and reviews to identify impairments and monitor outcome, using measures recommended by CDE (Gosling, 2015).

Aims to ask: Are the gaps in the clinical dataset? Why? What are barriers and challenges to data collection?

Method: Two phases: frequency counts of data and practitioner interviews. Clients have a wide range of age (0–18 yrs), brain injury type and severity. In clinical practice, associates assessed 267 children with brain injury and their families.

Measures: a) PedsQL, FAD, BRIEF, SDQ, CASP. b) Interview scripts.

Procedure: a) Frequency analysis of questionnaires collected 2013–2019; b) Six associates recruited as ‘participants’ for semi-structured interview. A purposive sampling method was adopted. Thematic Analysis (Braun & Clarke, 2006) performed.

Results: a) There are large gaps in the database. The totals completed measures at baseline ranges from n = 163–41 (Peds-FIM-parent; PedsQL core-child). Most commonly reviewed once were Peds-FIM, Peds-QL, and SDQ (n = 35, 34, 28 respectively). b) Five key themes were identified from the interview scripts: impact of outcome measures on clients; construct of outcome measurement; culture of goal setting; helpful aspects of outcome measurement; barriers to data collection.

Conclusions: There were gaps in data collection. The interviews describe barriers and facilitators to data collection. Recommendations are given to address the issues by increasing knowledge and skills, improving the technology and including nomothetic (goals) and idiographic (questionnaire) outcomes.

117 How Good are our Goals? Understanding SMARTness in a Paediatric Neuropsychological Rehabilitation Service

Peter Tucker\textsuperscript{a}, Katie Byard\textsuperscript{b}, Sophie Gosling\textsuperscript{a}, Rebecca Ashton\textsuperscript{a}, Fergus Gracey\textsuperscript{a}

\textsuperscript{a}Recolo UK Ltd, Bath, United Kingdom, \textsuperscript{b}University of East Anglia, Norwich, United Kingdom

\textbf{ABSTRACT}

Background and aims: Goal setting is a key ingredient in rehabilitation with children and young people (Ylvisaker, 1998). It should be a core competency of any member of a rehabilitation team (Wade, 2009). Goals in rehabilitation should be SMART (Specific, Measurable, Achievable, Realistic and Timed).

This study employed a service evaluation in order to: 1. Examine reliability of goal quality rating items according to established SMART criteria; and 2. Identify goals associated with poorer ‘SMARTness’ to inform goal setting and audit practice.

Method: As part of a service evaluation cycle, a project was undertaken to evaluate the quality of a sample (n = 100) of anonymised paediatric neuropsychological rehabilitation goals. The text of each goal was rated by four senior practitioners within the service according to criteria set within a goals questionnaire (Grant & Ponsford, 2014). Five items relating to SMARTness were used, with a highest possible score 20.

Results: SMART tool total scores were normally distributed (mean = 12.36; sd = 3.19; range 5–20). Calculation using all five items provided a ‘good’ inter-rater reliability (ICC = 0.824). Items on the tool attracting low IRR included ‘does the goal assess criteria that are process oriented?’ (ICC = 0.288). 77\% of the goal sample had ‘high’ to ‘excellent’ IRR. 68\% of these goals (n = 53) were rated as having a high level of SMARTness. 32\% (n = 24) were rated as low in SMARTness. Goals with low IRR included those with: generalised wording, e.g. ‘to attend all Southend Utd activities as they are planned’; ambiguous goal difficulty, e.g. ‘to sit my exams (first mocks then GCSEs) in a way that helps me do my best whilst managing energy levels well’; and poorly defined tasks, e.g. ‘mum to be receiving appropriate therapy for depression by X.’ Goals rated reliably low on SMARTness had poor goal specificity, e.g. ‘to find out good things about my brain, what I do and to like myself.’

Conclusions: Rehabilitation practitioners can use this tool to quantify SMARTness of rehabilitation goals set with children, young people and their families. Not all individual items on the tool have adequate reliability and require modification. It is yet to be determined how SMARTness of goals relate to their meaningfulness to the client or their achievement in rehabilitation.
118 Smaller Hippocampal Volume and Verbal Episodic Memory Alterations in Acute Mild Traumatic Brain Injury

Olivier Fortier-Lebel\textsuperscript{a,b}, Benoit Jobin\textsuperscript{a,b,c}, Fanny Lecuyer-Giguère\textsuperscript{a,b,d}, Malo Gaubert\textsuperscript{e,f}, Jean-François Giguère\textsuperscript{b}, Jean-François Gagnon\textsuperscript{b,c,f}, Benjamin Bolley\textsuperscript{a,c}, Johannes Frasnelli\textsuperscript{a,b,c}

\textsuperscript{a}Université du Québec à Trois-rivières, Trois-rivières, Canada, \textsuperscript{b}Research Centre of the Hôtel du Sacré Cœur de Montréal, Montréal, Canada, \textsuperscript{c}Research Centre of the Institut universitaire de gériatrie de Montréal, Montréal, Canada, \textsuperscript{d}Université de Montréal, Montréal, Canada, \textsuperscript{e}Ludwig-Maximilians-Universität, Munich, Germany, \textsuperscript{f}Université du Québec à Montréal, Montréal, Canada

\textbf{ABSTRACT}

Episodic memory impairment is a symptom frequently observed after a mild traumatic brain injury (mTBI). However, few studies have investigated the impact of a single and acute mTBI on episodic memory and structural cerebral changes. To do so, two experiments were carried out by our laboratory. The objective of the first experiment was to assess verbal episodic memory by using a word recall test, in 52 patients (mean age 33.1 (12.2) years) (2–4 weeks post-trauma), compare them to 54 healthy control subjects (31.3 (9.2) years) and reassess both groups 6 months later. The second experiment consisted in measuring the hippocampal volume of a subgroup of these participants (20 mTBI and 20 healthy controls) using magnetic resonance imaging (T1-weighted images) and correlate the volumes with verbal episodic memory scores. The first experiment showed significantly reduced verbal episodic memory within the first month after a mTBI and a tendency for a reduction 6 months later, more pronounced for men. In the second experiment mTBI patients exhibited a generally reduced hippocampal volume; however, no linear correlation between the hippocampal volume and the memory scores were observed in any participant. The results obtained from these two experiments suggest verbal episodic memory alterations and smaller hippocampal volume in the acute phase of mTBI.

119 Incidence of Visual Midline Shift in Concussed High-School Athletes versus Controls: A Pilot Study

Eden Maxwell\textsuperscript{a}, Cindi Laukes\textsuperscript{a,d}, Willow Affleck\textsuperscript{c}, Bill Rosen\textsuperscript{a,b}

\textsuperscript{a}University Of Montana, Neural Injury Center, Missoula, United States, \textsuperscript{b}Bill S Rosen, MD, PC, Missoula, United States, \textsuperscript{c}Hellgate High School, Missoula, United States, \textsuperscript{d}University of Washington, Seattle, United States

\textbf{ABSTRACT}

Visual Midline Shift (VMS) is a type of post-trauma vision syndrome. Additional abnormalities of vision following trauma can be screened with the Vestibular/Oculomotor Motor Screening Assessment (VOMS). However, the VOMS does not include an assessment of VMS. Moreover, VMS is a common symptom following concussions and other traumatic brain injuries (TBI). To date, there is scant medical literature investigating this phenomenon, although it has been reported in TBI and other populations, including stroke, multiple sclerosis, and carbon monoxide poisoning. The purpose of this pilot study was twofold, to determine if there is a naturally occurring prevalence of Visual Midline Shift in the general, nonconcussed population, which has not been previously investigated, and to determine if VMS exists at a higher frequency in concussed individuals relative to the healthy, control group. If so, there would be cause for a reevaluation of content of the current concussion testing screening protocols, in particular the Vestibular/ Oculomotor Motor Screening Assessment (VOMS). Visual midline is the brain’s perception of an individual’s vertical center within their environment. A VMS is an alteration in perception of true vertical center, relative to their perceived body’s position. Dysfunction in the lateral geniculate ganglion is the presumed source of impairment. Should an individual suffer from a VMS, they may experience a variety of symptoms ranging from headaches, vertigo, dizziness and/or balance difficulties. As a result of this visual dysfunction an assortment of functional problems may arise, such as difficulty reading, grazing doorways and trouble maintaining a vehicle in the proper lane. Individuals can experience a left, right, posterior and/or an anterior VMS. The severity can vary, between and within an individual. Factors that may alter the severity of VMS may include stress, fatigue, and overstimulation. If an individual experiences a left sided midline shift, they will find themselves perceiving objects, such as doorways to be in line with their ‘falsey perceived’ midline, when the object is to the left of center. Consequently, they may graze the left doorway. Thirty-eight participants, nine of whom had suffered at least one concussion, completed a questionnaire detailing their concussion history and were then evaluated by an examiner who did not know their clinical history. In the control group, participants without knowledge of ever experiencing a concussion, 10% exhibited a Visual Midline Shift. More significantly, 45% of individuals with a history of concussion exhibited a Visual Midline Shift. This pilot data indicates the need for a larger study. Utilization of VMS testing could increase the power of the VOMS in clinical diagnostic examinations. A larger study could also help determine how soon after a concussion VMS develops.

120 Changes in Functional Brain Activity Following Exercise in Acute Pediatric Brain Injury: Preliminary Findings

Bhanu Sharma\textsuperscript{a}, Eric Koelink\textsuperscript{a}, Carol DeMatteo\textsuperscript{a,b,s}, Michael Noseworthy\textsuperscript{a}, Brian Timmons\textsuperscript{s}

\textsuperscript{a}McMaster University, Hamilton, Canada, \textsuperscript{b}CanChild Centre for Childhood Disability Research, Canada, \textsuperscript{s}School of Rehabilitation Science, McMaster University, Hamilton, Canada

\textbf{ABSTRACT}

Background: Concussions are among the most common sport-related injuries in children. The status quo of pediatric concussion management was physical activity avoidance until
symptom resolution. However, there now exists compelling
evidence to suggest that sub-maximal aerobic exercise can
improve symptom burden in acute concussion, whereas strict
rest immediately following injury may worsen or increase risk
of persisting symptoms. Consequently, clinical and scientific
opinions are shifting towards prescribing sub-maximal aerobic
exercise and/or encouraging physical activity in the acute
stages of concussion for the benefit of symptom resolution.
The problem is that we do not know how specific episodes of
exercise immediately following injury affect the concussed
pediatric brain. This is the first study to examine the effects
of acute sub-maximal aerobic exercise on functional brain
activity in children with concussion.

Methods: Prospective cohort study (with matched controls).
Children with sport-related concussion (and age- and sex-
matched healthy controls) completed a baseline MRI to exam-
ine resting state functional activity. Then, study participants
completed a 10-min bout of sub-maximal aerobic exercise,
akin to that being prescribed as part of concussion manage-
ment. Participants then re-entered the MRI within 2-min to
examine differences in resting state functional activity.
Children with a history of multiple concussions or other neu-
rological co-morbidity were excluded.

Results: We report on preliminary findings based on 6 children
with concussion and 4 healthy controls. We found that there
were no pre- post-exercise changes in resting state functional
activity in healthy controls (threshold, t = 2.771, p = 0.05).
However, in children with concussion, there were multiple
regions in the brain with reduced resting state functional
activity following exercise, principally the inferior parietal
lobe and post-central gyrus. Similarly, with group-wise com-
parisons, reductions in functional activity were observed in
concussed but not healthy children after—but not before-
exercise.

Discussion: While recruitment is ongoing, our preliminary
findings suggest that while exercise may benefit symptom
recovery, it may increase neurological vulnerability in children
with concussion. These findings raise important questions
about the role of exercise in pediatric concussion management,
and whether the timing and type of exercise needs to be
optimized to promote symptom recovery and brain health.

121 Neurocognitive Assessment Tools for Military
Personnel with Mild Traumatic Brain Injury: Where are we?

Chelsea Jones a, b, c, Lorraine Smith-MacDonald d, Suzette
Bremault-Phillips d

a Heroes in Mind, Advocacy and Research Consortium (HiMARC), Faculty of Rehabilitation Medicine, University of Alberta, Edmonton, Canada, b Leiden University Medical Centre, Leiden, Netherlands, c Department of National Defense, Edmonton, Canada, d Department of Occupational Therapy, Faculty of Rehabilitation, University of Alberta, Edmonton, Canada

ABSTRACT

Background: Mild traumatic brain injuries (mTBI) occur at
a higher frequency among military personnel than civilians.
A common symptom caused by mTBI is cognitive dysfunction.
Neuropsychological assessments are used by health-care pro-
fessionals as part of a multidisciplinary and best practice
approach for mTBI management. Such assessments support
clinical diagnosis, symptom management, rehabilitation, and
return-to-duty planning. Military health-care organizations
currently use computerized neurocognitive assessment tools
(NCATs). NCATs and more traditional “pen and paper” neu-ropsychological assessments present unique challenges both in
clinical and military settings. Many research gaps remain
regarding psychometric properties, usability, acceptance, feas-
ibility, effectiveness, sensitivity, and utility of both types of
assessments in military environments.

Objectives: (1) To explore what evidence exists regarding the
use of NCATs among military personnel who have sustained
mTBI; (2) evaluate the psychometric properties of the most
commonly tested NCATs for this population, and; (3) synthe-
size the data to explore the range and extent of NCATs among
this population, clinical recommendations for use, and knowl-
edge gaps requiring future research.

Methods: Studies were identified using MEDLINE (Medical
Literature Analysis and Retrieval System Online), EMBASE
(Excerpta Medica dataBASE), APA (American Psychological
Association) PsychINFO, CINAHL (Cumulative Index of
Nursing and Allied Health Literature) Plus with Full Text,
Psych Article, Scopus, and Military & Government Collection.
Data were analyzed via descriptive analysis, thematic analysis,
and the Randolph Criteria. Narrative synthesis and the PRISMA-ScR
(Preferred Reporting Items for Systematic Reviews and Meta-
Analyses extension for Scoping Reviews) guided reporting of
findings. Criteria proposed by Randolph et al. (2005) were util-
ized to evaluate the psychometrics of currently utilized NCATs.

Results: Of 104 articles, 33 studies met the inclusion criteria
for this scoping review. All included studies (n = 33) were quanti-
tative and the majority of studies were published in the US and
utilized US military personnel as participants. The most com-
monly utilized NCATs among the 33 studies were versions of
the ANAM, DANA, and IMPACT with a myriad of different
secondary measures utilized throughout the studies with the most
common including other neuropsychological assess-
ments and screens related to mTBI. The 3 main themes that
emerged through the studies included, (1) comparing “apples
to oranges,” (2), reliability issues, and; (3) issues with validity.

Conclusion: The psychometric properties of the most com-
monly used NCATs in military populations have yet to demon-
strate adequate validity, reliability, sensitivity, and clinical
utility among military personnel with mTBI. Additional
research is needed to further validate NCATs within military
populations, especially for (1) those living outside of the US
and (2) individuals experiencing other conditions known to
adversely affect cognitive processing. Knowledge gaps remain
warranting further study of psychometric properties and the
utility of baseline and normative testing for NCATs.
123 Concussions: A Broad-spectrum Injury Requiring Education and Awareness among Diverse Audiences

Shelina Babul, Kate Turcotte, Samantha Bruin, Karen Sadler, Shazya Karmali, Denise Beaton, Paul Van Donkelaar, Karen Mason, Blake Nicol, Amanda Black, Stephanie Cowle

a BC Injury Research & Prevention Unit BC Children’s Hospital, Vancouver, Canada, b University of British Columbia, Vancouver, Canada, c Parachute, Toronto, Canada, d British Columbia Centre for Disease Control, Vancouver, Canada, e University of British Columbia Okanagan, Kelowna, Canada, f SOAR – Supporting Survivors of Abuse and Brain Injury through Research, Kelowna, Canada, g Sport Injury Prevention Research Centre, University of Calgary, Calgary, Canada

ABSTRACT

Background: Concussions happen both within and outside of the sports and recreation setting. There is growing evidence around minor traumatic brain injury resulting from falls, motor vehicle crashes, and other events. In 2013, a widespread approach to concussion education and awareness was launched with the Concussion Awareness Training Tool (CATT, https://cattonline.com/), a series of online educational modules and resources based upon the latest evidence, expert consultation, and extensive external review.

Objectives: To provide easily accessible concussion education free-of-charge; and to extend concussion education and increase awareness from sports-related concussion to multiple audiences and contexts.

Methods: Using an integrated knowledge translation approach, CATT initially targeted medical professionals, coaches/parents, and school professionals; eLearning modules underwent pre/post intervention evaluation. CATT was then expanded to target non-traditional adult audiences by engaging in targeted formative research concerning the needs of worker and workplaces, and women’s support workers – those working with survivors of intimate partner violence. Formative research included an international environmental scan, semi-structured in-depth interviews, and focus groups. Recent work includes the development of two new CATT eLearning modules specific to university/college-level athletes and youth, with evaluations to include formative research/faculty validity and pre/post outcome evaluation.

Results: Original CATT resources demonstrated significant improvements in: physician knowledge among those treating more >10 concussions/year (p < 0.04, evaluated in 2014), physician behavior (p < 0.01, 2014), parent/coach knowledge (p = 0.002, evaluated in 2015), and school teacher/administrator knowledge (p < 0.03, evaluated in 2016). Results from the formative research with adults included the impact of: lack of awareness of non-sport related concussion and post-concussion syndrome among the general public; levels of knowledge and support from health-care professionals regarding mental health symptoms of concussion; and stigma attached to invisible injury. Evaluations of CATT for Athletes and CATT for Youth are in process.

In partnership with the Canadian Concussion Harmonization Project, the Public Health Agency of Canada, and Parachute, the original CATT courses were updated in 2018–2020, and all eLearning modules are available in French.

To date, over 60,000 people worldwide have completed CATT training, over 27,500 print resources have been distributed, and training has been mandated by over 50 organizations.

Conclusions: CATT is a unique resource providing accessible, reliable concussion information customized to broad audiences. CATT recognizes the impact concussion has within and outside of sport and recreation. Recognized by the Canadian government, CATT is promoted nationally and internationally.

124 Identifying Target Behaviors and Intervention Functions to Improve Collaborative Goal Setting During Rehabilitation for Paediatric Acquired Brain Injury

Sarah Knight, Emma Lavender, Jill Rodda, Liz Hayles, Natasha Lannin, Vicki Anderson, Adam Scheinberg

a Murdoch Children’s Research Institute, Melbourne, Australia, b Department of Paediatrics, The University of Melbourne, Parkville, Australia, c Victorian Paediatric Rehabilitation Service, Royal Children’s Hospital, d Monash University, Melbourne, Australia

ABSTRACT

Background: While goal setting with children and their families is considered best practice during rehabilitation following acquired brain injury (ABI), its successful implementation in an interdisciplinary team is not straightforward. This paper describes the novel application of a theoretical framework to understand factors influencing goal setting with children and their families in a large interdisciplinary rehabilitation team to inform the content and delivery of an intervention to optimize the implementation of goal setting.

Methods: The Behavior Change Wheel (BCW), incorporating the COM-B model (Capability, Opportunity and Motivation for behavioral interventions), was used to guide intervention development. Factors influencing collaborative goal setting were identified from a focus group of rehabilitation clinicians and lived experience advisors. A comprehensive behavioral diagnosis of these factors was conducted through application of the theoretical domain framework (TDF). Using these data, the most appropriate intervention functions for inclusion in the intervention were identified. Decision-making was guided by evaluation criteria recommended by BCW with guidance and feedback from the focus group members.

Results: A total of 11 participants (9 paediatric rehabilitation clinicians, a young person and a parent with lived experience of paediatric ABI) participated in the focus group. Factors influencing collaborative goal setting were mapped to Capability (Skills, Knowledge, Beliefs about Capabilities, Behavioral Regulation), Opportunity (Environmental Context and Resources,) and Motivation (Social/Professional Role and
Identity). Five potential intervention functions were identified: Training, Environmental Restructuring, Enablement, Education, and Modeling.

Conclusion: The use of the BCW and COM-B has enabled the development of a theory- and evidence-informed, targeted behavior change intervention to improve goal setting for children with ABI in a large interdisciplinary rehabilitation service. The transparent and systematic approach taken can be used to guide intervention development for improving evidence-informed care in other aspects of paediatric rehabilitation.

125 Feasibility of an AR-based Memory Training

Lukas Lorentz\textsuperscript{a}, Kristina Müller\textsuperscript{a}, Michael Lendt\textsuperscript{a}, Bettina Studer\textsuperscript{a}

\textsuperscript{a}St. Mauritius Therapieklinik, Meerbusch, Germany

ABSTRACT

Objectives: The objective of the present study was to evaluate the feasibility and acceptability of an AR-based memory training mobile app (Crystal Ball) for children and adolescents. The prototype was conceptualized and developed within the framework of the Interreg North-West Europe “VR4Rehab” research program (https://www.nweurope.eu/projects/project-search/vr4rehab-virtual-reality-for-rehabilitation/). In the training participants are instructed to memorize a set of animals and subsequently find and collect them in a virtually augmented environment. During the task, a virtual assistant, the Crystal Ball, offers advice on compensational and encoding strategies in order to increase memory performance.

Methods: Twenty-three healthy children and adolescents, as well as 23 patients of similar age with neuropsychological deficits and 10 adult patients with neuropsychological deficits were recruited at the St. Mauritius Therapieklinik in Meerbusch, Germany. Participants were instructed on how to use the program and asked to engage with it for as long as they wanted. Afterwards a structured interview as well as a self-constructed feasibility questionnaire were administered. Additionally, observational data collected during the examination and data concerning the participants’ performance (time until completion, number of moves made, level of difficulty) were taken into account.

Results: Results of the feasibility questionnaire indicate a wide acceptance of the training in in healthy (m = 4.30 overall attractiveness on a 5-point Likert scale) as well as clinically impaired children and adolescents (m = 4.19). The older group showed lower levels of acceptance however (m = 3.33). Compensational and encoding strategies were only used sparingly across all groups (healthy group 30.43%; young clinical group 21.74%; old clinical group 0%). The observational data as well as information taken from the structured interview indicate that older patients had difficulty adapting to the smart phone system.

Conclusions: The Crystal Ball app appears to be an enjoyable alternative to conventional memory rehabilitation, which is typically conducted in front of a computer screen. This seems to be especially true for younger children. However, acceptance in the older age groups steadily declines. Furthermore, patients appear to rarely make use of the compensational strategies provided by the Crystal Ball, if not specifically asked to do so.

126 Supporting Students to Return-To-School After a Concussion: The Development of the SCHOOLFirst Website for Educators

Christine Provvidenza\textsuperscript{a}, Christina Ippolito\textsuperscript{a}, Alexandra Cogliano\textsuperscript{a}, Dayna Greenspoon\textsuperscript{a}, Katherine Wilson\textsuperscript{a,c}, Nick Reed\textsuperscript{a,b,c}

\textsuperscript{a}Bloordview Research Institute, Holland Bloordview Kids Rehabilitation Hospital, Toronto, Canada, \textsuperscript{b}Rehabilitation Sciences Institute, Faculty of Medicine, University of Toronto, Toronto, Canada, \textsuperscript{c}Department of Occupational Science and Occupational Therapy, Faculty of Medicine, University of Toronto, Toronto, Canada

ABSTRACT

Background: Returning youth to school post-concussion is an iterative process, in which educators play an important role. Although existing information identifies what steps educators can take to support youth when returning to school post-concussion, clear direction on how to action these steps are not always provided. ‘SCHOOLFirst’ was developed to assist educators with supporting youth to successfully return-to-school after a concussion. With the emergence of concussion evidence and resources, SCHOOLFirst has evolved from a paper-based resource into a bilingual website: https://schoolfirstconcussion.ca.

Objectives: Study objectives were to determine: (1) usability, intended use and satisfaction of the SCHOOLFirst website from the perspective of pre-service teachers; and, (2) user knowledge and confidence surrounding return-to-school processes before and after using the SCHOOLFirst website.

Methods: Thirty pre-service teachers participated in an Education Training Workshop where they received concussion education, and were provided with an opportunity to use the SCHOOLFirst website. Survey data was collected specific to participant demographics, the System Usability Scale (SUS) and a satisfaction questionnaire. Frequency distributions were calculated for demographics, pre/post workshop knowledge, confidence and satisfaction items. The Wilcoxon signed-rank test was used to compare means of pre-post workshop knowledge and confidence scores. Thematic analysis of open-ended satisfaction questions was completed.

Results: Participants found the website easy to use (89.3%), not complex (90%), and felt there was the right amount of information on the website (80.6%). Videos, website links and resources were identified as helpful. Website optimization opportunities included adding a search function and a website orientation video. The workshop used to deliver the website resulted in significant increases in overall concussion knowledge ($Z = -4.093$, $p < 0.001$), knowledge of the impact of concussion on return-to-school ($Z = -4.527$, $p < 0.001$) and confidence in the participants’ role in supporting students with return-to-school ($Z = -4.517$, $p < 0.001$).
Conclusion: The SCHOOLFirst website was developed by an interdisciplinary team. It is informed by research evidence and the experiences of stakeholders supporting students with return-to-school post-concussion. End-user feedback was used to enhance the website to ensure that needs were met. Broad dissemination of the website will occur to drive access to essential resources that can help educators optimally support youth to return-to-school following a concussion.

127 A New Approach for Assessing Executive Functions in Traumatic Brain Injury Inpatient Rehabilitation; Assessment of Participation and Executive Functions (A-PEX)

Rotem Elia^a,b,c, Yael Lugassy^a,b,c, Yaron Sachar^c, Hagay Amir^d, Rachel Kizony^b,e

^a^Department of Occupational Therapy, Loewenstein Rehabilitation Hospital, Ra’anana, Israel, ^b^Department of Occupational Therapy, Faculty of Welfare and Health Sciences, University of Haifa, Haifa, Israel, ^c^Department of Brain Injury Rehabilitation, Loewenstein Rehabilitation Hospital, Ra’anana, Israel, ^d^Department of Orthopedic Rehabilitation, Loewenstein Rehabilitation Hospital, Ra’anana, Israel, ^e^Department of Occupational Therapy, Sheba Medical Center, Tel Hashomer, Israel

ABSTRACT

Introduction: In the last two decades, ecologically valid assessments have been recommended for the assessment of Executive Functions (EF) deficits. In order to meet this recommendation performance-based assessments have been developed, assessing EFs during performance of Instrumental Activities of Daily Living (IADL) such as household management tasks. However, for patients who are hospitalized in an inpatient rehabilitation facility for long periods of time, these activities do not represent their actual everyday participation, thus impede the ecological validity of these tools for inpatients. The Assessment of Participation and Executive Functions (A-PEX) aims to fill this gap by evaluating EF during participation in daily, leisure, and social activities relevant for inpatient rehabilitation setting, of adults following Traumatic Brain Injury (TBI). It includes six functional domains, such as treatment schedule management or cell-phone use, and two EF scales: cognitive and behavioral. The application of such a tool in an inpatient rehabilitation setting for evaluating EF during actual participation in everyday life situations that are relevant to the patient’s current condition and context may provide new opportunities for treatment planning, measuring progress, and predicting the outcome of rehabilitation.

Objectives: To describe the initial psychometric properties of the A-PEX in hospitalized patients with and without brain injury.

Patients & methods: A-PEX was administered to 12 hospitalized adults with orthopedic injuries and 12 adults following TBI matched for age and gender. Both groups underwent assessments in two time-points, 4 weeks apart. For the TBI group, the second assessment included the computerized bill-paying task from the Executive Function Performance Test (EFPT) as well as the A-PEX.

Results: There were no significant age differences between groups (t = -0.11, p = 0.9). In the TBI group, significant differences were found between the two time-points in all functional domains of the A-PEX (p < .01). Whereas, in the orthopedic group, no significant differences were found in A-PEX scores between the first and second assessments. In both time-points, significant differences were found between the groups in most of the functional domains and both EF scales of the A-PEX (p < .05). In the TBI group, negative correlations were found between the EFPT and most of the A-PEX domains (r = -0.6 to r = -0.78); higher cognitive performance was related to better performance in A-PEX.

Conclusion: The findings established initial discriminant and concurrent validity of the A-PEX. The functional domains used to evaluate EF were relevant to inpatient rehabilitation. These initial findings indicate that evaluating EF deficits through actual everyday participation during inpatient rehabilitation following TBI is feasible. Further research is currently in progress for establishing A-PEX reliability and validity in adults following TBI, including its ability to predict community participation post-discharge.

128 Concussion Education in the School Setting: A Scoping Review

Kylie Mallory^a,b, Lauren Sal^b,c, Andrea Hickling^b,d, Heather Colquhoun^a,d, Emily Kroshus^e,f, Nick Reed^a,b,d

^a^Rehabilitation Sciences Institute, Faculty of Medicine, University of Toronto, Toronto, Canada, ^b^Bloordview Research Institute, Holland Bloordview Kids Rehabilitation Hospital, Toronto, Canada, ^c^Applied Psychology and Human Development, Ontario Institute for Studies in Education, University of Toronto, Toronto, Canada, ^d^Department of Occupational Science and Occupational Therapy, Faculty of Medicine, University of Toronto, Toronto, Canada, ^e^Center for Child Health, Behavior and Development, Seattle Children’s Research Institute, Seattle, United States, ^f^Department of Pediatrics, University of Washington, Seattle, United States

ABSTRACT

Background: Concussions are a prevalent injury among youth, and youth have been found to lack concussion knowledge. Concussion education has been suggested to enhance concussion knowledge and promote positive behaviors surrounding concussion. Concussion education plays an important role in preparing youth and the adults who care for them to seek the recommended care and recovery practices if injured. As experiencing a concussion can impact return to learn, school is an important setting for concussion education and management. Recent recommendations and legislation have led to an increase in concussion education provided in schools, however little is known about the delivery, development and evaluation
of this education. Gaining a better understanding of concussion education implemented in the school setting will lead to tailored education and a more supportive environment.

Objectives: A scoping review was conducted to examine concussion education implemented within a school setting. The specific objective of this review was to explore concussion education description, delivery, development and evaluation.

Methods: Following scoping review methodological frameworks and reporting guidance (PRISMA-ScR), six databases were searched (MEDLINE, CINAHL, EMBASE, PsycINFO, SPORTDiscus and ERIC) to identify published articles from 2002 to July 2020 that implemented concussion education in a school setting. Included studies provided a description of the concussion education and were written in English. Studies were excluded if they focused on a one-to-one treatment model or were conference abstracts, theses, protocol papers or white papers.

Results: A total of 11,373 articles were identified and screened, with 27 studies included in this review. The studies delivered education to various stakeholders within the school including students (n = 12; 44.4%), coaches (n = 5; 18.5%), educators (n = 3; 11.1%), parents (n = 1; 3.7%) and a mixed audience (n = 6; 22.2%), with the majority of studies delivered in the high-school setting (n = 17; 63.0%). The education delivered varied based on the format and included presentations, modules, toolkits, videos and interactive arts-based components. As well, six studies (22.2%) developed the education based on a theory, model or framework. All education included some evaluation; however, the evaluation tools used, and evaluation frequency varied between studies.

Conclusions: Schools are an important setting for educating students (athletes and non-athletes), educators, coaches, parents and other stakeholders as such education has the potential to promote a more supportive and positive environment surrounding concussion. This study found substantial variability in the education delivered in schools and the need to further evaluate this education to ensure it is best-suited for school-based stakeholders. Future research is needed to evaluate the quality of the education provided and the impact this education has on positively changing concussion knowledge and behaviors.

130 Epilepsy Prophylaxis, Diagnosis and Treatment in Patients with Disorders of Consciousness: An IBIA DoC SIG International Survey and Recommendations

Marie-Michele Briand\textsuperscript{a,b,c}, Nicolas Lejeune\textsuperscript{a,b,d,e}, Nathan Zasler\textsuperscript{a}, Rita Formisano\textsuperscript{f}, Olivier Bodart\textsuperscript{h}, Anna Estraneo\textsuperscript{j}, Wendy Magee\textsuperscript{k}, Aurore Thibaut\textsuperscript{a,b}

\textsuperscript{a}Coma Science Group, GIGA Consciousness, University of Liège, Liège, Belgium, \textsuperscript{b}Centre du Cerveau², CHU of Liège, Liège, Belgium, \textsuperscript{c}IRDPQ, Department of Physical Medicine and Rehabilitation, Quebec City, Canada, \textsuperscript{d}DoC Care Unit, Centre Hospitalier Neurologique William Lennox, Ottignies-Louvain-la-Neuve, Belgium, \textsuperscript{e}Institute of Neuroscience, UCLouvain, Brussels, Belgium, \textsuperscript{f}Concussion Care Centre of Virginia Ltd, Tree of Life Services Inc., Department of Physical Medicine and Rehabilitation, Virginia Commonwealth University, Richmond, United States, \textsuperscript{g}IRCCS, Santa Lucia Foundation, Rome, Italy, \textsuperscript{h}Epileptology, Department of Neurology, CHU of Liège, Liège, Belgium, \textsuperscript{i}IRCCS, Don Carlo Gnocchi Foundation, Florence, Italy, \textsuperscript{j}Neurology Unit, Santa Maria della Pietà General Hospital, Nola, Italy, \textsuperscript{k}Boyer College of Music and Dance, Temple University, Philadelphia, USA

ABSTRACT

Introduction: Epileptic Disorders (ED) are prevalent following acquired brain injuries (ABI). However, ed prevalence is not well established in the literature among patients with disorders of consciousness (DoC). There are currently no best practice guidelines for assessment or management of ed in this patient population. Up to 32% and 47% would have post-acquired brain injury seizure (bagnato et al., 2013) and epileptiform activity (pascale et al. 2016) respectively. This study aimed to identify clinician practice regarding epilepsy prophylaxis, diagnosis and treatment in patients with DoC as well as providing current evidence-based recommendations regarding same.

Methods: A cross-sectional online survey was e-mailed to physician members of the International Brain Injury Association’s working with persons with DoC. The survey included 32 questions, the data of 24 of them divided into 10 demographic questions and 14 related to ED (a. Prophylaxis – n = 4, b. Diagnosis – n = 2, and c. Treatment – n = 8) were analyzed for this present study.

Results: Fifty physician responses were included in the final analysis. (a) Withdrawal of antiepileptic drug (AED) therapy was guided by the absence of evidence of clinical seizure whether the AED was given prophylactically or for actual seizure/epilepsy treatment. Levetiracetam was the most common prescribed AED for prophylaxis. (b) Standard EEG was the most frequently diagnostic method utilized for recognizing epileptic abnormalities and the majority prescribed it when there are concerns regarding lack of neurological progress. (c) AED prescription was reported to be triggered by the first clinically evident seizure. Its selection was primarily guided by the criterion of the low-risk side effects. The most frequently prescribed for ED or epileptic abnormalities treatment was the levitiracetam.

Conclusion: The survey highlighted significant discrepancies in how ED is prevented, diagnosed and treated in patients with DoC. Our results demonstrate the need for research on the topic and for the development of clinical guidelines for this patient population.

Recommendations:

- Prophylaxis: A 7-day period of treatment is appropriate after severe TBI, and in the majority of ABI from other etiologies. Levetiracetam appears to be an AED of choice.
- Diagnosis: When no neurological progress is observed, a standard EEG is recommended although the gold standard to diagnose epilepsy or epileptic abnormalities is a more prolonged period of testing, at least 24 h EEG with video.
• Treatment: Levetiracetam is favored due to its mild sedating effects, quick titration rate, minimal drug–drug interaction and no monitoring needed. In the case of epilepsy, the period without seizure recommended before attempting to start AED withdrawal is still unknown for patients with DoC.

135 Exploratory Study of below 10 G Head Impact Telemetry in Varsity Football Players

Laurie-Ann Corbin-Berrigan a,b,d, Eric Wagnac b,d, Sophie-Andrée Vine t c, d, Camille Charlebois-Plante c, d, Samuel Guay c, d, Meaghan Aussant-Bibeau a, Dominique Godin a, Louis De Beaumont c, d

aUniversité Du Québec à Trois-Rivières, Trois-Rivières, Canada, bEcole de Technologie Supérieure, Montréal, Canada, cUniversité de Montréal, Montréal, Canada, dCentre de recherche du CIUSS du Nord-de-l’Île-de-Montréal, Montréal, Canada

ABSTRACT

Background: It has been well documented that contact sport athletes, such as football players, are at risk of repeated head impacts. These repeated head impacts may be classified as concussive, a head impact resulting in concussion, and sub-concussive, a head impact below concussion threshold. Both sub- and concussive head impacts have been linked to long-term cognitive deficits in a variety of contact sport athletes. Head impacts are measured through accelerometers allowing to calculate the magnitude at which impacts occur in real-time in the practice of sport, in gravitational force (G). Head impact telemetry studies have allowed for the creation of long-term cognitive deficits prediction tools. Currently, solely impacts of 10 G or greater are accounted for in the prediction of long-term deficits, on the basis that impact of low magnitudes may be recorded in settings other than head impacts, such as running or jumping. It is unknown, however, if the 10 G cut-off measure prevents the collection, and representation of actual head impacts in contact sport that may contribute to long-term deficits.

Objective: The primary objective of this exploratory study was to report and characterize subconcussive head impacts below 10 G in varsity football players during regular season games.

Design: Cross-sectional exploratory study.

Setting: Varsity football games in the 2019–2020 regular football season.

Participants: 13 varsity football players (aged 21–25 years old) evolving in 3 different teams in the greater Montreal area, Quebec, Canada.

Outcome Measures: Subconcussive head impacts magnitude was measured with CUE Sport SensorTM (Athlete intelligence, WA, USA) technology. Sensors were attached to the inner part of players’ regular helmets and provided time-stamped head impact magnitude in G units. Football games were filmed. Footages from football games were independently watched a posteriori by two raters who matched head impacts recorded by CUE Sport SensorsTM to potential mechanisms of impacts (type of impact, direction, type of play, etc.). Results were cross-references between raters and solely impacts with clear mechanisms and in agreement between the two raters were retained for data analysis.

Results: Among 13 football players over 5 different regular season games, 151 head impacts below 10 G with clear mechanisms were recorded. On average, participants sustained 13.36 ± 9.10 below 10 G head impacts in the course of one football game. Most below 10 G impacts were recorded in defensive gaming situations, with line and skill players as susceptible of sustaining such head impacts.

Conclusions: Results from this exploratory study indicate that some below 10 G head impacts occur with clear head impact mechanisms in the context of varsity football. Further study is warranted to determine the extent to which these impacts should be accounted for in the calculation of long-term sub-concussive head impact associated health deficits.

136 School Transition After Traumatic Brain Injury (STATBI): COVID-19 Impacts on Support Services for Students with TBI

Jennifer Lundine a,b, Angela Ciccia c, Drew Nagele d

aThe Ohio State University Dept of Speech & Hearing Science, Columbus, United States, bNationwide Children’s Hospital Division of Clinical Therapies & Inpatient Rehabilitation Program, Columbus, United States, cCase Western Reserve University Dept of Psychological Sciences, Cleveland, United States, dNagele NeuroRehab Consulting, Philadelphia, USA

ABSTRACT

Objectives: The objective of the School Transition After Traumatic Brain Injury (STATBI) project is to rigorously evaluate the impact of BrainSTEPS, a formal return-to-school (RTS) program, on academic, social, and health outcomes for students in grades K-12 who have experienced TBI of any severity, compared to students who have no formal RTS programming. In 2020, the study shifted to examine the effects of COVID-related educational changes on students who experienced a TBI prior to the pandemic.

Methods: STATBI uses a mixed method, cohort-controlled research design. The IRB-approved protocol includes electronic survey administration and virtual interviews with parents and children. The data included in this presentation is cross-sectional, although the full STATBI protocol is longitudinal. Measures include standardized assessments of executive function, participation, social, and cognitive abilities, in addition to semi-structured interviews with parents, students, teachers, and BrainSTEPS team members. Between 11/2020 and 1/2021, 250 families were invited to participate in this portion of the study.

Results: Of the 46 families that completed majority of the protocol, the average student age was 14.2 years (SD = 3.3). The sample included students with mild (n = 19), moderate (n = 12), and severe (n = 13) TBI. The average age at injury was 11.8 years (SD = 4.3) and average time since injury was 2.7 years (SD = 2.1). A total of 44 families completed the COVID questionnaire with 6.8% (n = 3) reporting that their...
students had been diagnosed with COVID, though none required hospitalization. Students with COVID missed 5 or more days of school. 13.6% (n = 6) of families reported a household family member having a diagnosis of COVID. Most families reported that their students were attending school in either a hybrid model (40.9%, n = 18) or fully remote (45.5%, n = 20). Families reported the following areas of accommodation were needed: physical accommodations (25%, n = 11), learning/thinking (36.4%, n = 16), and behavioral/social (22.7%, n = 10). Additional interview data regarding COVID, barriers and facilitators of COVID-related school changes for children with TBI, and performance across all measures in the protocol are currently being analyzed and will be available by the time of presentation.

Conclusions: The STATBI project is unique in its focus on RTS for youth with TBI, and this data is particularly pertinent as it highlights the impact of COVID-related school changes on students who experienced a TBI prior to the beginning of the pandemic. Our sample included many students who reported having mild injuries but who continued to have academic needs that warranted a referral to the BrainSTEPS program. Majority of the enrolled participants were engaged in school via hybrid or remote options with a consistent minority requiring academic supports. Implications of COVID-related school changes on students with TBI based on data collected during the first – unique and challenging – year of a longitudinal study will be discussed.

137 Gaps in Concussion Management across School-Aged Children

Katherine Snedaker, Jennifer Lundine, Katy O’Brien, Angela Ciccia, Mohammad Nadir Haider

aThe Ohio State University Dept of Speech & Hearing Science, Columbus, United States, bNationwide Children’s Hospital Division of Clinical Therapies & Inpatient Rehabilitation Program, Columbus, United States, cUniversity of Georgia Dept of Communication Sciences and Special Education, Athens, United States, dCase Western Reserve University Dept of Cognitive Science, Cleveland, United States, eUniversity at Buffalo, State University of New York, Buffalo, United States, fPINK Concussions, Norwalk, USA

ABSTRACT

Objectives: All 50 states have different return to play laws for students with concussion that guide activities to safely return student athletes to the playing field. Most state laws apply only to high-school students injured during school-sanctioned sports, and not younger students, club sports, or other injury mechanisms like recreational activities. Despite the prevalence of concussion in children of all ages, many may be missed by existing concussion laws.

Methods: We present 4 years of descriptive data from a single school district in Connecticut, cataloging concussions reported to school nurses. Data was collected prospectively to examine how age, sex, setting of injury (school versus non-school), and mechanism of injury impact identification and management of concussion in students across school levels.

Results: Across 4 school years, 154 Elementary/Middle School (E/MS) and 230 high-school (HS) students reported to school with concussion. E/MS students experienced fewer concussions at school (39.0% versus 61.4%; p < 0.001) and from sports than HS (30.5% versus 62.6%; p < 0.001). More E/MS males than females sustained concussions (37.7% female), while this difference was reversed for HS (61.7% female). E/MS (2.81 days; p = 0.033), and particularly female E/MS students (4.14 days) and those injured outside of school (3.59 days; p = 0.017), were at risk for longer time to evaluation. E/MS males received medical clearance more quickly than females (22.95 days versus 32.57). In contrast, no differences were found between HS-aged males and females by injury setting, mechanism of injury, or management factors. Limitations to academic and physical activity were the most commonly recommended accommodations for all students.

Conclusions: Differences observed in E/MS students with concussion by sex, injury, identification, and management variables are not observed in HS students. Only male E/MS students required less than a month on average to be cleared for full activity. These results suggest that younger students, particularly females or those not injured in school or sports, may be at risk for delayed identification and prolonged time to clearance. Future research should characterize these shortcomings in more detail to inform needed policy changes.

138 Quantifying the Relationship Between Clinician Administered Measures of Vestibulo-ocular Reflex and Oculomotor Function and Patient-reported Outcome After Pediatric Mild TBI

Adrienne Crampton, Kathryn Schneider, Mathilde Chevignard, Michal Katz-Leurer, Miriam Beauchamp, Chantel Debert, Isabelle Gagnon

aSchool of Physical and Occupational Therapy, McGill University, Montreal, Canada, bSport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, Canada, cAlberta Children’s Hospital Research Institute, University of Calgary, Calgary, Canada, dHotchkiss Brain Institute, University of Calgary, Calgary, Canada, eMontreal Children’s Hospital-McGill University Health Centre, Montreal, Canada, fSorbonne Université, CNRS, INSERM, Laboratoire d’Imagerie Biomédicale, Paris, France, gSorbonne Université, GRC 24 Handicap Moteur et Cognitif et Réadaptation, Paris, France, hRehabilitation Department for Children with Acquired Neurological Injury and Outreach Team for children and Adolescents with Acquired Brain Injury, Saint Maurice, France, iPhysical Therapy Department, University of Tel-Aviv, Tel-Aviv, Israel, jABC’s Laboratory, Ste-Justine Hospital Research Center, Montreal, Canada, kDepartment of Psychology, University of Montréal, Montreal, Canada, lDepartment of Clinical Neuroscience, University of Calgary, Calgary, Canada
139 Characterizing the Evolution of Vestibulo-ocular Reflex Function Over Time in Children and Adolescents After a Mild Traumatic Brain Injury

Adrienne Crampton\textsuperscript{a}, Kathryn Schneider\textsuperscript{b,c,d}, Lisa Grilli\textsuperscript{e}, Mathilde Chevignard\textsuperscript{f,g,h}, Michal Katz-Leurer\textsuperscript{i}, Miriam Beauchamp\textsuperscript{j,k}, Chantel Debert\textsuperscript{l}, Isabelle Gagnon\textsuperscript{a,e}

\textsuperscript{a}School of Physical and Occupational Therapy, McGill University, Montreal, Canada, \textsuperscript{b}Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, Canada, \textsuperscript{c}Alberta Children's Hospital Research Institute, University of Calgary, Calgary, Canada, \textsuperscript{d}Hotchkiss Brain Institute, University of Calgary, Calgary, Canada, \textsuperscript{e}Montreal Children's Hospital-McGill University Health Centre, Montreal, Canada, \textsuperscript{f}Sorbonne Université, CNRS, INSERM, Laboratoire d’Imagerie Biomédicale, Paris, France, \textsuperscript{g}Sorbonne Université, GRC 24 Handicap Moteur et Cognitif et Réadaptation, Paris, France, \textsuperscript{h}Rehabilitation Department for Children with Acquired Neurological Injury and Outreach Team for children and Adolescents with Acquired Brain Injury, Saint Maurice, France, \textsuperscript{i}Physical Therapy Department, University of Tel-Aviv, Tel-Aviv, Israel, \textsuperscript{j}ABC's Laboratory, Ste-Justine Hospital Research Center, Montreal, Canada, \textsuperscript{k}Department of Psychology, University of Montreal, Montreal, Canada, \textsuperscript{l}Department of Clinical Neuroscience, University of Calgary, Calgary, Canada

OBJECTIVE
Objectives: Forces involved in mild traumatic brain injury (mTBI) can lead to visual and vestibular impairments. In pediatric mTBI, high rates of abnormalities are observed in vestibulo-ocular reflex (VOR) and oculomotor (OM) function. While it has been demonstrated that such clinical findings post-mTBI may lead to a more negative prognosis, there remains a lack of understanding of how measured impairments may affect a child or adolescent’s daily functioning. Therefore, our objectives were to determine the extent to which clinician administered measures of VOR and OM function relate to patient-reported levels of activity limitations and participation in children and adolescents within 21 days post-injury.

Methods: This cross-sectional study took place at a tertiary care pediatric hospital. One hundred and one participants with mTBI aged 6 to 18 were included. Participants were assessed on a battery of VOR and OM tests within 21 days of injury. Outcome measures included the Dizziness Handicap Inventory (DHI) and Cardiff Visual Ability Questionnaire (CVAQ) to measure patient-reported vestibular and visual functional abilities respectively. The Vestibular/Ocular Motor Screening Tool (VOMS) (considering both symptom provocation and performance on each task), Head Thrust Test (positive/negative), computerized Dynamic Visual Acuity (DVA) Test (LogMAR) and video Head Impulse Test (gain) were administered to assess VOR and OM function. Linear regressions examined the associations between clinician-administered measures of VOR and OM function and patient-reported functional outcomes.

Results: Our sample consisted of 101 youth (54.4% female) with a mean age of 13.92 (SD: 2.63) and mean time since injury of 18.26 (SD: 6.16) days. Associations were found between: 1) DHI score and age (1.773 (CL: 0.473 to 3.073), p = 0.01), VOR symptom provocation (18.499 (CL: 11.312 to 25.686), p = <0.001) and DVA (–29.433 (CL: –59.206 to –2.60) p = 0.03) and 2) version symptom provocation and CVAQ score (0.796 (CL: 0.185 to 1.406), p = 0.01). High abnormal proportions were found on both VOMS VOR performance (21.21%) and VOMS version performance (56.70%). Of both statistical and clinical significance was the association between symptom provocation induced by VOR and the DHI, indicating that the presence of symptom provocation on VOR VOMS tasks would increase DHI score by 18.499 (p = <0.01) points, as well as the association between symptom provocation induced by OM tasks and the CVAQ, indicating that the presence of symptom provocation on VOMS version tasks would increase CVAQ score by 0.796 (p = 0.01) logits.

Conclusions: Findings highlight that symptom provocation induced by VOR and OM tasks is associated with poorer patient reported functional outcome, underlining the detrimental impact of symptoms on one’s daily functioning. Elevated proportions of abnormal function demonstrated on VOR and version performance variables emphasize a need for both objective and symptom-based measures. Our findings will assist clinicians when interpreting patient-reported measures activity limitation and participation.
Results: Our sample consisted of 52.8% females, with a mean age 13.98 (2.4) years and assessed on average 19.07 (range: 8–33) days following injury. An effect of age on visual motion sensitivity (OR 1.43, p = 0.03) and of female sex on near point of convergence (OR 0.19, p = 0.03) was identified. Change over time indicating improvement was demonstrated by VOMS global symptom provocation (T1-T2: OR 9.90, p = 0.012), vertical smooth pursuit performance (T1-T2: OR 4.04, p = 0.03; T1-T3: OR 3.12, p = 0.04), vertical voluntary saccade performance (OR 6.06, p = 0.005; T1-T3: OR 5.91, p = 0.01) and right VOR gain (0.07, p = 0.01). Version performance and VOR symptom provocation showed high abnormal proportions (14.71–41.18% and 12.12–15.15% respectively) at T1, trending towards recovery and stabilizing by T2 and T3. Conclusions: Results indicate impairments to the VOR pathway may be present, potentially driving symptom provocation. Vertical version findings underline the need to include relevant tasks in assessment batteries. As pathways involved in vertical smooth pursuits and saccades differ from those involved in the horizontal movements, failing to assess one direction may result in overlooking an impairment. Findings demonstrate the added value of including symptom and performance-based measures when assessing the VOR, as well as the relative stability of constructs measured beyond 3 months post mTBI.

140 Exploring the Intended Behaviors of Youth Towards Providing Social Support to a Peer with a Concussion

Kylie Mallory\textsuperscript{a,b}, Katherine Wilson\textsuperscript{c}, Kiera DiLeonardo\textsuperscript{b}, Andrea Hickling\textsuperscript{b,c}, Nick Reed\textsuperscript{a,b,c}

\textsuperscript{a}Rehabilitation Sciences Institute, Faculty of Medicine, University of Toronto, Toronto, Canada, \textsuperscript{b}Bloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, Canada, \textsuperscript{c}Department of Occupational Science and Occupational Therapy, Faculty of Medicine, University of Toronto, Toronto, Canada

**ABSTRACT**

Background: Youth experience longer recovery times after a concussion and a greater number of symptoms compared to younger children. Sustaining a concussion can lead to isolation and reduced social participation. Youth are strongly influenced by their social networks, and social support is sought out during concussion recovery. Despite this, the intended behaviors of youth towards supporting their peers after they sustain a concussion have yet to be explored.

Objectives: (1) To identify the intended behaviors of youth towards providing social support to a peer with a concussion; and (2) to examine if demographic factors and concussion knowledge contribute to these intended behaviors.

Methods: A novel survey informed by the Theory of Planned Behavior was completed by 200 youth (M = 15.3 years, SD = 1.52 years). The survey included demographic and concussion knowledge questions that were comprised of checkbox, yes/no, open-ended and true/false responses. Questions related to social support were comprised of 4-point Likert scales. Data analysis included descriptive statistics, Wilcoxon Rank Sum Tests and Spearman Rank Correlation Coefficients.

Results: Over 30% of youth reported intentions to engage in behaviors that endorsed isolating or discrediting their peers recovering from a concussion. Females (W = 2411, p < 0.0005), older youth (rho = 0.411, p < 0.0005) and having higher concussion knowledge (rho = 0.219, p = 0.002) were associated with more favourable intentions to provide social support. Participating in high-risk sports (hockey, soccer, football and/or basketball) resulted in significantly less favourable intentions to provide social support (W = 6721, p < 0.0005). Unexpectedly, a personal history of concussion or knowing someone with a history of concussion had no significant effect on intentions to provide social support.

Conclusions: This study provides the first exploration of the intended behaviors of youth towards supporting their peers after they sustain a concussion. The findings identify factors that contribute to the intended behaviors of youth towards providing social support to their peers such as age, concussion knowledge and high-risk sport participation. As not all youth intend to provide social support, these findings have the potential to inform targeted education initiatives aimed at enhancing concussion knowledge and creating more supportive environments for concussion recovery in youth.

141 Blood Biomarkers of Brain Injury in Women who Have Experienced Intimate Partner Violence: A Pilot Study

Naomi Maldonado-Rodriguez\textsuperscript{z}, Jon Smirl\textsuperscript{b}, Jennifer Cooper\textsuperscript{d}, Colin Wallace\textsuperscript{a}, Eve Valera\textsuperscript{c}, Cheryl Wellington\textsuperscript{d}, Paul Van Donkelaar\textsuperscript{a}

\textsuperscript{a}University of British Columbia, School of Health and Exercise Sciences, Kelowna, Canada, \textsuperscript{b}University of Calgary, Faculty of Kinesiology, Calgary, Canada, \textsuperscript{c}Harvard Medical School, Charlestown, United States, \textsuperscript{d}University of British Columbia, Department of Pathology and Laboratory Medicine, Vancouver, Canada

**ABSTRACT**

Background: At least 1 in 3 women will experience intimate partner violence (IPV) in their lifetime. Among these, up to 92% report symptoms that are consistent with brain injury (BI) and 50% report at least one incident involving strangulation. Previous studies have demonstrated neuropsychological and neurophysiological deficits related to IPV-related BI however, there remains a need to characterize the physiological sequelae of IPV-related BI. In the case of IPV-related BI where injury is often chronic and repetitive, blood biomarkers may provide insight into potential pathophysiological mechanisms underlying chronic symptoms.

Objective: The purpose of this exploratory study was to examine the relationship between IPV-related BI and blood-based biomarkers of neurological injury and inflammation.
Methods: Women who have experienced IPV (n = 24), between the ages of 18 and 50, were recruited from various women-serving community organizations. BI load, operationalized as the composite measure of BI recency, severity, and frequency, was assessed using the Brain Injury Severity Assessment (BISA) tool. Post-traumatic stress disorder (PTSD), anxiety, depression, substance use, and history of abuse were also assessed. Biomarkers of inflammation and neurological injury, more specifically tau, neurofilament light (NFL), glial fibrillary acidic protein (GFAP), interleukin-6 (IL-6), interleukin-10 (IL-10), tumor necrosis factor alpha (TNF-α), and C-reactive protein (CRP) were quantified using an ultrasensitive single-molecule immunoassay. Stepwise multiple regressions were undertaken to explore the relationship between BI load and biomarker concentration while accounting for age, PTSD severity, anxiety, depression, history of abuse, and years of substance use.

Results: Serum blood samples were collected from 24 women, with a mean time of 21 months since last self-reported BI. No biomarkers of interest were significantly predicted by BI load. IL-10 concentration was positively associated with PTSD severity and negatively associated with depression scores and history of abuse. TNF-α concentration was positively associated with PTSD severity. Lastly, IL-6 concentration was negatively associated with history of abuse. Tau, NFL, GFAP, and CRP were not significantly accounted for by any of the predictors.

Conclusion: Our findings support the theory that IPV survivors may experience chronic low-grade systemic inflammation, reflecting the chronic ongoing PTSD-related stress in survivors’ lives. With these preliminary analyses and limited power, we did not identify relationships between BI load and common biomarkers of neurological injury; as we move forward, a larger sample and a shorter range in time since last BI will allow us to examine these relationships more adequately.

142 A Cross-Cultural Assessment of Brain Injury in Women who Have Experienced Intimate Partner Violence

Shambhu P Adhikari, Naomi Maldonado-Rodriguez, Julia Daugherty, Nathalia Molinares, Colin Wallace, Jonathan Smirl, Miguel García, Carlos José De los Reyes, Natalia Ruzzante, Paul Van Donkelaar, Eve Valera

University of British Columbia, Kelowna, Canada, University of Granada, Granada, Spain, Universidad De la Costa, Colombia, University of Calgary, Canada, Universidad Del Norte, Colombia, Harvard Medical School and Massachusetts General Hospital, United States

ABSTRACT

Objective: At least one in three women will experience intimate partner violence (IPV) in their lifetime. Among these, up to 92% report symptoms that are consistent with brain injury (BI) due to head impacts and/or strangulation. The purpose of this study was to conduct a cross-cultural assessment of IPV-related BI in a sample of women from 4 countries (Canada, Colombia, Spain, USA).

Methods: 282 participants were included in this secondary analysis of prospectively collected data. Participants completed the Brain Injury Severity Assessment (BISA) tool as well as assessments of depression, anxiety, and post-traumatic stress disorder (PTSD). Mann Whitney U-test and Kruskal–Wallis test were conducted to compare differences between two and three groups respectively. The multiple linear regressions were undertaken to analyze the impact of the Post Traumatic Stress Disorder (PTSD), depression and anxiety on the BISA score.

Results: Overall, 56% of women reported at least one IPV-related BI. Site-specific results demonstrated 94% (Canada), 66% (USA), 28% (Colombia), and 32% (Spain) of women reporting at least one IPV-related BI. BISA total scores and sub-scores were higher at the North American (Canada: Mean = 3.63, SD = 2.06, USA: Mean = 3.81, SD = 2.43) than at the sites in Colombia (Mean = 0.72, SD = 21.39) and Spain (Mean = 0.80, SD = 1.39). The higher the BISA score, higher is the number of participants with strangulation. Similarly, the proportion of participants who experienced strangulation is greater in instances when IPV occurred more frequently, more recently or more severely. The PTSD significantly predicted the BISA score holding strangulation constant, F (2, 268) = 44.60, P < 0.001, R2 = 0.25. Similarly, the depression and anxiety also significantly predicted the BISA score holding strangulation constant, F (2, 268) = 40.46, P < 0.001, R2 = 0.23. Thus, across all four sites, the BISA scores were associated with PTSD, depression, and anxiety and these relationships were modulated by the experience of strangulation.

Conclusion: We demonstrated that 28% to 94% of women sustained at least one IPV-related BI across four international sites with the rate, severity, frequency, and recency of these BIs being higher in North America than in Colombia or Spain. This may be due to differences in recruitment strategies, the nature of the services provided at the respective recruitment sites, and potential cultural differences regarding awareness and perception of what constitutes IPV.

143 How the Community Neuropsychologist can Help Patients Improve the Outcome of Brain Injury. Important Factors, but Frequently Forgotten. Practical Perspective

Barbara Koltuska-Haskin

Private Practice, Albuquerque, United States

ABSTRACT

Most of the brain injury patients are referred for a neuropsychological evaluation in order to find out if and how their brain functions have been affected. Completing the neuropsychological evaluation is a very important step in the process of recovery. It tells the patient which brain functions are still good or very good and which have been affected and how much affected. At the exit session, all recommendations are made about how to improve and/or maintain...
cognitive functioning. Also, mood, anxiety and other emotional problems should be addressed and recommendations should be made for treatment if necessary. However, it is very important to talk to the patients about the lifestyle behavior that accelerates healing. The human brain does not work in isolation. The healthier the body, the faster the brain will recover from the trauma. It is very important to talk to patients about:

- Proper nutrition
- Getting enough sleep and rest.
- Doing daily walking and exercising (if recommended by PT)
- Practicing Yoga (if no medical contradictions)
- Practicing active learning and positive brain stimulation
- Practicing mindfulness and meditation daily.
- Practicing gratitude for mental up-lifting.
- Striving for progress, not perfection

144 Exploring Family-centered Care in Pediatric Acquired Brain Injury Rehabilitation: The Family Perspective

Taylor Jenkin\(^a\), Vicki Anderson\(^{a,b,c,d}\), Kate D’Cruz\(^e\), Adam Scheinberg\(^{a,d,f}\), Sarah Knight\(^{a,d,f}\)

\(^a\)Murdoch Children’s Research Institute/The University of Melbourne, Melbourne, Australia, \(^b\)Melbourne School of Psychological Sciences, The University of Melbourne, Melbourne, Australia, \(^c\)Royal Children’s Hospital, Melbourne, Australia, \(^d\)Department of Paediatrics, The University of Melbourne, Melbourne, Australia, \(^e\)La Trobe University, Melbourne, Australia, \(^f\)Victorian Paediatric Rehabilitation Service, Royal Children’s Hospital, Melbourne, Australia

ABSTRACT

Background and Objectives: Paediatric acquired brain injury (ABI) can have acute and long-term impacts on children/adolescents across a range of cognitive and functional domains and can adversely impact family functioning. A family-centered approach to paediatric rehabilitation is therefore considered best practice. While there is widespread recognition of the impacts of paediatric ABI on families, and of the importance of supporting and involving them in their children’s care, families often report having unmet needs during rehabilitation. Additionally, few studies have investigated the implementation of family-centered care in paediatric ABI rehabilitation, resulting in a lack of research evidence to guide clinicians and services in implementing this approach.

This study aimed to develop a better understanding of family-centered care from the perspectives of children/adolescents with ABI and their families engaged in rehabilitation. This included interview questions about their experience of participating in rehabilitation, how they were supported, barriers experienced and suggested changes/improvements.

Methods: Qualitative, semi-structured interviews were conducted with nine caregivers, four siblings, and three children/adolescents with ABI, who had received rehabilitation within a state-wide paediatric rehabilitation service in Australia. Interview transcripts were analysed using constructivist grounded theory methods.

Results: Data analysis revealed key insights into the dynamic nature of family involvement in rehabilitation, emphasising varied levels of participation across family members and over time as the child/adolescent with ABI recovered and matured. Family members described being involved in rehabilitation through participating in the child’s/adolescent’s rehabilitation exercises and discussing their treatment and progress with the rehabilitation team. Caregivers also reflected on their involvement in ensuring that rehabilitation recommendations were implemented at home.

While participants described the importance of family involvement, they emphasised the rehabilitation team’s valuable role in guiding rehabilitation, particularly given that many families had little, if any, prior knowledge of ABI and its treatment.

Family members recalled having had limited opportunities to express their needs over the course of their child’s or sibling’s rehabilitation. However, they highlighted the importance of care focusing on the child/adolescent with ABI, while still expressing a desire for greater consideration of the family as a whole.

Family members’ descriptions of their involvement in rehabilitation were often situated within their experiences of being caregivers or siblings of a child/adolescent with an ABI more broadly. Importantly, the findings highlighted that their experiences of rehabilitation reflected only one aspect of a complex system of services that children/adolescents and their families may access following ABI.

Conclusions: These findings capture insights into families’ experiences of participation in paediatric ABI rehabilitation, and outline the ways that families can be involved in in children’s/adolescents’ care. Consideration of the family as a whole was emphasised, highlighting the importance of developing and implementing rehabilitation programs that target both child and family needs.

145 Visible Signs of Concussion and Cognitive Screening in Community Sports

Jonathan Reyes\(^a\), Biwade Mitra\(^{b,c,d}\), Michael Makdissi\(^{e,f}\), Patrick Clifton\(^j\), Jack Nguyen\(^h\), Peter Harcourt\(^h\), Teressa Howard\(^d\), Peter Cameron\(^{b,c,d}\), Jeffrey Rosenfeld\(^{b,j}\), Brendan Major\(^b\), Catherine Willmott\(^{b,j}\)

\(^a\)Turner Institute For Brain And Mental Health, Camberwell, Australia, \(^b\)National Trauma Research Institute, The Alfred Hospital, Melbourne, Australia, \(^c\)Emergency & Trauma Centre, The Alfred Centre, Melbourne, Australia, \(^d\)Department of Epidemiology & Preventive Medicine, Monash University, Melbourne, Australia, \(^e\)Florey Institute of Neuroscience and Mental Health, Melbourne Brain Centre, Heidelberg, Australia, \(^f\)Olympic Park Sports Medicine Centre, Melbourne, Australia, \(^g\)Australian Football League, Melbourne, Australia, \(^h\)Department of Surgery, Monash University, Clayton, Australia, \(^i\)Department of Neurosurgery, The Alfred Hospital, Melbourne, Australia, \(^j\)Department of Surgery, F. Edward Hébert School of
Video surveillance and detection of players with visible signs of concussion by experienced medical staff facilitates rapid on-field screening of suspected concussion in professional sports. This method, however, has not been validated in community sports where video footage is unavailable. This study aimed to explore the utility of visible signs of concussion to identify players with decrements in performance on concussion screening measures. In this observational prospective cohort study, personnel with basic training observed live matches across a season (60 matches) of community male and female Australian football for signs of concussion outlined in the community-based Head Injury Assessment form (HIAf). Players identified to have positive signs of concussion (CoSign+) following an impact were compared to players without signs (CoSign-). Outcome measures, the Sport Concussion Assessment Tool (SCAT3) and Cogstate, were administered at baseline and post-match. CoSign+ (n = 22) and CoSign- (n = 61) groups were similar with respect to age, sex, education, baseline mood, and medical history. CoSign+ players exhibited worse orientation, concentration, recall, and slower reaction time in attention and working memory tasks. Comparing individual change from baseline to post-match assessment revealed 100% (95% CI: 84%-100%) of CoSign+ players demonstrated clinically significant deficits on SCAT3 or Cogstate tasks, compared to 59% (95% CI: 46% to 71%) of CoSign- players. All CoSign+ players observed to have a blank/vacant look demonstrated clinically significant decline on the Standardized Assessment of Concussion (SAC). Detection of visible signs of concussion represents a rapid, real-time method to screen players suspected of concussion in community sports where video technology and medical personnel are rarely present. Consistent with community guidelines, it is recommended that all CoSign+ players are immediately removed from play for further concussion screening.

146 Family First: Learning from a Secondary Prevention Programme with Families where a Child has an Acquired Brain Injury.

Bridget Smyth, Chris McCusker, Bridget Smyth, Eunan McCrudden, Meg Irwin

ABSTRACT

An emerging evidence base documents the critical and facilitative role that injured children’s families play in restoration of function, enhancement of child quality of life (QoL) and in their contribution to society in the longer term (e.g. Fitzpatrick et al., 2018) In light of the evidence base and given local service experience in both the voluntary and statutory sector of delivering family-targeting programs Brain Injury Matters and the Psychological Services Department, Belfast Health & Social Care Trust embarked upon the creation and delivery of the Family First Service in conjunction with the National Lottery Fund NI in 2015.

The Family First Service aims to develop parental understanding as well as develop their skills to predict, pre-empt and prevent the development of additional difficulties in the wake of an ABI in childhood. In so doing the service aims to help families become authors of their own pathway, to effectively advocate for their children and navigate around obstacles, barriers and professional pre-conceptions regarding the long-term implications of ABI in childhood.

Objectives: This presentation will explore how, over a five-year period, the Family First Project has reached its target population (and surpassed expectations regarding the demand for such a service). It will review how the project has been experienced (in terms of content, format & method of intervention) by service users (families, referrers & those delivering the project).

Methods: A systematic evaluation and outcomes framework, integrating standardised and service user, goal-focused assessments was built into the infrastructure of the project from the outset. Three pillars of service evaluation (Accessibility, Acceptability & Effectiveness) were explicitly monitored.

Results: Outcomes and learning experiences from the project will be discussed, including comments and observations from service providers, staff and the evaluator of the service.

Conclusion: Findings will be discussed in the context of previous literature and service-related considerations.

147 Positive Effects of an Intensive Multidisciplinary Intervention Six Years After Traumatic Brain Injury: A Case Study of an Irish Case Manager’s Experience

Siobhan Mc Sweeney

ABSTRACT

Background: Sustaining a traumatic brain injury is a significant event that requires rehabilitation efforts from the injured person in cooperation with rehabilitation services and professionals. The impact of their severe brain injuries and long recoveries, however, can result in ongoing mental health and behavioral issues. This case study explores the interventions and positive outcomes achieved using a case management approach for a man experiencing significant psycho-social and behavioral issues 6 years post-traumatic brain injury.

Case description: I first met my client in his family home, 6 years post a traumatic brain injury suffered following a road traffic accident which had wide-ranging consequences for him. At the time of the accident he was 42 years of age, married with three children and two stepchildren. He was self-employed and had 16 people employed in his company. On the day I met him, six years later he was alone, confined to a separate area of the family home because the family relationship had completely
broken down due to his alcohol misuse and violence. He was depressed, suicidal, and was surviving on take away food. The fundamental goal of case management is to support brain injury clients to improve their quality of life by assessing and identifying their specific needs and how these might match with community resources. This requires case managers to be extremely creative with resources, and flexible with where to find these resources. Following initial assessment, a home-delivered meal program was immediately sourced to provide for the delivery of more substantial meals. A private company was identified and this gentleman was transferred to their 24-hour supported living environment which provided multidisciplinary neurorehabilitation including psychiatry, psychology, occupational therapy, dietetics, and physiotherapy. A long-term transition to home plan, coordinated by case management was also enacted.

Outcomes: Over the course of the following 6 months this gentleman made significant physical, behavioral, and psychological gains. The purpose of this case study is to highlight the lived experience of the long-term effects of behavioral issues and depression experienced post-traumatic brain injury, and the positive outcomes that can be achieved using a case management coordinated approach.

148 The Cognitive Status of Patients with Chronic Subdural Hematoma

Jurre Blaauw, Heleen den Hertog, Hester Lingsma, Bram Jacobs, Joukje van der Naalt

aUniversity Medical Centre Groningen, Groningen, Netherlands, bErasmus Medical Center, Rotterdam, Netherlands, cIsala Hospital Zwolle, Zwolle, Netherlands

ABSTRACT

Introduction: Chronic Subdural Hematoma (CSDH) is one of the most common neurological and neurosurgical disorders, frequently affecting the elderly. One of the most common symptoms of CSDH is cognitive deficit which is predominantly seen in older CSDH patients. From other studies regarding traumatic brain injury it is known that cognitive impairment has a large influence on quality of life. Whereas cognitive impairment at presentation is well described in these patients, little is known about post-treatment cognitive status. Furthermore, the extent to which cognitive deficits can be attributed to the occurrence of CSDH and not to older age, is unknown.

Objective: To determine the long-term cognitive status of patients with CSDH and to study which patient-related factors are associated with poor cognitive status after treatment.

Methods: CSDH patients in three level 1 trauma centers in the Netherlands were prospectively followed as part of a randomized clinical trial comparing surgical to medical treatment. Cognitive status was determined using the Telephone Interview for Cognitive Status (TICS), 3 months after diagnosis. The maximum score of the TICS is 50 points, and a score of 34 or lower indicates cognitive impairment. Using Mann-Whitney or Chi2 when appropriate, we compared age, sex, treatment modality, Markwalder Grading Scale (MGS) a clinical severity scale specifically for CSDH, between patients with a TICS score in ≤34 to patients with a score >34.

Results: Thirty-three patients with CSDH were included. Mean age was 72 (SD ± 12.2), and 24 (74%) were male. Mean TICS score was 34 (SD ± 4.5) with a score of ≤34 in 18 patients (55%). Patients with TICS score of ≤34 were older compared to those with TICS scores above 34 (mean age 74.5 ± 12.7 vs. 71.0 ± 10.9).

No statistically significant differences (TICS ≤34 vs. ≤35) in sex [male 12/18 (66%) vs. 12/15 (80%)], treatment modality [surgical treatment: 14/18 (78%) vs. 9/15 (60%)] or baseline MGS score: [score 1, 13/18 (78%) vs. 14/15 (93%)] were found.

Conclusion: Cognitive impairment after CSHD is very common and is associated with older age of patients. Cognitive scores are not related to sex, treatment modality or clinical severity, measured by MGS. Early recognition of cognitive deficit in CSDH patients might allow early intervention aimed to improvement of cognition. We suggest that assessment of cognitive status should be incorporated within the standard follow-up of patients.

149 Greater Acute Concussion Symptoms are Associated with Longer Recovery Times in NCAA Division III Collegiate Athletes

Grant Iverson, Douglas Terry, Bruce Maxwell, Ross Zafonte, Paul Berkner, Nathan Cook

aHarvard Medical School, Boston, United States, bMassGeneral Hospital for Children Sports Concussion Program, Waltham, United States, cSpaulding Rehabilitation Hospital, Charlestown, United States, dColby College, Waterville, United States, eHome Base, A Red Sox Foundation and Massachusetts General Hospital Program, Boston, United States, fUniversity of New England, Biddeford, United States

ABSTRACT

Objectives: We examined the association between the severity of acute concussion symptoms and time to return to school and to sports in National Collegiate Athletic Association (NCAA) Division III collegiate athletes. We hypothesized that students with the lowest burden of acute symptoms, measured in the first 72 hours, would have the fastest return to school and sports and those with the highest burden of symptoms would have the slowest return to school and sports.

Methods: This prospective naturalistic observational cohort study monitored the recovery of collegiate student athletes from 11 NCAA Division III colleges who sustained a sport-related concussion between 2014 and 2019 (5 academic years). Athletic trainers prospectively monitored concussion recovery using the Head Injury Tracker (HIT), a free injury surveillance application created by the Maine Concussion Management Initiative. In the first year the HIT was deployed to 5 colleges and by the final year it was used in 11 colleges. This injury surveillance cohort included 808 athletes from 11 NCAA Division III colleges who sustained a concussion between 2014 and 2019. Concussions were identified by the medical
staff at the colleges, sometimes in collaboration with the students’ other health-care providers. Athletic trainers documented time to return to school and to sports. Recovery time was calculated as the number of days between the injury date and the date of return to school and the date of return to sports.

Results: Women (median = 5 days) took slightly longer than men (median = 4 days) to return to school (p = .001; r = −0.11, small effect). Women and men did not differ on time to return to sports (p = .32, r = −0.04). A greater proportion with high acute symptoms remained out of school at 5 (Odds Ratio, OR = 4.53), 7 (OR = 4.98), and 10 (OR = 4.80) days compared to those with low acute symptoms. A greater proportion with high acute symptoms remained out of sports at 10 (OR = 4.11), 14 (OR = 3.46), and 21 (OR = 3.01) days compared to those with low acute symptoms.

Conclusions: This study shows a strong association between having a high burden of acute post-concussion symptoms and having a slower return to school and sports in Division III collegiate athletes. Moreover, it also illustrates the converse: that athletes with a low burden of acute symptoms have a faster return to school and sports. Health-care providers who assess athletes within the first few days following concussion should know that the severity of acute symptoms is fairly strongly associated with functional recovery. Clinical monitoring and management strategies could be adjusted based on acute symptom burden. For example, those with high acute symptoms can be considered at “higher risk” for slower recovery and should be monitored more closely and provided with more frequent re-evaluation.

150 Risk for Sustaining Concussion Among Children in the United States General Population: A Prospective ABCD Study

Nathan Cooka,b,c,d, Grant Iversona,b,c,d

aHarvard Medical School, Boston, United States, bMassachusetts General Hospital, Boston, United States, cMass General Hospital for Children Sports Concussion Program, Waltham, United States, dSpaulding Rehabilitation Hospital, Charlestown, United States

ABSTRACT

Objectives: Identifying risk factors for sustaining concussion is important to help to target or inform prevention efforts, but there are no prior prospective studies relating to risk factors for sustaining concussion among children in the general population. We examined potential risk factors, assessed when children were 9 or 10 years old, and the occurrence of concussion during a one-year follow-up period in a large, diverse, representative cohort of children from the U.S. general population. We hypothesized that (i) prior concussion, (ii) ADHD, (iii) impulsive tendencies, (iv) accident proneness, (v) male gender, and (vi) greater body mass index would be associated with increased risk of sustaining concussion.

Methods: This prospective cohort study used data from the Adolescent Brain Cognitive Development (ABCD) Study. Children were recruited from schools across the US, sampled to reflect the sociodemographic variation of the US population. A sample of 11,013 children 9 and 10 year old children (47.6% girls; 65.5% White) was prospectively followed for an average of one year (mean = 367.9 days, SD = 40.8, range 249–601). Potential risk factors were clinical, health history, and behavioral characteristics assessed at baseline including: (i) caregiver-reported concussion history based on the Ohio State Traumatic Brain Injury Screen-Short Modified; (ii) attention-deficit/hyperactivity disorder (ADHD) status based on the Kiddie Schedule for Affective Disorders and Schizophrenia for the Diagnostic and Statistical Manual of Mental Disorders—Fifth Edition, a computerized structured diagnostic interview conducted with caregivers; (iii) impulsivity and accident proneness from the Child Behavior Checklist; and (iv) body mass index. Caregiver-reported concussion during a 1-year follow-up period based on the Ohio State Traumatic Brain Injury Screen-Short Modified was the primary outcome. Logistic regression was used to determine which potential risk factors were prospectively associated with a concussion over the 1-year follow-up period.

Results: In the one-year follow-up period between ages 10 and 11, 1 in 100 children (n = 123, 1.1%) sustained a concussion. In univariate models, three baseline predictors (ADHD, prior concussion, and accident proneness) were significantly associated with sustaining a concussion. In a multivariate model, controlling for all other predictors, only prior concussion remained significantly associated with the occurrence of a concussion during the observation period (Odds Ratio = 5.49, 95% CI: 3.40–8.87).

Conclusions: This prospective cohort study found that 1 in 100 children, ages 9 and 10, sustain a concussion over the course of 1 year. The most robust and only independent prospective predictor of sustaining a concussion was history of a prior concussion. History of concussion is associated with 5.5 times greater odds of sustaining concussion between ages 10 and 11 among children from the general US population.

151 Bringing Concussion Education and Advocacy to the Next Generation of Healthcare and Public Health Professionals: Concussion Alliance’s Novel Service Learning Undergraduate Internship

Conor Gormallya, Elizabeth Sandelb, Malayka Gormallya

aConcussion Alliance, Seattle, United States, bClinical Professor, Physical Medicine and Rehabilitation, University of California/Davis School of Medicine, Davis, USA

ABSTRACT

Concussion Alliance (concussionalliance.org) is a non-profit concussion education and advocacy organization that seeks to increase public understanding of concussions and concussion treatment through in-depth, accessible digital resources. Founded in 2018, the organization has used education and advocacy to promote evidence-based concussion management and remove barriers to care faced by people with persistent post-concussion symptoms. Concussion Alliance provides a robust website with accessible information and tools for
patients and family members regarding care and treatment and a biweekly newsletter, the Concussion Update, that covers the latest news and research. The organization has developed a novel undergraduate internship program that trains future advocates and healthcare and public health professionals. Concussion Alliance has educated and trained undergraduate interns and volunteers – aided by leading professionals in the field – in creating and maintaining these educational resources through the Concussion Education & Advocacy Internship Program. These undergraduates plan to go onto careers in healthcare or public health. Interns consistently cite their experience with Concussion Alliance as valuable for skill-building. Also, they report feeling the internship has opened their eyes to the concussion epidemic, the extent of misunderstanding about concussions as brain injuries, and the difficulty of finding and receiving appropriate care.

During the first 2 weeks of the program, interns receive an in-depth, multimedia concussion curriculum that builds the foundation for their work; the details of this curriculum will be presented at the conference. With Dr. Elizabeth Sandel’s book Shaken Brain: The Science, Care, and Treatment of Concussion as a core text, this curriculum is augmented by weekly topic-specific materials from expert guest speakers and cohort discussions with mentors throughout the internship. Guest speakers and mentors have included Kelli Williams Gary, Ph.D., Yelena Goldin, Ph.D., Neera Kapoor, O.D., Margaret Naeser, Ph.D., Monique Pappaid, M.Ed., Ph.D., Nicole Roberts, Dr. Ph., Elizabeth Sandel, M.D, Ronald Savage, Ed.D., Eve Valera, Ph.D., and Nathan Zasler, M.D.

Concussion Alliance has trained 26 interns from Carlton College in the first three years of the program (2018, 2019, and 2020). The interns have researched, written, and designed web resources on headache treatments, cognitive-behavioral therapy, mental health interventions, exercise therapy, vision therapy, and medications for concussion symptoms. Their work appears on website pages and in the newsletter that fosters an understanding of concussion: “What Happens to Your Brain,” “The Invisible Injury,” “Post-Concussion Syndrome,” and “Mental Health” – and in our newsletters. The internship experience results in a growing group of enthusiastic, knowledgeable undergraduate students and college alumni well prepared to positively affect the concussion field as they advance their careers in science and healthcare. In 2021, the program offers internships to undergraduates at Bryn Mawr College (PA), Carleton College (MN), Clarkson College (NY), and the University of Washington (WA).

152 Exploring Patient, Family Member and Professional Perspectives of Neuro-Rehabilitation Hospital Family Meetings Using a Participatory Action Research Approach

Philomena Butlera, Anne O’ Loughlin

aNational Rehabilitation Hospital, Dun Laoghaire, Ireland

ABSTRACT

Formal interdisciplinary (IDT) family meetings provide an important opportunity for communication between patients, families, and rehabilitation professionals. This study set out to explore participants’ experiences and to examine how other professionals viewed the social work role in family meetings in a rehabilitation hospital setting using a participatory action research approach (PAR). A PAR approach was used for the study which involved hospital social workers (N = 8), a rehabilitation consultant, and the author, a social work academic and former medical social worker. All were engaged in the study design, data collection and analysis. A quantitative, descriptive study design was adopted, involving the use of a cross-sectional survey. Work package 1 consisted of a survey of all IDT teams in the hospital (N = 85 respondents) of which 52% (N = 38) were from the Brain Injury Program (BIP). Work package 2 involved survey interviews carried out by the practitioner researchers with patients under the care of the BIP who had attended a family meeting (51%/N = 38). Work Package 3 involved surveying a minimum of one family member of each patient who had attended a family meeting (N = 100) of which 55%/N = 55 were from BIP. Data analysis utilised an interpretive induction framework (Kuczynski & Daly, 2002). The majority of BIP patients and their family members had overwhelmingly positive experiences of family meetings and there were few suggestions about how meetings could be improved. 71% of patients and 83% of families reported that IDT staff had prepared them well for their family meeting. 100% of BIP patients reported that they felt involved in all discussions while 71% of patients and 55% of family members felt involved in decision-making. IDT members, however, reported a lack of preparation beforehand, that the format of family meetings was too formal and rigid and that patients, particularly those with a cognitive impairment were not sufficiently involved in discussions or decisions. Findings suggest that in many cases, patient and family members had attended their first family meeting in the neuro-rehabilitation setting and thus their expectations were low and easily met. Having the opportunity to sit with all members of an IDT and medical team for an hour was met with such appreciation that there may not have been much consideration of any difficulties or any improvements that could be made. IDT members, on the other hand, raised some concerns and suggested that for family meetings to be effective, a set of planned, standardised arrangements and pre-meeting preparations need to be put in place to promote and maximise the participation of all patients and their family members. In preparation for the role of family meeting facilitation, the implementation of education and training programs for IDT members is strongly recommended.

153 Initial Clinical Presentation and Rehabilitation Pathways for Young, School Aged-Children with Concussion

Elizabeth Teela, Nathan Cookb,c,d, Grant Iversonb,c,d, Douglas Terryb,c,d, Debbie Friedmanf,g, Lisa Grilli, Isabelle Gagnon

a,b,c,d Epsom Hospital, Epsom, Surrey, UK; f,g Neurosurgery, University of Melbourne, Melbourne, VIC, Australia
ABSTRACT

Objectives: Concussions are common among elementary school-aged children (5–12 years old). Few studies have investigated the clinical presentation and recovery needs of young children with concussion, which is necessary to optimize recovery strategies to their developmental needs. Therefore, the purpose of this study was to describe and compare initial physiotherapy findings and prescribed rehabilitation pathways for elementary school-aged children with concussions.

Methods: Prospectively collected clinical data from young children presenting to the Montreal Children’s Hospital Concussion Clinic between September 2017 and August 2019 were analyzed. Outcomes of interest included: 1) findings from the initial physiotherapy examination (cervical range of motion, Post-Concussion Symptom Inventory (PCSI), Bruininks–Oseretsky Test of Motor Proficiency Edition 2 (BOT-2) Body Coordination domain composed of Bilateral Coordination and Balance subtests, and a modified version of the Vestibular/Ocular Motor Screen (VOMS) where, in addition to documenting symptom provocation, the physiotherapist reports any abnormal eye movement pattern (e.g. nystagmus, overshoot/undershoot, etc.) observed during the test); and 2) rehabilitation pathways (exercise, vestibular, and cervical therapy) prescribed to patients. We compared patients across several age groupings (5–7 years: n = 52, 8–10 years: n = 146, 11–12 years: n = 183) using Kruskal–Wallis (continuous) or Chi-square (categorical) tests, with roughly equal numbers of boys (n = 208) and girls (n = 179) represented in the sample.

Results: The 11–12-year-olds were significantly more likely to have one or more clinician-observed abnormal finding during the VOMS (5–7 years: n = 0; 0%, 11–12 years: n = 27, 16%; χ²(1) = 7.69, p = 0.006) and cervical examination (5–7 years: n = 1, 2%; 11–12 years: n = 35, 21%; χ²(1) = 7.69, p = 0.006) compared to 5-7-year-olds only. The 5-7-year-old group had significantly better norm-referenced BOT-2 Bilateral Coordination scale scores compared to the 8–10 and 11–12-year-old groups [median scaled scores (IQR): 5–7 years = 20 (18–21); 8–10 years = 18.5 (16–20); 11–12 years = 19 (17–20); χ²(1) = 9.11, p = 0.01]. No group differences in BOT-2 balance, BOT-2 body coordination, or post-injury PCSI scores were observed. For rehabilitation outcomes, significant differences were observed for exercise-based therapy (5–7 years: n = 8, 15.4%; 8–10 years: n = 61, 41.8%; 11–12 years: n = 80, 43.7%; χ²(1) = 14.36, p < 0.001), vestibular therapy (5–7 years: n = 0, 0%; 8–10 years: n = 14, 9.6%; 11–12 years: n = 43, 23.5%; χ²(1) = 22.94, p < 0.001), and cervical therapy (5–7 years: n = 0, 0%; 8–10 years: n = 5, 3.4%; 11–12 years: n = 20, 10.9%; χ²(1) = 11.69, p = 0.003), with 11–12-year-olds more frequently prescribed rehabilitation.

Conclusions: In our sample, 5-7-year-olds with concussion presented with fewer abnormalities on visual/vestibular and cervical assessments as well as fewer rehabilitation needs than 11–12-year-olds. The frequency and severity of deficits observed at the initial physiotherapy appointment, and the subsequent need for rehabilitation, in our sample appear lower than values reported for adolescents and young adults with concussion throughout the literature. These findings could be driven by several factors, including physiological differences influencing injury and recovery, mechanism of injury, or sample-specific differences, and should be explored in the future.

154 Feasibility and Safety of a Remote Graded Exertion Protocol Designed for Children and Adults with Mild Traumatic Brain Injury

Christophe Alarie a,b,c, Elizabeth Teel d,e, Corina Alexandrescu a, Pascale Dupont a, Émile Asselin a, Isabelle Gagnon d,e, Bonnie Swaine a,b,c

aSchool of Rehabilitation, Faculty of Medicine, University of Montreal, Montreal, Canada, bCentre for Interdisciplinary Research in Rehabilitation of Greater Montreal (CRIR), Montreal, Canada, cInstitut Universitaire sur la Réadaptation en DÉficiencE Physique de Montréal (IURDPM), Montreal, Canada, dSchool of Physical and Occupational Therapy, Faculty of Medicine, McGill University, Montreal, Canada, eTrauma Center and Pediatric Emergency Medicine, Montreal Children’s Hospital, McGill University Health Center, Montreal, Canada

ABSTRACT

Objective: Graded exertion tests (GXT) can inform exercise prescription for individuals with mild traumatic brain injury (mTBI), but existing GXTs require in-person supervision from health professionals and large equipment (e.g., treadmill). Thus, when in-person visits are limited, clinicians may not have the tools to safely and precisely prescribe exercise. We developed the Montreal Virtual Exertion (MOVE) protocol as an at-home, no-equipment GXT for children and adults with mTBI, but the protocol had to first be assessed in healthy controls. Therefore, our objective was to determine the feasibility and safety of the MOVE protocol in healthy children and adults.

Methods: The MOVE protocol is a 7-stage, at-home GXT that can be supervised remotely via a telehealth platform. During each stage, the participant performs a single exercise for 1 minute followed by 1 minute of rest whereby self-reported measures of heart rate, rating of perceived exertion and global symptom state are recorded by the remote assessor. Exercises progress from walking in place to Burpees and are ordered based on ascending metabolic equivalent. Feasibility
outcomes included: 1) Participant’s ability to complete the full protocol; 2) Delivering the protocol remotely without technological failures; 3) Recording of self-reported measures (e.g., Heart Rate [HR], Borg Rating of Perceived Exertion [RPE], Global Symptom Scale); and 4) Inducing exertion progressively. Safety outcomes were occurrence of adverse events, including falls, injuries, or symptom exacerbation. The MOVE protocol would be considered feasible and safe if: 1) an 80% successful completion rate was achieved for feasibility outcomes 1–3; 2) self-reported measures significantly increased (using a repeated-measures ANOVA) throughout the protocol (feasibility outcome 4); and 3) ≤4 minor and/or ≤2 major adverse events were reported.

Results: Participants were healthy children and adults (n = 40, children: 12.05 ± 3.7 years old, adults: 37.3 ± 15.5 years old, range: 6–63 years old; female: 50%). All were able to complete all 7 stages of the MOVE protocol and no major technological issues were experienced. Self-reported measures were recorded within the 1-min rest period 95.4% of the time, but were more difficult to collect in children (children: 90.7%, adults: 100%; \( \chi^2[1] = 13.6, p = 0.0002 \)). HR (F[7,312] = 57.2; p < .0001), RPE (F[7,312] = 104.4; p < .0001), and symptoms (\( \chi^2[1] = 108.7, p = .0001 \)) significantly increased throughout the protocol. No other feasibility outcome differed between children and adults or by sex. One minor adverse event among adults was reported; a 24-year-old female reported mild dizziness at protocol conclusion which resolved within 5 min.

Conclusions: The MOVE protocol is a feasible and safe assessment to remotely deliver to healthy children and adults in their own home without requiring equipment. The MOVE protocol has potential as a GXT in telehealth context and future research should aim to evaluate its feasibility and its potential use to inform exercise prescription in individuals with mTBI.

155 Employment and Accommodation Needs in Individuals with Traumatic Brain Injury: A Pilot Study

Sara Hanafe, Angela Colantonio, Sarah Munce, Sally Lindsay

aRehabilitation Sciences Institute, Temerty Faculty of Medicine, University of Toronto, Toronto, Canada, bKITE-Toronto Rehabilitation Institute, University Health Network, Toronto, Canada, cBloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, Canada, dDepartment of Occupational Science and Occupational Therapy, University of Toronto, Toronto, Canada, eDalla Lana School of Public Health, University of Toronto, Toronto, Canada, fInstitute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Canada

ABSTRACT

Introduction: Traumatic brain injury (TBI) is a leading cause of disability worldwide. Sex and gender influence employment in TBI. A large facilitator to employment in TBI is having workplace accommodation, however in many cases accommodations are unavailable or may not fit the needs of the individual. Further, it is unknown how the Coronavirus Disease 2019 (COVID-19) pandemic is impacting employment and accommodations for persons with TBI. This study aims to investigate sex and gender-specific workplace accommodations in persons with TBI, while considering the impact of COVID-19 on transitioning to work and on mental health in adults with TBI.

Methods: The proposed research is a pilot study with an observational cross-sectional design. Sixty adults with TBI, including men, women and gender diverse people within the age range of 18–65 years inclusive, will be recruited. An online survey will be self-administered through Research Electronic Data Capture. The survey includes questions on demographics (e.g., sex, gender, age, ethnicity, injury severity, mechanism of injury); questions from the Canadian Survey on Disability 2017 on employment status, requirements and unmet needs for workplace accommodations; and questions from Statistics Canada on the impact of COVID-19 on work status.

Results: Data collection is in progress. Planned analyses include multinomial logistic and multivariable linear regression analyses to evaluate the relationships between the predictor (i.e., sex, gender) and main outcome variables (i.e., the number and type of accommodations needed, change in employment status and mental health due to COVID-19). Descriptive statistics, between-group comparisons for sex and gender, and sex-specific and gender-specific stratification will be completed to understand emerging trends.

Conclusion: Sex and gender influences in TBI can serve to inform rehabilitation professionals, employers and persons with TBI, to enable sex- and gender-sensitive interventions for community participation practices. Findings from this study will contribute to the body of evidence on sex- and gender-specific workplace accommodations, while bridging the knowledge gap of how to improve transition to work in persons with TBI. Results will also further the understanding of the specific needs of men, women and gender-diverse persons with a disability during community participation post-discharge, including during unprecedented times.

156 What Influence Social Participation of People Aging with a Traumatic Brain Injury?

Pascale Simard, Samuel Turcotte, Olivier Piquer, Marie-Eve Lamontagne

aUniversité Laval, Québec, Canada, bCentre interdisciplinaire de recherche en réadaptation et intégration sociale (CIRRIS), Québec, Canada, cCentre de recherche de l’Institut universitaire en gériatrie de Montréal (CRUJG), Montréal, Canada, dUniversité de Montréal, Montréal, Québec

ABSTRACT

Introduction: Traumatic brain injury survivors now live longer. Little is known regarding the specific challenges when the after-effects of a TBI are intertwined with the typical changes that occur with aging. The many positive effects of social participation in seniors without TBI have been widely documented. However, to this date, there is very little information regarding the experience of social participation in aging as perceived by individuals with a traumatic brain injury.
Objectives: The purposes of this study are to 1) highlight the experience of aging for people living with TBI; 2) identify barriers and facilitators to their social participation and 3) identify interventions that enhance social participation according to the population concerned.

Method: A descriptive exploratory design study was used. In-depth interviews with elders who experienced TBI at their young age were conducted. Interviews took place in a local organization specializing in working with people living with TBI. Data were qualitatively analyzed with deductive and inductive methods.

Results: 10 participants were interviewed. The average age of the sample was 64.9 years old; they were all members of the organization for a minimum of 1 year and lived with TBI for more than 5 years. Participants reported having the impression of aging prematurely. Ten facilitators (e.g., feeling valued while doing the activity) and five barriers (e.g. presence of physical limitations) to social participation were highlighted by the participants. According to them, interventions promoting social participation could be divided into 5 categories (e.g. supporting personal projects and teaching compensatory strategies).

Conclusion: This study provides insight into the specific issues experienced by people aging with a TBI. To promote healthy aging, community organizations need to focus on interventions that support social participation in order to overcome barriers experienced by people living with sequelae after TBI.

157 Implementing a Strength-based Approach for People Living with Traumatic Brain Injury: Preliminary Analysis of Perceived Barriers and Facilitators

Pascale Simardab, Samuel Turcottec, Catherine Valléed, Marie-Eve Lamontagnea,ab

àUniversité Laval, Québec, Canada, bCentre interdisciplinaire de recherche en réadaptation et intégration sociale (CIRRIS), Québec, Canada, cUniversité de Montréal, Montréal, Canada, dCentre de recherche de l’Institut universitaire en gériatrie de Montréal (CRIUAM), Montréal, Canada, eCentre de recherche CERVO, Québec, Canada

ABSTRACT

Introduction: Traumatic brain injury [TBI] can lead to long-term consequences such as mental health issues, impaired judgment, apathy, etc. Community-based organizations play a major role in providing long-term support for people living with the aftermath of a TBI. The strengths-based approach is an intervention that emphasizes integration into the community and the use of the resources of the person and his/her environment. This approach has been shown to be effective with a variety of people, however, it has never been used with people living with the sequelae of a traumatic brain injury (TBI). To make the necessary adaptations and thus facilitate the implementation process within the associative environments in Canada, a study of the determinants of its implementation is necessary.

Objectives: The objective of this study is to document perceived barriers and facilitators to the implementation of the strengths-based approach within a Canadian community organization.

Methods: A qualitative design study was chosen to interview employees and managers of a community association specializing in services for people living with TBI. A questionnaire based on the Consolidated Framework for Implementation Research model was used. Data were analyzed according to a deductive and inductive approach.

Results: A total of 15 participants were interviewed. Memory problems present in some individuals with TBI as well as difficulties in self-perception was identified as potential obstacles to the use of the strength-based approach. On the other hand, stakeholders identified the fit and the similarities between the strength-based approach and their current interventions as key facilitators. In addition, having recurring coaching over a certain period was identified by stakeholders as a strategy that could greatly facilitate implementation.

Conclusion: By taking these results into account, we can then make the necessary adjustments to ensure a better implementation within the association’s context. These data will contribute to the evidence base regarding ACF adaptation processes with diverse populations, thereby increasing potential avenues for supporting community integration and social participation of populations in vulnerable situations.

158 Women’s Support Worker eLearning for Brain Injury in Intimate Partner Violence Evaluation

Blake Nicol, Paul van Donelaar, Karen Mason, Shelina Babul

aUniversity of British Columbia Okanagan, Kelowna, Canada, bUniversity of British Columbia, Vancouver, Canada

ABSTRACT

Background: Women who experience physical intimate partner violence (IPV) are at high risk of suffering a brain injury (BI) (Kwako et al., 2011). Currently, most staff at women’s shelters tend not to be highly educated on IPV-related BIs, and do not typically screen their clients for BIs (Nicol et al., 2021). Online training may help staff at women’s shelters provide better BI-informed care to their clients.

Objective: The objective of this study was to develop a new online eLearning module within the Concussion Awareness Training Tool (cattonline.com) specifically focused on IPV-related BI, and measure its effectiveness in increasing BI awareness and knowledge among staff members at women’s shelters.

Methods: We applied a mixed-methods approach which included a survey to measure participant knowledge before and after completing the CATT for Women’s Support Workers (CATT-WSW) online training module. The surveys took ~15 minutes to complete, and the eLearning module took ~45 minutes. Changes from pre- to post-training were assessed using a paired t-test. Participants also had the opportunity to participate in a one-on-
one interview with a member of the research team 6 months post-training to better understand what, if any, effect the training had on how they worked with women in their job.

Results: Eighty-five participants recruited from among staff at women’s shelters across Canada completed the pre-survey, the online training, and the post-survey. The average BI knowledge score increased significantly from the pre-survey (8.17/12) to the post-survey (9.79/12) (p < 0.0001). Furthermore, nine participants completed the one-on-one interview 6 months post-training. An analysis of the interviews highlighted three main themes arising from the eLearning module: knowledge, mindfulness, and advocacy. All participants felt their awareness and knowledge of IPV-related BIs had increased from the training and said they would recommend the training to coworkers.

Conclusion: Women’s shelter staff have typically lacked training with regards to IPV-related BIs. The results from this study showed the CATT-WSW eLearning module was effective in increasing awareness and knowledge of IPV-related BIs among women's shelter staff as well as preparing how they advocate for, and are mindful of, their clients with BIs. This online training may help improve the care women with IPV-related BIs receive, and ultimately improve their quality of life.

159 Application of Traumatic Encephalopathy Syndrome (TES) Consensus Criteria in a Community-based Brain Injury Cohort: Psychometric Challenges and Recommended Reporting Guidelines

Kristen Dams-O’Connora, Ashlyn Bulsab

aIcahn School of Medicine at Mount Sinai . . ., New York, United States

ABSTRACT
Background: Traumatic brain injury (TBI) and/or repetitive head injury (RHI) sustained in the context of accidents, sports, military service, or intimate partner violence is a major public health concern. There is great interest in understanding the neuropathological mechanisms of post-traumatic neurodegeneration and its hallmark clinical features that may permit in vivo diagnosis and treatment. The National Institutes of Health/National Institute of Neurological Disorders and Stroke recently supported a consensus-based effort to propose research criteria for the in vivo diagnosis of traumatic encephalopathy syndrome (TES), the proposed clinical correlate of chronic traumatic encephalopathy (CTE).

Objective: To examine the feasibility, psychometric challenges, and rates of TES in a community-based sample of individuals with TBI and/or RHI. The goal of this work is to inform best practices for investigating and reporting the prevalence and clinical relevance of TES diagnosis, which is necessary for their refinement and potential clinical application.

Method: We applied the recently published consensus-based TES criteria to clinical data from participants in the Late Effects of TBI (LETBI) brain donor program. Proposed diagnostic criteria for TES were informed by qualitative data collected retrospectively from informants of decedents who underwent postmortem evaluation for CTE neuropathology. As such, we endeavored to translate the consensus-based diagnostic algorithms to prospectively collected psychometric test data. We calculated normative data-based z-scores to define levels of impairment, and wherever possible we calculated minimal clinically important differences (MCID) to define symptom progression. We used these data to define the core clinical features of TES (Cognitive Impairment, Neurobehavioral Dysregulation, and Progressive Course). We examined rates of TES across head trauma exposure groups, and used descriptive statistics to characterize variability in TES rates by group across differing psychometric thresholds of impairment and decline.

Results: Depending on how TES criteria were interpreted, which data points were used to operationalize clinical features, and how constructs such as “impairment” and “decline” were defined, rates of TES ranged (from <10-100%) in our sample (n = 190). Based on these results, we developed minimum reporting guidelines for future studies that apply TES criteria to other samples, which will permit comparisons across studies and refinement of diagnostic criteria based on relevant biological variables.

Conclusion: Knowledge about the later-life implications of remote head trauma exposure is evolving rapidly, and interest in in vivo diagnosis of TES/CTE is outpacing the rate of scientific discovery. As CTE diagnostic criteria are refined and TES criteria are updated accordingly, open science and transparent reporting of research findings across studies will be critical to achieving our ultimate goal of diagnosing and treating post-traumatic neurodegeneration during life.

160 A Description of Adolescent Mild Traumatic Brain Injury at a Pediatric Level II Trauma Center

Geoff Boyer, Heather Rhodes, Saptarshi Biswas, Antonio Pepe, Aaron Worthley, Anthony Shadiack

aGrand Strand Medical Center, Myrtle Beach, United States

ABSTRACT
Objective: Mild TBI accounts for three-quarters of all adults and the majority of pediatric TBI injuries. This study aims to describe the characteristics of adolescent mTBI in Myrtle Beach, South Carolina.

Methods: A retrospective study on prospectively collected Trauma Registry data of adolescent trauma patients (10–15 years) with an initial GCS of 13–14 who were admitted to an ACS verified Level 1 and state verified Level II Pediatric trauma center in Myrtle Beach, South Carolina, inclusive years July 1, 2016 to July 1, 2020. Descriptive statistics were analyzed according to patient characteristics (age, race, gender, insurance provider, GCS); primary outcomes (mechanism of injury, mode of injury, injury severity score); and secondary outcomes (morbidity, comorbidities, discharge disposition). An HCA IRB exempt determination facilitated the data extraction from an integrated organizational repository. Injuries, causes, and procedures were coded using ICD10; additional diagnostic and injury severity scoring were done using the AIS system.
Results: A total of 290 patients were identified in the study period (July 1, 2016 to July 1, 2020). The mean age was 13, which included mostly Caucasian (88%) males (66%). Primarily the injury type was blunt (89%) trauma cause by an MVC (26%). The chief injury or complaint was orthopedic (31%) with a mean ISS of 6.1 and GCS of 14.9. Of the mTBI adolescents, 45% were partially activated, 50% had private insurance and were discharged home (92%) at a mean rate of 39 hours. The trauma patients were primarily visitors (55%) and only 2% of the 290 patients followed up with the local neurologist for relief of post concussive symptoms. Of those seen in the emergency department 46% received CT imaging of the head, which resulted in 15% positive intracranial complications, such as hematoma (52%) or hemorrhage. Conclusions: The adolescent mTBI population is largely made up of white male visitors with a mean age of 13. The majority of the injury patterns relate to orthopedics (31%) with almost half of the patients (46%) receiving CT imaging of the head resulting in 15% diagnosed intracranial complications, such as hematoma or hemorrhage. This study should be used to create a risk prediction model to aid in identifying those mTBI patients who are most at-risk of complications.

162 Constructing a Dutch Register on Childhood Aphasia

Femke Nouwens\textsuperscript{a}, Ineke van der Meulen\textsuperscript{a,b}, Robert Pangelila\textsuperscript{a}, Gerard Ribbers\textsuperscript{b,\textsuperscript{\textdagger}}

\textsuperscript{a}Rijndam Rehabilitation, Rotterdam, Netherlands, \textsuperscript{b}\textsuperscript{\textdagger}Erasmus MC, dept. of Rehabilitation, Rotterdam, Netherlands

**ABSTRACT**

Background: Aphasia is a language deficit resulting from brain damage, usually occurring in adults after stroke. Though rare, children with acquired brain injury can also suffer from aphasia. As this group is very heterogeneous regarding etiology, age and level of language acquisition, little is known on the effectiveness of speech and language treatment (SLT) on acquired childhood aphasia (ACA). RCTs are nearly impossible and large observational studies are lacking. Still, ACA is a chronic condition in many of these children, seriously impeding daily life. To improve care for children with ACA we need accurate longitudinal data.

Objective: To construct a Dutch national register on ACA, with five-year data on language function, SLT and satisfaction with SLT from stakeholders.

Design: a longitudinal prospective observational study.

Participants: Children in the age of 2–18 years, requiring SLT for acquired language or communication problems after brain injury.

Methods: Core outcome sets of language tests for four age categories were established via a Delphi-procedure among professionals of 23 Dutch health-care institutions. A pilot of six months was conducted in two rehabilitation centers to test and optimize online data collection. Questionnaires on medical history concerning brain injury, psychosocial and SLT data, were completed by parents and SLT-therapists in the online data collection program Gemstracker\textsuperscript{a}. Language tests were conducted within a month of onset and 6 months later. We present here the results of the pilot.

Results: The response rate was 86%. In the course of six months 18 children from 2 to 17 years old were included. ACA was caused by a stroke (n = 7), trauma (n = 7), epilepsy (n = 1), a tumor (n = 2) and one cause was unclear. In spontaneous speech 35% of the children were severely impaired (unable to express themselves without help in simple conversations), 65% were mildly impaired. Severe word finding difficulties were found in a third of the children. Six months later, 38% of the children improved in spontaneous speech and word finding, but none of them showed complete recovery of their language problems. In contrast, language difficulties deteriorated in 12% and remained stable in 50% of the children.

Conclusion: The pilot phase showed a large willingness among parents to participate in the Dutch register on ACA. There are only a few longitudinal studies on language recovery after ACA, most of them in small groups. In line with these studies, our data suggest that prognosis of language recovery after ACA is not favorable. Until now, determinants for language recovery in ACA have not been determined. There is a great need for large observational longitudinal studies to obtain more insight in ACA, its impact on functioning in daily life and possible ways to improve communication. The Dutch register on ACA will enable such studies.

164 Bedside Decision Aids Can Improve Generalized Seizure Management in Non-acute Rehabilitation Settings

Alasdair FitzGerald\textsuperscript{d}, Seona Corbett\textsuperscript{a}, Sarah Taghizadeh\textsuperscript{e}, Peter Fernandes\textsuperscript{b,c}

\textsuperscript{d}Dept. of Rehabilitation Medicine, NHS Lothian, Edinburgh, Scotland, \textsuperscript{b}Neurology Directorate, NHS Lothian, Edinburgh, Scotland, \textsuperscript{c}Edinburgh Neuroscience, Edinburgh University, Edinburgh, Scotland

**ABSTRACT**

Objectives: Epileptic seizures are a recognized complication following brain injury. Early treatment of prolonged seizures reduces potential for serious complications. Neurorehabilitation units in non-acute settings do not have access to the type of emergency response that can be provided in acute hospitals. Transfer of patients to acute hospitals for seizure management delays effective response and is disruptive both to the patient and the receiving unit if the patient has communication, cognitive, behavioral or other complex needs. To enable effective early treatment and reduce need for transfers we developed a clinical protocol that can be consistently and safely applied in a non-acute setting.

Methods: A protocol was designed in accordance with abilities of expected users using a structured decision support approach augmented with a training program. Twenty medical and nursing colleagues were surveyed in relation to their experience in using the protocol, survey being conducted within a week of their having used it.
Results: Survey responses demonstrates high levels of user satisfaction and engagement in delivering the protocol. Conclusions: We believe that this protocol is effective in enabling staff confidence in safe and effective seizure management. We also believe that this protocol is transferable to other non-acute clinical settings in which a similar seizure prevalence and management challenges might be anticipated.

165 Patterned Sensory Enhancement for Improving Sit-to-Stand Transfer Performance in Children & Adolescents with Acquired Brain Injury: A Case Series

Marie Snyder, Elena Bradley, Nicole Spurgeon, Heather McLean

aKendrick Krieger Institute, Department of Physical Therapy, Baltimore, United States. bKennedy Krieger Institute, Department of Child Life, Baltimore, United States

ABSTRACT

Objectives: Patterned sensory enhancement (PSE) is a neurologic music therapy (NMT) technique that uses rhythmic, melodic, harmonic, and dynamic-acoustical elements of music to provide temporal, spatial, and force cues for movements which reflect functional exercises and activities of daily living. Previous research has shown benefits of combining PSE and sit-to-stand (STS) transfer training in children with spastic diplegic cerebral palsy with immediate improvements in joint kinematics, ability to perform STS with increased load, and long-term improvements in overall gross motor capabilities. The purpose of this case series was to describe the use and benefits of PSE during transfer training with individuals who had a diagnosis of acquired brain injury (ABI).

Methods: This case series was conducted via retrospective chart review. Three patients, ages 7–19 years, all with ABI of varying etiologies were included. Participants had received PSE in conjunction with transfer training activities as part of physical therapy sessions during an inpatient rehabilitation admission. PSE was provided via guitar by a board-certified music therapist who was trained in NMT techniques. Participants performed 1–2 STS without PSE and then again with PSE during which the music therapist tailored musical patterns and accompaniment to elicit desired movements from the patient. Physical assistance or supervision was provided by a physical therapist based on each patient’s needs. Time to complete the sit-to-stand transfer (T-STS) was measured with and without PSE during a single therapy session. The timer was started at initiation of anterior weight shift and stopped when full upright posture was achieved. In addition, the quality of movement patterns was compared for STS performed with and without PSE.

Results: All patients included in this case series showed within-session improvement in speed and quality of movement during STS performance with the addition of PSE. Mean T-STS without PSE was 6.35, 2.17, and 3.67 seconds whereas with PSE it was 4.73, 0.56, and 2.28 seconds for patients A, B, and C, respectively. Qualitative improvements included increased speed; improved quality, control and fluidity of movement; less reliance on external support; and decreased ataxic movements. The addition of PSE had no effect on the level of assistance that the patients required to complete a STS.

Conclusions: PSE shows promise as an adjunct intervention to improve transfer performance within session during pediatric and adolescent brain injury rehabilitation. Limitations of this case series include variability within diagnosis of ABI, comorbidities, and patient presentation, retrospective data analysis, single session use of intervention, and lack of long-term reassessment. Future research should consist of more robust prospective studies with data taken within and across multiple therapy sessions, larger sample size, as well as inclusion of longer-term follow-up.

166 Blurred Lines in Cognitive Neuro-rehabilitation: Professional Boundaries or Optimal Patient Outcomes?

Sameera Patel, Jaishika Seedat, Kelly-Ann Kater

aUniversity Of Witwatersrand, Johannesburg, South Africa

ABSTRACT

Objective: Given the increasing number of adults surviving and living with brain injury, tailored rehabilitation is vital to maximize outcomes for the survivor of traumatic brain injury (TBI). It is unfortunate that systemic and contextual factors impede this whereby insufficient numbers of rehabilitation professionals result in little choice but to work outside professional boundaries. This is a growing concern in a context such as South Africa (SA).

Method: The current study explored the aspect of cognitive neuro-rehabilitation to understand if speech-language therapists (SLT) felt suitably equipped to intervene in this area, if they worked as part of a multidisciplinary team with cognitive neuropsychologists, and their professional insights into who could and should fulfill this role in rehabilitation in SA where there are insufficient numbers of qualified cognitive neuropsychologists to provide the services for TBI survivors. A qualitative design was employed, whereby an electronic survey was sent to all SLTs in SA. A final sample of 29 SLTs recruited via purposive and snowball sampling participated in the study. Thematic content analysis was used to analyze the data.

Results: The findings confirmed that despite adequate understanding of the boundaries between rehabilitation professionals in the area of neurocognitive rehabilitation, SLTs often had little choice but to work outside their parameters. Cognitive neuro-rehabilitation is a complex area to manage. Despite gaps specifying the role of the SLT in this area, participants confirmed that they often had little choice but to provide cognitive neuro-rehabilitation given the scarcity of cognitive neuropsychologists in SA. Occupational therapists, cognitive neuropsychologists and SLTs were each highlighted to make valuable contributions in the rehabilitation of the TBI survivor. Participants confirmed the intrinsic link between cognition and communication and were vocal that any professional scope of practice that prevents any flexibility, and which narrowly defines which professional does what, is short-sighted
and ultimately impedes patient progress and outcomes. This is especially relevant in contexts where patient to rehabilitation professional ratios are skewed in favor of the patient, and where geographical location of services only advantages a minority of the population.

Conclusion: The data provides valuable clinical and theoretical insight into management of cognitive-communication deficits by SLTs and has foreground how SLTs view their role with cognitive neuro-rehabilitation and ultimately their role in the reintegration of TBI survivors into previous life roles. The need for increased collaboration between SLTs, occupational therapists and cognitive neuropsychologists is highlighted. The notion of a transdisciplinary model of care warrants consideration if one weighs patient outcome against territorial impeding, but is a model that the context needs to be well prepared for.

Keywords: traumatic brain injury, cognitive neuro-rehabilitation, speech-language therapist, cognitive neuropsychologist, professional boundaries

167 Health-Care Utilization and Costs Among Individuals with a Concussion in Ontario: A Population-based Study

Laura Langer, Mark Bayley, Charissa Levy, Sarah Munce, Alan Tam, David Lawrence, Claire de Oliveira

KITE, Toronto Rehabilitation Institute – University Health Network, Toronto, Canada; 2Toronto Rehabilitation Institute – University Health Network, Toronto, Canada; 3Faculty of Medicine, University of Toronto, Toronto, Canada; 4Toronto ABI Network, Toronto, Canada; 5Department of Occupational Science & Occupational Therapy, University of Toronto, Toronto, Canada; 6Rehabilitation Sciences Institute and Institute of Health Policy, Management & Evaluation, University of Toronto, Toronto, Canada; 7Faculty of Kinesiology and Physical Education, University of Toronto, Toronto, Canada; 8Mt Sinai Hospital, Toronto, Canada; 9Centre for Addiction and Mental Health, Toronto, Canada; 10Centre for Health Economics and York Medical School, University of York, Keslington, UK; 11ICES, Toronto, Canada; 12Institute for Health Policy, Management and Evaluation, University of Toronto, Toronto, Canada

ABSTRACT

Background: Concussion affects 1.2% of the population of Ontario annually; rural regions of the province and children have higher rates of concussion.

Objective: To characterize post-concussion health-care utilization in Ontario.

Methods: Using administrative health databases, all residents of Ontario with a concussion diagnosed in either primary care (ICD-9 code 850) or emergency departments (ED) (ICD-10 code S06) between 2008 and 2016 were identified. Cases were followed for 2 years following injury for concussion-related health-care utilization with relevant specialist physicians (i.e., neurology, ENT, physiatry, psychiatry, ophthalmology, etc.). Billing fee codes among specialists and time from index to visit were analyzed. Health-care costs of individuals requiring more than 2 specialist visits more than 6-months post injury were compared to age, sex, and geography matched individuals who did not require specialized follow-up care after their concussion.

Results: 1,330,036 cases were identified from 2008 to 2016; 2 years of health-care data post-injury was available for 1,022,588 cases diagnosed between 2008 and 2014. 80% of all cases were diagnosed in the ED. Over 85% of cases identified in the ED had follow-up by a primary care physician after their injury with a mean time of 83.9 days (SD 123.3) median 25 days after ED diagnosis; rural regions had a mean follow-up of 107.9 (SD 150.9) days, median 39 days. 51.9% of adults and 50.3 % of children (<18 y-o) required at least 1 specialist visit for their concussion post-injury. The mean number of specialist visits was 3.2 (SD 9.2) and a median of 2 visits for those who sought specialized care after their concussion; the mean time between index and first specialist visit was 203.8 (SD 192.9) days for adults, 213.5 (SD 201.0) days for rural adults, and 276.0 days (SD 202.6) for pediatric cases. There were 67,420 neurology visits with a mean of 2.6 (SD 3.7) visits per person, 70,404 psychiatry visits with a mean of 9.5 (SD19.3) visits per person, 13,571 neurosurgery visits 3.1 (SD 5.5) mean number of visits per person, 19,780 physiatry visits with a mean of 4.7 (SD 10.0) visits per person, 101,788 ENT visits with a mean of 2.4 (SD 2.3) visits per person, and 103,417 ophthalmology visits with a mean of 3.8 (SD4.2) visits per person associated with the concussion cohort in the 2 years following their injury. Among those who saw a specialist after their concussion, 50% of pediatric cases saw an ENT post-injury; there was no dominant specialty for adult cases. There were fewer psychiatry (p < 0.0001) and physiatry visits (p < 0.0001) for rural residents.

Conclusions: There are discrepancies in post-concussion health-care utilization based on age group and living in a rural/non-rural classified area. Addressing these will improve access to concussion care.

168 fNIRS Imaging with Naturalistic Stimuli to Detect Consciousness Level: A Pilot Study with Healthy Participants

Tamar Mizrahi, Noam Somech, Vadim Axelrod

aThe Gonda Multidisciplinary Brain Research Center, Bar-Ilan university, Ramat Gan, Israel; 2Department of Brain Injury Rehabilitation, Sheba Medical Center, Ramat Gan, Israel

ABSTRACT

Detecting conscious processing of DOC (disorders of consciousness) patients is a challenge. Knowing to what extent a DOC patient is conscious may affect clinical decisions at the acute level, as well as prognosis and treatment options at the sub-acute and chronic levels. The introduction of neuroimaging in detecting consciousness of DOC patients has truly revolutionized the field. Despite substantial progress, the paradigms used today are still far from optimal. In recent years, naturalistic stimuli have been successfully used in basic
research as well as in clinical applications. Several studies also adopted this approach with DOC patients using functional MRI (fMRI). However, conducting fMRI experiments with DOC patients involves various challenges, such as the transportation of the patient to the imaging facility. Therefore, ideally, it is better to test the DOC patients at bedside. The goal of the present pilot study conducted with healthy subjects was to develop a new paradigm for probing consciousness level using naturalistic stimuli, a paradigm that does not depend on the MRI. We used functional near infrared spectroscopy (fNIRS), a well-established noninvasive neuroimaging technique that, similarly to the fMRI, measures brain hemodynamic response. In our paradigm, we recorded brain activity in the frontal lobes using fNIRS while the participants listened to three kinds of auditory stimuli: music, story, and scrambled story. By applying inter-subject-correlation analysis, we found relatively high correlations between subjects during the story and music, but not during the scrambled story. In addition, our preliminary results show that the effects could be detected in a high percentage of individual subjects. Overall, our results might pave the way to clinical application, proposing a new neuroimaging paradigm to detect consciousness level at bedside. This approach might complement routine behavioral assessment of patients with DOC, thus improving diagnosis accuracy for this patient population.

169 Identifying Prioritization Criteria for Patients with mTBI Waiting for Multidisciplinary Rehabilitation Services: A Delphi Study Protocol

Julien Déry\textsuperscript{a,b}, Élaine De Guise\textsuperscript{c,d}, Marie-Eve Lamontagne\textsuperscript{a,b}

\textsuperscript{a}Université Laval, Québec, Canada, \textsuperscript{b}Centre interdisciplinaire de recherche en réadaptation et intégration sociale, Québec, Canada, \textsuperscript{c}Université de Montréal, Montréal, Canada, \textsuperscript{d}Centre de recherche interdisciplinaire en réadaptation du Montréal métropolitain, Montréal, Canada

\textbf{ABSTRACT}

Background: Traumatic brain injury (TBI) is a growing public health problem. Mild TBI is associated with a broad range of difficulties at the physical, cognitive and emotional level. Several authors studied the course of recovery to predict outcomes following mTBI. Identifying prognostic factors that can contribute to poor prognosis in mTBI is important to target patients with the greatest needs and adjust rehabilitation services consequently. Prioritization and clinical decision based on prognostic factors in mTBI rehabilitation programs are needed.

Objective: The aim of this study is to obtain a consensus about patient prioritization criteria based on prognostic factors related to persistent post-concussive symptoms in patient with mTBI.

Methods: We will conduct a Delphi survey with participants expert in the topic being investigated. We will include rehabilitation clinicians (i.e. occupational therapists, physiotherapists, neuropsychologists and a clinical coordinator), a program manager, decision-makers, researchers and patients who have experienced an mTBI. We will use an online questionnaire platform (LimeSurvey) to conduct the multiple rounds of Delphi survey. We have previously conducted a systematic review of systematic reviews to gather the prognostic factors related to persistent symptoms in adults with mTBI. We will present those results and ask to score on a 9 levels Likert scale the relevancy of each factor for prioritizing patients with mTBI waiting for multidisciplinary rehabilitation services. Consensus on the inclusion of a criterion will be define as a median score of 7 and over whereas consensus toward the exclusion of a criterion as a median score of 3 and less, with sufficient agreement.

Discussion: The results will benefit future development of a patient prioritization tool designed to manage waiting list in a specialized rehabilitation program. Identifying prioritization criteria is a complex task that should be performed through a valid method to obtain a consensus. Only few studies focused on the identification of prioritization criteria in rehabilitation settings. This study represents a first step of many more towards the development of a shared decision-making process to rally differing perspectives concerning patient prioritization criteria and tools in rehabilitation settings.

170 Early Onset Dementia in Veterans With TBI: Is there an Additional Impact for those with Epilepsy?

Mary Jo Pugh\textsuperscript{a}, Hamada Altalib\textsuperscript{b}, Sidney Hinds\textsuperscript{c}, Maria Raquel Lopez\textsuperscript{a}, Anne Van Cott\textsuperscript{e}

\textsuperscript{a}VA Salt Lake City/University of Utah, Salt Lake City, United States, \textsuperscript{b}VA Connecticut Healthcare System and Yale University, West Haven, United States, \textsuperscript{c}Uniform Services University of the Health Sciences, Bethesda, United States, \textsuperscript{d}VA Miami Healthcare System and University of Miami, Miami, United States, \textsuperscript{e}VA Pittsburgh Healthcare system, Pittsburgh, United States

\textbf{ABSTRACT}

Research Objectives: To identify the association of TBI and epilepsy on diagnoses of early onset dementia (EOD) in a cohort of Post-9/11 era Veterans as both are associated with dementia in older individuals and are more common in Post-9/11 Veterans than the general population.

Design: Retrospective observational study of Post-9/11 Veterans in VA care FY02-FY18 using national longitudinal data from Departments of Defense and Veterans Affairs. Participants: Post-9/11 Veterans <65 years at VA care entry and >3 years of care.

Main Outcomes: EOD was operationalized using ICD-9-CM/10 diagnoses for diagnoses found reliable in prior research (Alzheimer’s and frontotemporal dementia). TBI severity was identified using self-reports (VA Comprehensive TBI Evaluation) and ICD-9-CM/10 codes. Epilepsy was identified using ICD-9-CM/10 codes and anticonvulsant medications. Covariates included socio-/military demographics, prior deployment and comorbid conditions associated with
dementia. Logistic regression analysis identified associations with EOD for epilepsy and TBI severity controlling for potential confounders.

Results: Among the 1,055,873 Veterans who met inclusion criteria 923 met criteria for EOD (7.4/1000 epilepsy; 0.7/1000 no epilepsy). Epilepsy (aOR 2.41 [1.98–2.93]) and TBI of all severity was associated with EOD (aORs: mTBI 1.67 [95% confidence interval: 1.40–1.99]; moderate/severe TBI 2.31 [1.80–2.98]; penetrating TBI 2.87 [2.08–3.97]). Other significant predictors (aORs >1.5; p < .001) included age 50–64 and 40–49 (vs. 30–39), other neurological conditions, stroke, schizophrenia, depression, and bipolar disorder.

Conclusions: Epilepsy and TBI (of all severities) were associated with EOD. Consistent with prior research there was a near linear association of TBI severity and EOD, but no significant interaction between TBI and epilepsy. Thus, each condition contributes to EOD. However, those with more severe TBIs have higher risk for epilepsy and EOD suggesting the mechanism of added impact of TBI severity may work through other neurological/neuro-degenerative conditions. Indeed, other strong predictors of EOD (e.g., stroke) supports this hypothesis and the idea that multimorbidity associated with TBI may reveal phenotypes of neurodegenerative outcomes that require further evaluation.

171 Lead Toxicity Due to Retained Intracranial Bullet Fragment: A Case Report and Review of the Literature

Daniel Aaronson\textsuperscript{a}, Hirad Hedayat\textsuperscript{a}, Ahmed Awad\textsuperscript{a}

\textsuperscript{a}Medical College of Wisconsin, Department of Neurosurgery, Milwaukee, United States

\textbf{ABSTRACT}

Background: Lead toxicity (plumbism) secondary to retained lead bullet fragments is a rare complication in patients with gunshot wounds. To our knowledge, there has not been a definitive case reported of lead toxicity due to retained intracranial bullet fragments.

Case Description: A 23-year-old man presented after being found down. Computed tomography scan of the head revealed bullet fragments within the calvarium adjacent to the left transverse sinus. During follow-up he developed symptoms of plumbism with paraesthesias in his bilateral hands and thighs, abdominal cramping, and labile mood. Plumbism was confirmed with sequentially elevated blood lead levels. The patient opted for surgical removal of the bullet fragments, which led to a reduction in blood lead levels and resolution of his symptoms.

Conclusions: Although rare, lead toxicity from retained intracranial bullet fragments should be considered in patients who have suffered a gunshot wound to the head and have symptoms of lead toxicity with elevated blood lead levels. For safe and easily accessible intracranial bullet fragments in patients with plumbism, surgical intervention may be indicated.

172 Factors Influencing Veterans’ Receipt of Guideline-recommended Practices for Post-concussive Sleep Disturbance and Headache

Adam Kinney\textsuperscript{a,b}, Nazanin Bahraini\textsuperscript{a,b}, Jeri Forster\textsuperscript{a,b}, Lisa Brenner\textsuperscript{a,c}

\textsuperscript{a}Rocky Mountain Mental Illness Research, Education and Clinical Center, Department of Veterans Affairs, Aurora, United States, \textsuperscript{b}Department of Physical Medicine and Rehabilitation, University of Colorado Anschutz School of Medicine, Aurora, United States, \textsuperscript{c}Departments of Physical Medicine and Rehabilitation, Neurology, and Psychiatry, University of Colorado Anschutz School of Medicine, Aurora, United States

\textbf{ABSTRACT}

Objectives: To increase understanding regarding barriers and facilitators of clinicians’ implementation of recommendations for post-concussive sleep disturbance and headache within the VA/DoD mild traumatic brain injury (mTBI) clinical practice guideline (CPG).

Methods: This was a convergent parallel mixed methods design. Participants included 19 stakeholders (13 clinicians; 4 researchers; 2 policymakers) from Veterans Health Administration (VHA) facilities nationwide. Stakeholders rated recommendations for sleep disturbance and headache on a scale of 1 (low quality) to 7 (high quality) using the psychometrically sound AGREE-REX instrument. A descriptive analysis was performed to understand the recommendations’ 1) clinical credibility (e.g., evidence quality); 2) alignment with stakeholder values; and, 3) implement-ability. We conducted semi-structured interviews with stakeholders and used descriptive-interpretive analysis to reveal factors influencing the implementation of recommendations into care.

Results: Stakeholders rated the recommendations for managing sleep disturbances as clinically credible (mean $\bar{M}$ = 5.26, standard deviation $SD = 1.20$), consistent with stakeholder values (M = 5.00, SD = 1.25), and implementable (M = 5.05, SD = 1.41). Headache recommendations were also rated as clinically credible (M = 5.18, SD = 0.96), values-consistent (M = 5.09, SD = 1.14), and implementable (M = 5.11, SD = 1.41). Preliminary analysis of interviews revealed facilitators of implementing recommendations: 1) evidence underlying recommendations; 2) reflective of Veteran needs/preferences; 3) facility culture; and, 4) access to specialty care providers. However, multiple barriers to implementation emerged: 1) inaccessibility at the point-of-care; 2) limited facility-level efforts encouraging implementation; 3) varying facility resources; and, 4) limited awareness of recommendations and formal training.

Conclusions: VHA stakeholders considered the recommendations to be suitable for implementation overall, but characteristics of the CPG, providers, and facilities were identified as barriers. Findings will inform a discussion of strategies capable of addressing the identified barriers to implementation, thereby maximizing Veterans’ receipt of quality care.
173 Internal Consistency Reliability of the MMN in Post Concussion Syndrome

Gwenyth Lu, Kiersten Mangold, John Connolly

Department of Linguistics and Languages, McMaster University, Hamilton, Canada. Neuroscience Graduate Program, McMaster University, Hamilton, Canada. ARIEAL Research Centre, McMaster University, Hamilton, Canada

ABSTRACT

Objective: The present study sought to investigate internal consistency reliability of the mismatch negativity (MMN) brain response in retired athletes who have sustained concussions and are now experiencing post-concussion syndrome (PCS).

Design: Cross-sectional, between-subjects

Setting: Lab setting, McMaster University campus

Participants: Our study recruited a total of thirty-nine subjects (20 controls) and 19 retired Canadian Football League (rCFL) athletes who had sustained concussions on average 28 years ago. Controls were age-matched to the athletes and had no history of brain injury.

Independent Variables: Group (Concussed vs. Controls)

Outcome Measures: The number of trials necessary to obtain excellent internal consistency (Cronbach’s alpha, α [or coefficient alpha] ≥ 0.90) of the MMN elicited in response to auditory oddball paradigms. Successive amplitude and area under the curve (AUC) averages were calculated by averaging successive blocks of 10 trials (1–10, 1–20, 1–30, etc.) up to 130 trials. Amplitude and AUC averages were also acquired by averaging successive blocks of 10 random trials.

Main Results: We found that group and number of trials had a significant effect (p < 0.001) on MMN amplitude and AUC coefficient alpha values. MMN amplitude stabilized with excellent internal consistency (α ≥ 0.9) between 50 and 70 trials for control subjects whereas concussed subjects required 120–130 trials to achieve good to excellent internal consistency (0.9 ≥ α ≥ 0.8). When examining AUC of the MMN, the controls required 100–120 trials to achieve excellent internal consistency (α ≥ 0.9) and concussed subjects required 120–130 trials to achieve good internal consistency (0.85 ≥ α ≥ 0.8).

Conclusions: Chronic concussion affects the number of trials as well as the strength of the coefficient alpha needed to obtain an internally consistent MMN amplitude and AUC. This demonstrates that concussion can have long-term consequences on cognition, specifically automatic change-detection as manifested by the MMN. In addition, this provides implications for future electroencephalogram (EEG) research involving clinical populations.

174 Musical Alexia in Musician with Traumatic Brain Injury

Emily O’shea, Annamarie Engelhard, Kimberly Frey, Eric Spier

Craig Hospital, Englewood, United States

ABSTRACT

Music reading refers to processing pitch and rhythm from written symbols. Musical alexia is the impairment of interpreting either or both of those musical elements (Midorikawa, 2003). Few case studies exist on the study and treatment of musical alexia.

This case study describes a 49-year-old male presented to inpatient neurorehabilitation following a traumatic brain injury secondary to motor vehicle vs. pedestrian accident. Patient was classically trained in music from age 5, received a master’s degree in music performance from Juilliard, and was a professor performer, composer, and university music professor. Neuroimaging revealed bilateral frontal, left temporoparietal, left occipital, and inferior temporal encephalomalacia as well as hyperintensity in the left infratemporal tissue and the left occipital lobe. Additionally, hyperintense extra-axial material was noted along the upper parasagittal left frontal lobe.

Language testing revealed fluent output, mildly impaired confrontational naming, and intact auditory comprehension and repetition skills. Grapheme-phoneme correspondence and oral reading at the single syllable level were intact. As words and material increased in complexity, the patient relied on letter-by-letter reading, and reading efficiency was compromised. Patient’s reading presentation was consistent with a pure alexia (also referred to as alexia without agraphia or visual alexia). Using age-based normative data for the Nelson Denny Reading Test (NDRT), the patient scored within functional limits in Vocabulary and Comprehension, however, he scored in the fourth percentile for Reading Rate.

The patient was competent in areas of music abilities, including performance, aural skills, notation, and single-note and symbol identification. Assessment revealed reliance on note-by-note reading and inaccurate, as well as inefficient, sheet music sight-reading. Sight-reading was measured using novel music in 4 categories (intermediate rhythms, easy violin, intermediate violin, easy-intermediate piano). Sight-reading assessment tracked speed via beats per minute (BPM) and errors of pitch, rhythm, and bowings. The patient performed at elementary levels in all four categories.

An interdisciplinary program targeted musical and visual alexia. Rehabilitation exercises focused on whole-unit recognition training, sight/score reading, chord recognition, music auditory/visual memory/identification tasks, and composition. Compensatory strategy training focused on integration of visual and auditory skills. Adaptations included alterations of color, size, and spacing of sheet music on paper and digital display. Home exercise program included visual attention tasks, sight and prose reading practice, and music theory exercises.

Evaluations repeated at time of discharge revealed global improvements. NDRT Reading Rate improved from the fourth percentile to the ninth percentile. Patient improved from reading at the single, multisyllabic word level at 4.7 seconds per word to the short phrase level at 1.2 seconds per word. Chord reading improved from 4.5 seconds per chord to 3.2 seconds per chord. Sight-reading improved across all four categories from average sight-reading speed of 45 BPM with 8.75 errors to 78 BPM with 2.5 errors.
**175 Lithium in Precipitating Delirium – A Literature Review**

Myriam Vigny-Pau\(^a\), Shiliang Ge\(^a\), Shweta Aswani\(^b\), Fallon Ponnambalam\(^a\), Ananya Pathak\(^c\), Shree Bhalerao\(^d\)

\(^a\)University of Toronto, Toronto, Canada, \(^b\)St. Michael’s Hospital, Toronto, Canada, \(^c\)University of Guelph, Etobicoke, Canada

**ABSTRACT**

Introduction: While consultation-liaison (CL) psychiatrists are frequently consulted to assist with the management of lithium in medically ill and complex patients, there are currently no clear clinical guidelines to help inform these decisions. Current literature on the potential role of lithium in precipitating delirium remains limited to isolated case reports. This paper aims to provide a review of the existing literature on the association between lithium and delirium to help inform the decisions of practicing clinicians with regard to the management of delirium in medically ill and complex patients.

Methods: The databases Ovid MEDLINE, EMBASE, APA PsycInfo, and CINAHL were searched for the 40 articles included in this review. Complete search terms can be found in Appendices A and B.

Results: The existing literature was found to be largely composed of case reports and case series, citing lithium’s delirigenic properties and its drug–drug interactions with other concurrent psychiatric therapies. The case reports identify select mood stabilizers, neuroleptics, antidepressants, NSAIDs and ECT as interacting with lithium to induce delirium at therapeutic levels. Withdrawal of lithium therapy was also noted to precipitate delirium. Risk factors that predispose patients to lithium-associated delirium are also described.

Discussion: Despite the limited body of literature, broad guidelines could be drawn from it. Precautions such as lower dosing and increased serum lithium-level monitoring are recommended in the elderly, as well as when initiating ECT or when co-prescribing lithium and a neuroleptic. A significant gap in the literature with regard to this subject was identified by this review, and future research directions were highlighted.

**176 Lithium in Traumatic Brain Injury – A Literature Review**

Myriam Vigny-Pau\(^a\), Shiliang Ge\(^a\), Shweta Aswani\(^b\), Fallon Ponnambalam\(^a\), Ananya Pathak\(^c\), Shree Bhalerao\(^d\)

\(^a\)University of Toronto, Toronto, Canada, \(^b\)St. Michael’s Hospital, Toronto, Canada, \(^c\)University of Guelph, Etobicoke, Canada

**ABSTRACT**

Introduction: Consultation-liaison (CL) psychiatrists are frequently consulted to assist with the management of lithium in traumatic brain injury (TBI) patients. There are currently no clinical guidelines to help inform these decisions. This paper aims to provide a review of the existing literature on the use of lithium in the management of the neurocognitive and neuropsychiatric sequelae in TBI patients.

Methods: The databases Ovid MEDLINE, EMBASE, APA PsycInfo, and CINAHL were searched for the 27 articles included in this review. Complete search terms can be found in Appendices A and B.

Results: The existing literature was found to be composed largely of animal studies, case reports, and case series, some of which conflicted with each other with regard to the effectiveness of lithium as a treatment in TBI. The case reports showed instances of neuropsychiatric sequelae of TBI responding well to lithium therapy, and the animal studies suggested that individuals already treated with lithium may recover better neurocognitively post-TBI due to lithium’s neuroprotective mechanisms.

Discussion: No clinical or dosing guideline could be established using the current body of literature, but some broad guidelines could be drawn. Patients may neurocognitively benefit from their lithium being maintained post-TBI, given the results of the animal studies, and may benefit neuropsychiatically from treatment with lithium post-TBI. A significant gap in the literature with regards to this subject was identified, and future research directions were identified.

**177 Do Prism Glasses in Conjunction with Optometric Vision Therapy Improve Outcome Measure Scores in a Sample of mTBI Patients?**

Julia Dahlby\(^a\), Patrick Rushton\(^b\), Ben Dyck\(^c\), Benjamin Freedman\(^a\), Alexandra Harriss\(^a\), Julia Pearce\(^a\), Cirelle Rosenblatt\(^d^b\)

\(^a\)Advance Concussion Clinic, Vancouver, Canada, \(^b\)University of British Columbia, Vancouver, Canada

**ABSTRACT**

Introduction: In recent years, the utility of optometric vision therapy in mTBI rehabilitation has been called into question. Key arguments include a lack of empirical evidence of oculomotor dysfunction and its contribution to concussion symptoms. While optometric vision therapy and use of optical devices such as prismatic (prism) lenses has demonstrated benefit for those with mTBI, skepticism exists around efficacy and the lasting benefit of this therapy.

Objective: Changes in the scores on the Concussion Grading Scale (CGS), Dizziness Handicap Inventory (DHI), and Pain Catastrophizing Scale (PCS) before and after initiation of prism glasses therapy were analyzed in a sample of patients who also attended optometric vision rehabilitation with a registered neuro-optometrist.

Methods: Subjects were selected from a pool at Advance Concussion Clinic (ACC), an interdisciplinary clinic in Vancouver, Canada. Inclusion criteria required subjects having sustained an mTBI in the last 5 years, and be attending interdisciplinary treatment at ACC, with regular outcome measure (OM) administration during rehabilitation, including 1 administration before prism lenses and 2 administrations post.
A retrospective chart review was conducted. Paired 2-sample T tests compared means between time point 1 (t1) and time point 2 (t2), and means between t1 and time point 3 (t3) to determine how time with prism lenses affected OM reporting. Mean time of OM administration before prism glasses (t1) was 1.75 months, and mean time after prism glasses (t2 and t3, respectively) was 0.75 months and 3.25 months.

Results: The population consisted of 4 patients (75% female) (mean age = 50.5 years). The results of the analysis on DHI (t1 vs. t2) was t(3) = 1.67, p = 0.096, and on DHI (t1 vs. t3) was t(3) = 3.23, p = 0.024. CGS and PCS p-values were not found to be significant across t1 vs t2, or t1 vs t3. Average DHI scores decreased from “moderate” to “mild” after administration of prism glasses. CGS scores remained “very high.” Average PCS scores changed from 48%(t1), to 41%(t2) and 21%(t3), which while not statistically significant, was clinically meaningful.

Conclusion: Our results indicate a statistically significant difference in DHI scores between t1 and t3 after initiation of prism glasses. This indicates the potential for prism glasses to improve the mTBI patient’s dizziness and associated symptoms, which holds immeasurable value to their quality of life. A larger sample size and longitudinal data would be beneficial to elucidate the effects of vision therapy and prism glasses on mTBI treatment. Given the complex and challenging nature of concussion recovery, it could be detrimental to exclude a potentially valuable and effective therapy from an mTBI patient’s rehabilitation program.

179 Understanding Concussion in Terms of Complexity: A Cluster Analysis Approach to Help Facilitate Interdisciplinary Management
Alexandra Harris*, Aliya Babul*, Danit Macklin*, Samuel Rosenblatt*, Julia Dahlby*, Kostas Ikonomou*, Benjamin Freedman*, Cirelle Rosenblatt*ab

*a Advance Concussion Clinic, Vancouver, Canada, b University of British Columbia, Vancouver, Canada, c Balance and Concussion Therapy Center, Teaneck, United States

ABSTRACT
Introduction: The importance of subtyping concussion has evolved in response to evidence of its greater complexity. The delineation of these specific symptom areas, or post-concussion disorders, are critical to understanding both the particular features of an individual’s injury, as well as informing targeted rehabilitation pathways.
Objective: To determine whether a bottom-up, unsupervised machine learning approach, could provide insight into different concussion clinical profiles.
Methods: In this retrospective study design, initial intake data from a battery of self-report outcome measures were extracted from the Advance Concussion Clinic’s database, including the Patient-Reported Outcomes Measurement Information System (PROMIS v2.1), Dizziness Handicap Inventory (DHI), and Immediate Post-Concussion Assessment and Cognitive Test (ImPACT). A correlation matrix extracted redundant features (r > 0.55), that were subsequently removed from the analysis. Principal component analysis (PCA) further reduced the dimensionality of the dataset. Sklearn’s agglomerative clustering algorithm was then applied on the identified principal components. The maximum Silhouette score and minimum Davies Bouldin score were used to determine the optimal number of clusters within the data set. Group differences were evaluated using Mann-Whitney U tests.
Results: The mean age of participants was 35.66 ± 15.12 years. PROMIS parameters retained by the correlation matrix were: pain interference, fatigue, depression, anxiety, sleep disturbance, physical function and social function as well as pain intensity on a numeric score. From DHI, the total score and DHI Functional subgroup were retained. ImPACT scores for reaction time, visual-motor processing speed, and verbal memory were also used. The PCA reduced the dataset from 14 features to two features. Sklearn’s agglomerative clustering algorithm determined the optimal number of clusters was five (Silhouette score: 0.36, Davies Bouldin score: 0.83). Mann–Whitney U tests revealed statistically significant differences across all assessments in each of the determined cluster profiles (p < 0.0001).
Conclusion: The five clusters identified represented clinically distinct and statistically significant concussion subtypes. Each of the five clusters were retained measures from PROMIS (pain interference, fatigue, depression, anxiety, sleep disturbance, physical function and social function, pain intensity), DHI (total score and Functional subgroup) and ImPACT (reaction time, visual-motor processing speed, verbal memory). When compared to normative values, the derived clusters were best understood according to levels of complexity, ranging from Extremely Complex to Minimally Complex. Notably, this formulation of concussion subtypes is based on self-administered instruments, addressing the need to improve access to psychoeducation about injury, the opportunity for recovery, and direction towards interdisciplinary treatment targets. Understanding concussion in terms of complexity, with the utilization of AI, sets the stage for a more accurate concussion classification or subtype paradigm that better approximates its true heterogeneity and complex system disruptions.

181 Diffusion Tensor Imaging and Neurite Orientation Density Dispersion Imaging Analysis of Post-traumatic Headache
Yasushi Shibata*, Sumire Ishiyama b

a University Of Tsukuba, Mito, Japan, b Tsukuba University Of Technology, Tsukuba, Japan

ABSTRACT
Purpose: Post-traumatic headache is a complicated disorder. Magnetic resonance imaging (MRI) typically shows no or only mild injury despite patients complaining of severe sustained headache. In this study, we applied a new MRI technique involving diffusion tensor imaging (DTI) and neurite orientation density dispersion imaging (NODDI) in patients with
post-traumatic headache. The purpose of this study was to establish an objective diagnostic method for post-traumatic headache and to discover its pathophysiology.

Patients: Twelve post-traumatic headache patients (seven male and five female patients; mean age at 53.4 years old), 5 traumatic patients without headache (five males, mean age at 64.8 years old) and 9 age-matched healthy control (four males and five females, mean age at 58.6 years old) were included in this study.

Methods: Whole-brain DTI and NODDI scans were analyzed using tract-based spatial statistics for all patients. Regions of interest (ROIs) were placed at the splenium, body and genu of the corpus callosum, and the mean fractional anisotropy (FA) was measured. Healthy (age matched) volunteers underwent the same imaging. Informed consent was obtained from all patients and healthy volunteers. This study was approved by the internal review board and registered as a clinical trial in the UMIN Clinical Trial Registry. Statistical analyses were performed using the SPSS software program. Age was analyzed using a t-test, sex using a chi-square test and FA using the Mann–Whitney U-test.

Results: Tract-based spatial statistics and ROI analyses showed no significant differences in DTI findings and the FA between patients and healthy volunteers. The patients with post-traumatic headache demonstrated lower orientation dispersion at brain stem and cerebellum comparing with the traumatic patients without headache.

Discussion: Our study demonstrated the possibility of the disturbance of orientation dispersion as the pathophysiology of post-traumatic headache. The limitations of our clinical study were the retrospective design, small patient number and heterogeneity of symptoms, trauma type and duration from trauma to imaging. Social and psychological factors may have influenced the headache symptoms. A large prospective study will therefore be needed to control these variables. However, post-traumatic headache is relatively rare, so a preclinical animal study may be performed instead.

Conclusion: We performed DTI and NODDI analysis in patients with post-traumatic headache and traumatic headache without headache. The disturbance of orientation dispersion may be the pathophysiology of post-traumatic headache.

182 Teaching Educators about ABI: Evaluating the Usability of the Teach-ABI Module

Lauren Salvo, Hiba AlHakeem, Rhonda Martinussen, Shannon Scratch

Bloorsview Research Institute, Toronto, Canada; Ontario Institute for Studies in Education, University of Toronto, Toronto, Canada; University of Toronto, Toronto, Canada

ABSTRACT

Background: Acquired brain injury (ABI) is a leading cause of death and disability in children. After sustaining an ABI, many children experience lasting cognitive, physical, psychosocial, and communication outcomes, which may have a substantial impact on educational outcomes. In Canada, there is a significant gap in educators’ knowledge of ABI and preparedness to support students with ABI, as ABI is not recognized as a category of exceptionality and educators do not receive any formal training. An interdisciplinary team of experts collaborated to develop an interactive virtual module, Teach-ABI, to introduce paediatric ABI and strategies for supporting students with ABI in the classroom.

Objective: To evaluate teachers’ satisfaction with the Teach-ABI module and the impact of the module on teachers’ knowledge and confidence related to ABI, before conducting a broad-scale implementation initiative across Ontario.

Design: Two-phase evaluation study. The first phase of evaluation involved a mixed methods usability study to determine educators’ satisfaction with the navigation, content, and design of the module, as well as any suggestions for improving the module. Eight participants engaged in a virtual usability session over Zoom. The module review followed a think-aloud protocol, in which participants were asked to share what they were thinking, feeling, and doing as they navigated the module. After reviewing the module, participants completed the System Usability Scale and a semi-structured exit interview. The second phase of evaluation will involve a mixed methods pilot study focused on educators’ knowledge change, which will commence in Spring 2021.

Results: Qualitative content analysis revealed that the teachers were very satisfied with the module content, design, and navigation. They provided minor suggestions for improvement, which were used to revise the module before beginning the pilot study. The average score on the System Usability Scale was an A+, which indicates that the module is highly usable. Furthermore, the teachers were very engaged with the module content (reflecting and responding to content, evaluating content) as they navigated the module, and discussed the module’s ability to fill a gap in their training and impact their understanding of ABI. These findings will be explored further in the pilot study.

Conclusions: The present study contributes to the development and implementation of a virtual intervention that is the first of its kind. Testing the usability of the Teach-ABI module represented a crucial step in ensuring that it is co-created with teachers, the end users, to promote the uptake of the information. The long-term goal of the Teach-ABI program is to improve educational experiences and outcomes for children with ABI and their families across Canada and internationally.

183 Serial Intracranial Pressure Management in Traumatic Brain Injury Patients: Hypertonic Saline Treatment Given in Bolus via an Innovative Catheter System

Reagan Collins, Hector Garcia, Jeannie Lee, Benedicto Baronia

Texas Tech University Health Science Center School of Medicine, Lubbock, United States; Texas Tech University Health Science Center, Department of Neurology, Lubbock, United States; Texas Tech University Health Science Center,
Department of Surgery, Lubbock, United States,  dTexas Tech University Health Sciences Center, Department of Pediatrics, Lubbock, United States

ABSTRACT
Objective: The purpose of this study is to monitor intracranial pressure (ICP) change among patients with traumatic brain injury (TBI) treated with boluses of hypertonic saline.
Methods: Patients who present to the emergency department of the University Medical Center (UMC) with a TBI, indications for osmotic therapy, and need for close ICP monitoring will be selected for this study if they meet all other inclusion criteria. An external ventricular drain (EVD) will be placed for ICP monitoring; specifically, the IRRAflow® will be used as its innovative dual-lumen catheter system will allow administration of hypertonic saline (3%) as well as act as a drain to evacuate any fluid. 1 mL bolus of hypertonic saline will be administered every 30 seconds for a total of 2.5 minutes. ICP will be monitored in real time as the IRRAflow® allows for a continuous ICP reading. Serial ICP changes can be used as a measurement to aid in determining when osmotic therapy is no longer needed.
Results: Osmotic therapy, whether it is mannitol or hypertonic saline, has generally been administered via a central line catheter for TBI patients with the goal to minimize cerebral edema. The irrigation-style of the IRRAflow® EVD allows for a more direct administration of osmotic therapy. Prior studies using a combined delivery and evacuation catheter allowed for administration of antibiotics for ventriculitis treatment with successful results. This dual system has also been used to prevent blood clots in patients with subdural hematomas that were evacuated via an EVD after craniotomy.
Conclusions: The ability to administer hypertonic saline while evacuating fluid in TBI patients provides a new approach to osmotic therapy. Prior studies have incorporated this model to deliver treatment to the source of infection or to access and evacuate the source of active bleeding. The ability to apply this model to TBI patients may allow for more accurate assessment of ICP, determination of ICP response to hypertonic treatment, and management of TBI patients in a more proactive approach.

184 Elevated Rate of Head Impacts at Time of Injury in Concussed NCAA Division I American Football Players: Findings From the NCAA-Dod CARE Consortium

Jack Seifert, Alok Shah, Jaroslav Harezlak, Hiroki Naganobori, Jared Muench, Steven Rowson, Stefan Duma, Kevin Guskievicz, Jason Mihalik, Larry Riggen, Alison Brooks, Christopher Giza, Joshua Goldman, Gerald McGinty, Jonathan Jackson, Kenneth Cameron, Megan Houston, Paul Pasquina, Steven Broglio, Thomas McAllister, Michael McCrea, Brian Stemper

Medical College Of Wisconsin, Milwaukee, United States,  bMarquette University, Milwaukee, United States,  cClement J. Zablocki Veterans Affairs Medical Center, Milwaukee, United States,  dIndiana University School of Public Health, Bloomington, United States,  eVirginia Tech, Blacksburg, United States,  fUniversity of North Carolina at Chapel Hill, Chapel Hill, United States,  gUnited States Air Force Academy, Colorado Springs, United States,  hUnited States Military Academy, West Point, United States,  iUniformed Services University, Bethesda, United States,  jUniversity of Michigan, Ann Arbor, United States,  kIndiana School of Medicine, Indianapolis, United States,  lUniversity of Wisconsin, Madison, United States,  mUniversity of California Los Angeles, Los Angeles, United States

ABSTRACT
Repetitive head impact exposure (RHIE) is a mechanism for concussion in contact sports. Head impact frequency and severity are thought to influence the risk and severity of incident concussion. Whereas prior studies focused specifically on the severity and number of head impacts leading up to concussion report, the number of impacts over time (i.e., RHIE) requires additional attention. This study compared the RHIE for NCAA division I athletes on their injury date versus all other contact sessions in which they participated. Based on previous findings from our group, it was hypothesized that concussed athletes experience an elevated RHIE on their injury date.

During the 2015–2019 NCAA American football competition seasons, athletes from six NCAA Division I programs wore helmets equipped with helmet-mounted accelerometer arrays for every contact session (i.e., game, scrimmage, contact practice) in which they participated. Impact time and impact accelerations were recorded for all head impacts. The time difference on days we recorded an incident concussion (i.e., ‘time delta’) was computed as the difference between the session’s first head impact up to and including the suspected concussive event. The number of head impacts over an athlete’s time delta was compared to the number of head impacts they experienced over the same time delta during all other sessions from the season of injury.

Over five competition seasons (2015–2019), a total of 78 concussions were sustained by 71 different athletes from six different NCAA Division I football teams. When comparing the number of head impacts at the time of concussion for each of the 78 concussions to the number of impacts over the same time delta in every other contact session for that player’s season, 59 concussions (76%) occurred at or above the 75th percentile of head impacts, 43 concussions (55%) occurred at or above the 90th percentile of head impacts, 25 concussions (32%) occurred at or above the 95th percentile of head impacts, and 15 concussions (19%) occurred at or above the 99th percentile.

The session RHIE was predicted to be elevated in athletes on the date of their concussion relative to their RHIE in all other contact sessions where a concussion was not sustained. Our findings agreed with this hypothesis and demonstrated that most athletes experienced an elevated rate of RHIE from the first recorded head impact to the time of their concussion than over the same period from every other contact session in their season of injury. Identifying athletes at elevated concussion risk remains a primary goal for sports medicine stakeholders.
These results indicate that monitoring transient elevations in session-based RHE may be a factor in identifying athletes who may be susceptible to incident concussion.

186 Long Term Risk for Mood and Anxiety Disorders after Pediatric Traumatic Brain Injury: A Population-Based, Birth Cohort Analysis

Dmitry Esterov, Julie Witkowski, Allen Brown, Amy Weaver, Dana McCall

ABSTRACT

Introduction: While an association between pediatric traumatic brain injury (TBI) and increased psychiatric symptoms early after injury has been widely described, the long-term risk of mood and anxiety disorders remains unclear. To better understand the long-term association between early childhood TBI and risk of development of mood and anxiety disorders, we conducted a population-based birth cohort study, comparing individuals with TBI prior to age 10 to two age- and sex-matched referents from the same birth cohort, to determine the risk of subsequent development of mood and anxiety disorders by age 25.

Methods: This population-based study utilized a birth cohort of 5,518 individuals born from January 1, 1976 through December 31, 1982. TBI cases prior to age 10 ("index date") were identified electronically using an exhaustive list of diagnostic codes and manually confirmed and classified by injury severity using the Mayo Classification System for TBI Severity. Each TBI case was matched to two sex- and age-matched referents from the same birth cohort with no history of TBI prior to the index date. Clinical diagnostic codes prior to age 25 were electronically obtained and classified into an anxiety, mood, or bipolar diagnosis, and then each diagnosis was manually confirmed. Cox proportional hazards regression models were fit to estimate the association between childhood TBI status and being diagnosed with the psychiatric condition of interest, adjusting for the child’s race and mother’s age and education level at the child’s birth. Associations were summarized using hazard ratios (HRs) and corresponding 95% CIs.

Results: Among 561 TBI cases, >98% had Mayo Classification Possible/Probable (consistent with mild/concussive) TBI. 115 TBI cases and 215 matched referents were diagnosed with at least one anxiety, mood, or bipolar diagnosis. There was no significant association between childhood TBI status and anxiety (adjusted HR 1.01, 95% CI 0.71–1.43, p = 0.97). The risk of a subsequently diagnosed mood disorder (bipolar or depression) was 16% higher in individuals who experienced a childhood TBI compared to referents, however, this association was not statistically significant (adjusted HR 1.16, 95% CI 0.92–1.47, p = 0.21). When the cohort was stratified by sex, a significantly increased risk of a subsequently diagnosed mood disorder in individuals with a childhood TBI compared with referents was observed among females (adjusted HR 1.40, 95% CI: 1.04–1.89, p = 0.025) but not among males (adjusted HR 0.91, 95% CI: 0.61–1.36, p = 0.65), although, this difference in risk was not statistically significant based on the test for interaction (p = 0.12).

Conclusions: In this population-based sample of predominantly mild/concussive TBI, isolated TBI prior to age 10 was not significantly associated with an increased risk of anxiety or mood disorder by age 25. Further studies are needed to identify certain individuals at increased risk, and to further understand sex differences in outcomes.

187 Controversy on Amantadine Use in Patients with Disorders of Consciousness: An IBIA DoC SIG International Survey and Recommendations

Marie-Michele Briand, Nicolas Lejeune, Nathan Zasler, RITA Formisano, Olivier Bodart, Anna Estraneo, Wendy Magee, Aurele Thibault

ABSTRACT

Introduction: Treatments in patients with disorders of consciousness (DOC) are limited (Thibault et al., 2019). In 2012, Giacino et al. published a randomized controlled trial and demonstrated the positive effect of Amantadine in patients with DOC. The Amantadine group, compared to the Placebo group, had a significantly faster functional recovery during the 4-week treatment period when measured by the disability rating scale (DRS) and the coma recovery scale-revised (CRS-R). In this study, medical complications were common in both groups, but no significant difference was reported between them. Since 2012, Amantadine has been recommended in many DOC clinical guidelines (e.g., Aan, 2018) prompting more frequent use among clinicians. Over time, some clinicians suspected a cause-and-effect relationship between Amantadine and myoclonus/epileptic seizure as reported in the Amantadine drug leaflet/pdr. Amantadine related epileptic myoclonus has been described in a single chronic patient with DOC (estrangeo et al., 2015).

Methods: To learn about Amantadine use in patients with DOC, a cross-sectional online survey on epilepsy in DOC was e-mailed to physician members of the International Brain...
Injury Association’s working with persons with DOC. The survey included 32 questions from which 8 were dedicated to Amantadine. The results of these 8 questions are reported in this study.

Results: from the 50 physicians who completed the survey, 43 answered the questions related to Amantadine (10 neurologists, 9 neurosurgeons, 18 psychiatrists and 6 from other specialties). The majority of responders frequently prescribed Amantadine (31/43-72.1% although less so in patients with epilepsy 27/43-62.8%) and/or EEG-based epileptic abnormalities (24/43-55.8%). When Amantadine was prescribed regardless of the presence of epileptic disorders, the strategies for starting dosages and incremental titration rates varied among responders. Variability was also noted in how clinicians proceeded when seizures occurred while on Amantadine. Only a minority of responders frequently experienced seizures in their patients with DOC with Amantadine use (2/43-4.7%). Nonetheless, up to 23/43-53.5% suspected a potential causal relationship between Amantadine use and breakthrough seizures.

Conclusion: Amantadine is a recommended medication for patients with DOC. A majority of clinicians surveyed expressed concerns regarding an association between Amantadine and seizures/myoclonus as well as the lack of literature on the subject. In addition, significant discrepancies existed among the responders regarding Amantadine decision-making in this patient population.

Recommendations:

- Amantadine should be prescribed in patients with DOC at low risk of seizures and with normal EEG.
- Amantadine should be used carefully with patients with DOC known to experience seizures/myoclonus, EEG-based epileptic abnormalities or significant seizure risk.
- For patients with DOC at risk for seizures, low dosage with slow titration of Amantadine rate is recommended.
- If seizure occurs while on Amantadine, withdrawal is recommended. Additionally, the association should be challenged and documented while respecting the risks versus benefits.

188 Predictors of Mental Health after Pediatric Concussion

Alice Gornall1, Michael Takagi1, Franz Bab1, e, f, Gavin Davis1, Katie Davies1, Kevin Dunne1, e, f, Nicholas Anderson1, Peter Barnett1, e, f, Stephen Hearps1, Vanessa Rausa1, Vicki Anderson1, e, d

1Murdoch Children’s Research Institute, Parkville, Australia, 2Psychological Sciences, Monash University, Melbourne, Australia, 3Psychology Service, Royal Children’s Hospital, Melbourne, Australia, 4School of Psychological Sciences, University of Melbourne, Melbourne, Australia, 5Department of Paediatrics, University of Melbourne, Melbourne, Australia, 6Emergency Department, The Royal Children’s Hospital, Melbourne, Australia

ABSTRACT

Objectives: Children frequently report mental health difficulties after concussion, however, relatively little is known about the extent to which these may be precipitated or exacerbated by concussion. The present study aimed to address this gap by exploring psychological predictors of mental health difficulties after pediatric concussion.

Methods: One-hundred and fifteen children (5 to <18 years) with concussion were recruited in a single site longitudinal prospective cohort study conducted at a tertiary children’s hospital in Melbourne, Australia. Parents completed a pre-injury demographic questionnaire during emergency department admission within 48 hours of the concussion. Parents reported mental health symptoms 2-weeks and 3-months post-injury using the Child Behavior Checklist.

Results: Pre-injury factors accounted for 22.5–40.1% of mental health outcomes 2-weeks post-injury, and 31.5–36.3% of mental health outcomes 3-months post-injury. The presence of concussion symptoms prior to injury (e.g., headaches, nausea, irritability, sleep disruptions) consistently predicted mental health at 2-weeks and 3-months post-injury. Among children with pre-injury psychiatric diagnoses, higher ratings of pre-injury concussion symptoms were associated with more internalizing problems after concussion (e.g., anxiety, withdrawal, depressive symptoms). Pre-injury learning difficulties, pre-injury psychiatric diagnoses, family psychiatric history, lower resilience, and female sex were also associated with greater mental health symptoms after concussion. Mental health at 2-weeks strongly predicted mental health 3-months post-injury.

Conclusions: Concussion may both precipitate and exacerbate mental health difficulties after concussion. There is a close association between mental health in the acute and post-acute stages after concussion, therefore, early intervention should be prioritized. Understanding children’s mental health on an individual level in their broader social, developmental, and psychological context is key to clarifying factors maintaining mental health difficulties and tailor interventions accordingly.

189 Planning and Implementing an Online Cognitive Community to Develop Compensatory Skills: A Collaborative Approach

Michelle Ranae Wild, Annie Ricketts, Lisa Hirsch, Kristi Kragtorpe

1Brain Education Strategies & Technology, Laguna Hills, United States, 2Global Brain Injury Awareness, Bembridge, United Kingdom

ABSTRACT

There is a gap between the offerings of online support groups and the practical skills needed by brain injury survivors in their everyday lives. Online support groups typically provide
emotional support related to adjusting to injuries. We propose a novel community intervention: an online cognitive community specifically designed to help and develop compensatory skills and strategies for brain injury survivors. After an acquired brain injury there is a high correlation between effective rehabilitation strategies learned and community reintegration (Mahar & Fraser, 2011b). Community reintegration may involve many barriers. Common challenges include executive dysfunction and emotional dysregulation (Mahar & Fraser, 2011a). Reintegration can be facilitated with cognitive rehabilitation as an intervention, including the learning of compensatory skills and strategies that can be implemented at any stage of the recovery process (Tsoussides & Gordon, 2009).

This presentation describes our process of planning and implementing an online cognitive community, Brain Injury Cognitive Skills & Technology (BI-CST). BI-CST is a collaboration of two nonprofits, Global Brain Injury Awareness (UK) and Brain Education Strategies and Technology (USA) that formed a Facebook group to provide compensatory skills to overcome common cognitive challenges in brain injury survivors. The founders of this group are uniquely qualified to lead the efforts in patient-centered skill building for brain injury survivors due to their expertise in education, medicine, industry, and lived experience with brain injury. Our target audience is the brain injury community which includes survivors with cognitive issues, their families, caregivers, and rehab professionals. The group provides an opportunity to learn about brain injury and strategies to deal with cognitive deficits via accessible live and recorded webinars and members only activities. The focus of this group is on cognitive education rather than emotional support. We propose our community intervention encourages motivation to participate due to the expectation of positive cognitive, emotional, and psychosocial outcomes.

190 Cyberscams and Acquired Brain Injury: A Qualitative Exploration of the Lived Experience of Survivors and Close Others

Jao Carminati, Jennie Ponsford, Kate Gould

ABSTRACT

Objectives: People with acquired brain injury (ABI) may be particularly susceptible to online scams due to cognitive and psychosocial impairments commonly experienced after ABI. Despite this, there is little understanding of the lived experiences of ABI cyberscam survivors and their close others. This is an essential precursor for the design of much needed interventions. This study therefore aimed to qualitatively explore cyberscams from the perspectives of survivors with ABI and their close others.

Method: Participants were cyberscam survivors with ABI (n = 7) and their close others (n = 6). Semi-structured interviews were conducted, with questions relating to the scam experience, impacts, vulnerabilities and interventions. Interviews were transcribed and analysed using Braun and Clarke’s (2006) six-phase reflexive thematic analysis technique. Results: The most common scam types were romance and service-provider phone scams. Seven themes were identified: “who is at the helm: vulnerabilities,” “the lure: scammer tactics,” “scammers aboard: scam experience,” “the discovery,” “sinking in: impacts,” “responding to the mayday: responses from others,” and “lifesavers: suggestions for intervention.” ABI-related difficulties increased scam vulnerability and complicated scam discovery and acceptance. Scams led to substantial financial loss, family conflict and emotional distress. Family members and external supports faced difficulty in assisting scam recovery and future scam prevention, leading to scam revictimisation cycles. Participants expressed a strong desire for cybersafety resource development, including capacity building for both people with ABI and their support networks. Conclusions: Cyberscams resulted in detrimental practical and emotional impacts for ABI cyberscam survivors and their family members and friends. Findings emphasize the need for further cyberscam awareness campaigns and targeted education in order to de-stigmatise and improve online safety for people with ABI.

191 The Association of Padded Headgear with Concussion and Injury Risk in Junior Australian Football: A Prospective Cohort Study

Jennifer Makovec Knight

Monash University, Clayton, Australia

ABSTRACT

Objectives: To assess whether padded headgear (HG) was associated with incidence of sports-related concussion (SRC), non-SRC head injury, and injuries to all body regions in junior Australian football. Design: Prospective cohort injury surveillance. Methods: 400 junior players (42.5% female) were enrolled across two seasons. Data on HG use, SRC, non-SRC head injury and injuries by body region were collected, with medical assessment and missed matches used as surrogates for injury severity. A multivariable logistic regression model was used to assess variables associated with injuries. Results: Twenty teams were monitored over 258 matches. Two hundred and four players (2,484 player hours) used HG throughout the season, and 196 (2,246 player hours) did not. The incidence rate of SRC was 3.17 (95% CI: 3.04–3.30) per 1000 player-hours and no differences were observed between males and females (RR 1.11; 95% CI: 0.40–3.06). HG use was not associated with reduced SRC (RR 1.09; 95% CI: 0.41–2.97), medical assessment (RR 1.44; 95% CI: 0.24–8.53) or missed matches for SRC (Risk difference 0.02; 95% CI: −0.00–0.03). No matches were missed for non-SRC head injury and HG use was not associated with non-SRC head injury risk (RR 0.52;
95% CI: 0.27–1.03) or medical assessment for non-SRC head injury (RR 0.27; 95% CI: 0.06–1.31). Adjusted for potential confounders, HG use was associated with increased odds of sustaining injuries to all body regions combined, adjusted OR 1.71; 95% CI: 1.02–2.82.

Conclusions: Currently available HG was not associated with lower risk of SRC or non-SRC head injury. There was suggestion of an association between HG use and PDC observed Match Injuries to all body regions.

193 Functional Ability, Anxiety and Participation in Children with and without Cerebral Palsy: Does Anxiety Mediate?

Chloe Howse\textsuperscript{a,b}, Qoutof Al Kindi\textsuperscript{a,b}, Peter Tucker\textsuperscript{a,b}

\textsuperscript{a}Recolo UK Ltd, London, United Kingdom, \textsuperscript{b}University of Bristol, West of England, United Kingdom

**ABSTRACT**

Objectives: Participation is a key rehabilitation outcome in children with cerebral palsy (CP). However, research is mixed concerning the impact of emotional difficulties on participation, with anxiety receiving little attention. Understanding the factors which impact participation is crucial to enhance the involvement and quality of life of children with CP. This study aimed to investigate impact of anxiety on the relationship between subjective functional ability and participation.

Methods: This investigation was a cross-sectional, between-subjects design which utilised an online survey. Parents of children with (n = 19, mean age = 12.26, s.d. = 2.75) and without CP (n = 17 n = 17, mean age = 11.06, s.d. = 3.84) aged between 5 and 17 years of age were recruited and the Child Adolescent Scale of Participation, Pediatric Quality of Life Inventory, and Spence Children’s Anxiety Scale were administered.

Results: Parental reports of children with CP’s participation were significant lower in comparison to typically developing children (U = 318.50, z = 5.03, p < .001). Additionally, parent-reported functional ability significantly predicted participation, F (1, 17) = 10.06, p = .006. However, neither total anxiety (BCa 95% CI [−11, .09]) nor separation anxiety (BCa 95% [−.13, .08]) significantly mediated this relationship.

Conclusions: These findings support participation as a key consideration for clinicians working in neuropsychological rehabilitation. Further research is needed to investigate the impact anxiety, especially separation anxiety may have on participation in children with CP.

194 Making Housing More Accessible: Perspectives of People with Physical Impairment, Occupational Therapists and Architects

Di Winkler\textsuperscript{a}, Jacinta Douglas\textsuperscript{b}, Kate D’cruz\textsuperscript{a}, Isabella Goodwin\textsuperscript{a}, Cornelia Wellecke\textsuperscript{a}, Elise Davis\textsuperscript{a}, Peter Mulherin\textsuperscript{a}

\textsuperscript{a}Summer Foundation, Box Hill, Australia, \textsuperscript{b}La Trobe University, Melbourne, Australia

**ABSTRACT**

Objectives: This study provided a professional and lived experienced perspective on the design features being considered for inclusion as minimum accessibility standards in the 2022 National Construction Code (NCC) in Australia. The aim of the project was to examine the cost, difficulty, importance and impact of incorporating accessible design features into the design of homes of people with physical impairment.

Methods: Three separate online surveys were conducted to examine the importance and impact of accessible design features. These included a) a survey of 24 architects and access consultants to explore the cost and difficulty of incorporating accessible design elements into new builds; b) a survey of 145 people with physical impairment (including people with an acquired brain injury and neurological impairment) on the changes people would make to their own home and others’ homes; and c) a survey of 144 occupational therapists to examine the impact of accessible design features on hospital discharge and ageing in place.

Results: The results demonstrated many design features, including width of pathway to entrance, shower size, height of switches and slip resistant flooring are neither difficult nor costly to incorporate at the design stage into new houses, apartments and townhouses. From the perspective of people with mobility impairment and occupational therapists the following accessible design features were identified as the most important: step-free entrance to the home and large step free shower access. Wider internal passageways, level access throughout the home and inclusion of bathroom/bedroom downstairs were also identified as of importance, especially for wheelchair users. Survey respondents, inclusive of people with mobility impairment and occupational therapists, highlighted the importance of accessible design to facilitate access, inclusion and safety within the home with concerns raised about hospital discharge to homes in which people with mobility impairment cannot safely exit in an emergency.

Conclusions: The results demonstrated that many accessible design elements are not costly or difficult to incorporate pre-build and would not only enhance the lives of people with physical impairment but may also reduce hospital day bed costs and better enable older people to age in place. The study also identified a set of accessible design features that are most important to consider as mandatory requirements for minimum access design in the NCC. Inclusion of the design features identified as important by those with lived experience and professionals will make housing more accessible for all Australians.

195 Altered Cognitive Abilities in Children with Multiple Sclerosis: Evidence from Meta-analyses

Elena Lysenko\textsuperscript{a}, Maria Bogdanova\textsuperscript{b,c}, Marie Arsalidou\textsuperscript{a,d,e}

\textsuperscript{a}Neurobiological Foundations of Cognitive Development – Neuropsy Lab, HSE University, Moscow, Russian Federation, \textsuperscript{b,M.S. Sochenov First Moscow State Medical University (Sochenov University), Ministry of Health of Russia, Moscow, Russian Federation, \textsuperscript{c}Research and Clinical Center of Pediatric
ABSTRACT
Multiple sclerosis (MS) is a chronic, inflammatory disease with progressive neurodegeneration. A pediatric-onset multiple sclerosis is a rare form of MS, expressed when the manifestation of disease starts before 18 years of age. Cognitive impairment is more frequently observed in children with MS, compared to adults with MS. Many studies demonstrate a significant decline in the performance of children on intelligence measures, however, results on processing speed are not consistent across studies. The purpose of this study is to examine using quantitative meta-analyses the effect size of performance differences between children with and without MS on overall intelligence and information processing speed. Our literature search with relevant keywords yielded a total of 1590 articles. A series of selection criteria were applied to identify eligible articles that reported behavioral scores for children with and without MS. We used Hedges’ g to analyze data from fourteen studies that examined intelligence, information processing speed, or both. Results show that children with MS show lower scores on general intelligence and slower speeds for information processing than typically developing children. The effect is robust (g = 0.85) for general intelligence, and moderate for speed of processing (g = 0.57). Our findings confirm that cognitive abilities are significantly affected in children with MS, however, the degree of this effect is more robust for general intelligence. Theoretically, findings can contribute to neurocognitive models of development and practical results may inform clinical and educational practice that can benefit children with MS.

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196 Developing Social-ABI-ility: Using Social Media for Connection and in Rehabilitation After Brain Injury

Melissa Brunnera, Rachael Riedjikb, Petra Amramovicb, Melissamia, Emmapower, Leanne Toghera

aThe University of Sydney, Sydney, Australia, bThe University of Technology Sydney, Sydney, Australia

ABSTRACT
Objectives: Due to changes in cognition and communication following an acquired brain injury (ABI), many people experience a significant loss of friendships after their injury. Social media may offer an important way for people with an ABI to connect and might reduce some of the difficulty they can have in face-to-face conversations. People with brain injury have reported experiencing challenges in using social media and rehabilitation professionals have described being inadequately prepared to support them in its use. Standard speech pathology clinical practice is yet to include social media skills training. However, we know that rehabilitation after a brain injury should target social media use and include explicit instruction targeting communication, participation, and risk management. In 2020, people increasingly used the Internet and social media for work, education, and to connect socially. It was apparent that interventions and resources to support people with ABI and rehabilitation clinicians were desperately needed. This research aimed to develop a co-designed, evidence-based resource for people with ABI to learn about using social media safely after their injury.

Methods: An online self-guided course, social-ABI-ility, was developed for people with brain injury to learn skills in using social media safely and meaningfully. The development of the course included (a) a scoping review to identify key features of and any effective teaching approaches from existing social media skills training programs, (b) planning of course content using a co-design approach with stakeholders and people with lived experience of ABI, and (c) a pilot of the course involving 5 participants with ABI interested in improving their skills who reviewed the course and provided feedback from their perspective.

Results: No social media training resources were readily available for people with brain injury. Key recommendations for course design were identified in the scoping review, with training to be interactive and include practical components addressing online safety, and how to use platforms and connect with others. Target behaviors identified in the scoping review included: social participation, professional use (e.g., for employment or social marketing), cybersafety, social media (or information and communications technology) knowledge or use including content creation, and wellbeing. The online course components were proposed around these concepts with codesign participants’ feedback incorporated into the design and development of the course prior to the pilot study. Following the pilot, the social-ABI-ility course was further refined.

Conclusions: The social-ABI-ility self-directed online course is the first of its kind to support people with brain injury in using social media after their injury. The resource may drive sustainable change through helping people with brain injury to build their own social media mastery and participate in supportive online networks.

197 Influence of Symptom Burden, Neurocognitive, Vestibular-Ocular-Motor (VOM) and Academic Impairment on Time to Return To Play Following a Sports-Related Concussion (SRC)

Kerry Glenond, Glen Blenkinsopd, Antonio Belli, Matthew Pain
dLoughborough University, Loughborough, United Kingdom, eUniversity of Birmingham, Birmingham, United Kingdom
ABSTRACT
Objective: Determine if symptom burden, neurocognitive, vestibular-ocular-motor (VOM) and academic impairment within 14-days of a Sports-Related Concussion (SRC) is associated with a delayed Return To Play (RTP) in university student-athletes.

Methods: A prospective cohort study recruited rugby union university student-athletes. A baseline battery of tests was completed at preseason (July 2019–October 2020), consisting of a Perceived Academic Impairment Tool (PAIT) (modified 25 question, 0–6 Likert Scale, self-rated academic performance questionnaire), Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT), Post-Concussion Symptom Scale (PCSS) and Vestibular Ocular Motor Screening (VOMS). If a SRC was sustained, the battery was repeated at 2, 4, 8 and 14 days post-SRC, and the amount of academic time missed specifically due to SRC was recorded. Changes from baseline to reassessment time points for each test were analysed and used to define student-athletes as impaired or recovered, for both Reliable Change Indices (RCI) and poorer performance compared to baseline. Student-athletes were grouped into the long recovery group if they had not RTP within 30 days. A Quade’s ANCOVA was used to establish if RTP was different in those recovered or impaired and odds ratios to determine if there was greater risk of delayed RTP.

Results: During the season August 2019 to April 2020, 42 SRC were sustained among 40 individuals. Student-athletes with RCI decline or poorer performance on ImPACT did not longer to RTP. Results indicate a RCI increase in symptom burden delayed RTP at two, eight and 14 days post-SRC (2 days; 21.0 (20.0–32.0) Vs 26.0 (20.5–52.0) days, p = 0.035, OR = 2.400, 8 days; 21.0 (20.32.3) Vs 42.0 (24.0–88.5), p = 0.012, OR = 4.500, 14 days; 21.0 (20.0–37.0) Vs 64.5 (34.8–129.5), p = 0.031, OR = 7.364). RTP was delayed in those with RCI impairment in VOMS at 14 days (21.0 (20.0–35.5) Vs 45.0 (23.5–109.0), p = 0.012, OR = 3.333). Student-athletes with academic difficulty on PAIT took longer to RTP (2 days; 21.0 (20.0–26.0) Vs 27.0 (21.0–59.0), p = 0.024, OR = 4.889, 8 days; 21.0 (20.0–30.5) Vs 59.0 (22.0–109.0), p = 0.018, OR = 6.250). Greater risk of delayed RTP was seen in those with RCI impairment on near point convergence distance (2 days post-SRC: OR = 2.273 and 4 days OR = 7.364), contact academic time loss (2 days post-SRC OR = 6.923, 4 days OR = 1.538, 8 days OR = 1.667) and non-contact time loss (2 days OR = 1.778, 4 days; 2.111).

Conclusions: Using the PCSS, VOMS and measures of academic ability could help clinicians to identify those who may take longer to RTP. Clinicians may find this useful when setting RTP expectations and for coaches planning team selection.

198 Social Participation and Quality of Life as complementary measures to long-term Functional Outcome After Mild Traumatic Brain Injury in Elderly
Mayra Bittencourt^a, Hiela Rasul^b, Fatimah Aljassim^a, Jouke van der Naalt^a

^aUMCG, Groningen, Netherlands

Introduction: Mild Traumatic Brain Injury (mTBI) accounts for almost 85% of all TBI cases and approximately 25% of the patients are elderly. Although the Glasgow Outcome Scale is commonly used to assess functional outcome, few studies have assessed long-term outcome measures in elderly with mTBI. The aim of this study is to assess social participation and quality of life as complimentary measures of long-term outcome in elderly after mTBI.

Methods: Data from 155 elderly with mTBI (≥ 60 years) included in a prospective observational cohort study (UPFRONT-study) were investigated. Injury characteristics, age, education, sex, post-traumatic complaints and emotional distress were analyzed as predictive factors. Main outcome was determined 5 years post injury based on the Glasgow Outcome Scale (GOSE) and dichotomized into Complete Recovery (CR; GOSE = 8) and Incomplete Recovery (IR; GOSE<8). Social participation and quality of life were assessed as secondary outcome measures with the Communication Integration Questionnaire (CIQ) and WHO-Quality of Life scale (WHO-QoL), respectively. Univariate analysis and multivariate regression analysis were used to determine predictive factors. Significance threshold was set at p < 0.05.

Results: As determined by GOSE, 56% of the elderly showed complete functional recovery at 5 years, with half of patients exhibiting more than two complaints. Elderly with complete recovery scored higher on social participation compared to patients with incomplete recovery (p < 0.001). Education was found to be a significant predictor for functional outcome, whereas age and sex were predictive factors for social participation. Females scored higher than males on the domain home integration of social participation. Post-traumatic complaints were identified as predictive factors for all outcome measures (OR = 0.86; 95% CI: 0.79–0.93; p < 0.001).

Conclusion: This study shows that all of the three outcome measures provide consistent information on long-term outcome in elderly. Further research is recommended to integrate several outcome measures to a composite score and to evaluate scores on the social support, actual needs and financial situation among elderly with mTBI to gain more insight into determinant factors for long-term outcome.

199 Are Current Assessments for Concussion Enough to Holistically Manage the Student-Athlete Following a Sports-Related Concussion (SRC)?
Kerry Glendon^a, Glen Blenkinsop^a, Antonio Belli^b, Matthew Pain^a

^aLoughborough University, Loughborough, United Kingdom, ^bUniversity of Birmingham, Birmingham, United Kingdom

ABSTRACT
Objective: Determine if current cognitive assessments for Sports-Related Concussion (SRC) correlate with perceived academic ability.
Methods: A prospective cohort study recruited rugby union university student-athletes during preseason (July 2019-October 2019). Student-athletes completed the Perceived Academic Impairment Tool (PAiT) (a modified 25 question, 0–6 Likert Scale, self-rated academic performance questionnaire) and the Immediate Post-Concussion Assessment and Cognitive Testing (ImPACT). In the event of sustaining a SRC in the season (2019–2020), student-athletes repeated PAiT and ImPACT at 2, 4, 8 and 14 days post-SRC. The amount of academic time missed specifically due to SRC was recorded. This was separated into contact academic activities (seminars, laboratory sessions, lectures, tutor meetings) and non-contact academic activities (self-study, assignments, revision). Changes from baseline to reassessment time points for each test were analysed. Student-athletes were considered impaired if they had an increase in PAiT score, reported academic time loss, or had a change greater than already established Reliable Change Indices (RCI) on ImPACT’s composite tests.

Main Results: Academic impairment was reported on PAiT in some student-athletes following a SRC (54.8%, 33.3%, 21.4% and 16.7%). Some student-athletes were impaired on PAiT but not on ImPACT’s composites (verbal memory; 31.0%, 19.0%, 16.7%, 11.9%, visual memory; 35.7%, 23.8%, 16.7%, 16.7%, motor processing speed; 42.9%, 31.0%, 16.7%, 16.7%, reaction time; 45.2%, 26.2%, 14.3%, 11.9%). Conversely, some had impairment on ImPACT’s composites but not on PAiT (verbal memory; 11.9%, 26.2%, 28.6%, 14.3%, visual memory; 14.3%, 16.7%, 16.7%, 11.9%, motor processing speed; 9.5%, 0.0%, 4.8%, 28.6%, reaction time; 14.3%, 19.0%, 16.7%, 23.8%). Contact academic time loss (59.5%, 50.0%, 28.6% and 21.4%, at 2, 4, 8 and 14 days) and non-contact academic time loss (47.6%, 38.1%, 19.0%, 14.3%) was reported in this cohort. Some student-athletes had contact academic time loss but were not impaired on ImPACT’s composites (verbal memory; 35.7%, 26.2%, 14.3%, 16.7%, visual memory; 45.2%, 40.5%, 21.4%, 19.0%, motor processing speed; 47.6%, 47.6%, 23.8%, 21.4%, reaction time; 47.6%, 35.7%, 19.0%, 16.7%) and non-contact time loss but no impairment on ImPACT (verbal memory; 28.6%, 23.8%, 7.1%, 9.5%, visual memory; 35.7%, 28.6%, 14.3%, 11.9%, motor processing speed; 38.1%, 35.7%, 16.7%, 14.3%, reaction time; 38.1%, 28.6%, 9.5%, 14.3%). Conversely, some had impairment on ImPACT composites and no contact time loss (verbal memory; 11.9%, 16.7%, 19.0%, 23.8%, visual memory; 19.0%, 16.7%, 16.7%, 11.9%, motor processing speed; 9.5%, 0.0%, 4.8%, 0.0%, reaction time; 11.9%, 11.9%, 14.3%, 28.6%) or non-contact academic time loss (verbal memory; 16.7%, 26.2%, 21.4%, 23.8%, visual memory; 21.4%, 16.7%, 19.0%, 11.9%, motor processing speed; 11.9%, 0.0%, 7.1%, 0.0%, reaction time; 14.3%, 16.7%, 14.3%, 33.3%).

Conclusions: Using PAiT, measuring academic time loss, with traditional measures of neurocognitive impairment, such as ImPACT are needed to fully understand the implication of SRC on academic ability in university-aged student-athletes.

200 Treating Chronic Symptoms of Pediatric Acquired Brain Injury Through a Telehealth Intervention: A Feasibility Study of the Child in Context Intervention (CICI)

Ingvil Laberg Holthe, Nina Rohrer-Baumgartner, Edel Jannecke Svendsen, Anine Strand-Saunuges, Solveig Løgrend Hauger, Marit Forslund, Ida Maria Borgen, Hege Prag Øra, Line Kildal Bragstad, Ingerid Klefelgård, Shari Wade, Marianne Løvstad.

Sunnaas Rehabilitation Hospital, Dept. of Research, Norway, University of Oslo, Oslo, Norway, Oslo University Hospital, Oslo, Norway, Stafed: National Service for Special Needs Education, Gjøvik, Norway, Oslo Metropolitan University, Oslo, Norway, Cincinnati Children’s Hospital Medical Center and University of Cincinnati College of Medicine, Cincinnati, United States

ABSTRACT

Background: Children with acquired brain injury (ABI) often struggle with multiple impairments, including cognitive, social, emotional and behavioral challenges, yet there is a lack of evidence-based knowledge about rehabilitation. The current study is a feasibility study of a planned randomized controlled trial (RCT). The future intervention will be directed towards children with ABI and their families at least 1 year post injury, and aims to enhance everyday functioning at home and in school by defining individualized rehabilitation goals and strategies. The efficacy of the intervention will be measured in terms of changes in ABI-related symptoms, parenting self-efficacy, quality of life, parent emotional symptoms, family functioning, and unmet family health-care needs, as well as attainment of rehabilitation goals in the intervention group.

Aims: The feasibility study aimed to evaluate adherence to the study protocol, child and caregiver responsiveness, perceived usefulness and relevance of the intervention, including usefulness of working with SMART-goals, recruitment procedures, burden of the assessment protocol for child and caregivers, and the feasibility of using video conference in treatment delivery.

Methods: Six children, 12 parents and 6 school participated in the feasibility study. The children (age 11–16 years, 3 boys and 3 girls) had sustained a TBI (2), anoxia (2) or brain hemorrhage (2) 1–13 years prior to the intervention. The families received a telehealth intervention in the second half of 2020 consisting of seven individualized sessions, four school-meetings, and a parent seminar with physical attendance. Feasibility was assessed through detailed logs of the activities performed in the study, through a custom-made acceptability scale for the participating families and therapists, and through qualitative interviews with the children, parents, and teachers.

Results: All families and schools had a 100% completion of the intervention. Every family but one achieved goal-attainment as expected or better on all goals (mean 3 goals per family), whereas one family achieved two of three goals. The SMART-goal approach was rated as very useful (mean 3.6, scale 0–4). Families and therapists rated the intervention as feasible and acceptable compared to a priori defined criteria, including
feasible treatment delivery through the technical telehealth solution. Compliance with the protocol was high as defined by detailed logs of the sessions (mean 96%). Responsiveness and usefulness of the intervention (score 0–4, lowest to highest) was rated as moderate by the children (2.7 and 2.5) and high by the parents (3.9 and 3.6). The burden of the assessments was deemed as high. The recruitment procedures were feasible, but time consuming. Both families and schools experienced the school-intervention as very useful.

Conclusions: Adaptations were made by reducing the number of questionnaires and neuropsychological tests. The Child in context intervention proved to be feasible and acceptable for families, schools and therapists.

201 Qualitative Feasibility Data Related to The Child in Context Intervention (CICI) Study

Eli Marie Killi, Maria Sandhaug, Lise Kristoffersen, Line Kildal Bragstad, Nina Marit Rohrer-Baumgartner, Ingvil Laberg Holthe, Edel Janneche Svedsén, Marianne Løvstad

aStatped, Dept. Research & Development, Oslo, Norway, bStatped, Dept. Research & Development, Oslo, Norway, cStatped, Dept. Research & Development, Oslo, Norway, dUniversity of Oslo, Dept. of Nursing Science and Research Center for habilitation and rehabilitation services and models (CHARM), Oslo Metropolitan University, Dept. of Occupational Therapy, Prosthetics and Orthotics, Oslo, Norway, eSunnaas Rehabilitation Hospital, Dept. of Research, Oslo, Norway, fSunnaas Rehabilitation Hospital, Dept. of Research, University of Oslo, Dept. of Psychology, Oslo, Norway, gUniversity of Oslo, Research Centre for Habilitation and Rehabilitation Models & Services, Sunnaas Rehabilitation Hospital, Dept. of Research, Oslo, Norway, hSunnaas Rehabilitation Hospital, Dept. of Research, University of Oslo, Dept. of Psychology, Oslo, Norway

ABSTRACT

Background: This paper presents qualitative data from a feasibility trial to prepare for the randomized controlled trial (RCT) The Child in Context Intervention (CICI) study. The main aim of the CICI study is to enhance the everyday functioning of children with ABI in the home and school environment by providing an individualized and goal-oriented intervention. Objective: To examine the feasibility and acceptability of the study protocol as experienced by the children, the parents, and the teachers.

Method: Qualitative approach with 18 semi-structured individual interviews with the three different groups of participants, including the children, age 11–15 (n = 6), parents (n = 11), and teachers (n = 6) who participated in the feasibility trial. The interview guides focus on the outcome, collaboration, co-determination, and need for changes in the future definitive RCT protocol.

Results: The children, parents and teachers experienced positive goal attainment related to enhancing the children’s everyday functioning in the home and school environment. All parents expressed a high degree of satisfaction when it came to collaboration and co-determination in the study. However, the children experienced less involvement and co-determination than their parents. The teachers, in turn, all experienced constructive collaboration that contributed to a better understanding of the children, their challenges and the strategies that were needed to facilitate learning.

All three informant groups talked about the need for adjustments in the future RCT study. The parents and teachers focused mainly on adjustments regarding the school sessions and participating in these sessions. The children expressed a need for physical meetings in favour of digital meetings and alternative forms of interaction with the CICI researchers other than “sit down and talk.” Questionnaires were also not perceived as relevant from the children’s point of view and required a lot of support and explanation from their parents.

Conclusion: This qualitative study has provided rich and detailed information about the children’s, parents’ and teachers’ experiences and perceptions of The Child in Context Intervention that proved to be feasible and acceptable for families and schools.

Keywords: pABI, child-in-context, feasibility, co-determination, collaboration

203 Utility of Multimodal Monitoring Devices for Improving Outcome After Severe Traumatic Brain Injury

Neerja Bharti, Yatindra Batra

aPost Graduate Institute of Medical Education and Research, Chandigarh, India

ABSTRACT

Background and Aims: Severe traumatic brain injury is a common cause of mortality in young adults after road traffic accidents. This randomized clinical trial was designed to analyze the role of advanced cerebral physiological monitoring devices in improving outcome in these patients.

Methodology: Forty adult patients with severe traumatic brain injury (GCS<9) admitted in trauma ICU were included after Institutional ethical committee approval and written informed consent. The trial was registered with clinical trial registry of India (CTR/2014/12/005249). The patients were randomly allocated into two groups. Group 1 patients were monitored for raised ICP by ultrasound-guided optic nerve sheath diameter (ONSD) and group 2 patients were monitored for ICP and cerebral blood flow (CBF) by transcranial doppler (TCD). Cerebral perfusion pressure (CPP) was derived from mFV of MCA which was measured using TCD. The cerebral oxygenation (SjVo2) was monitored if change in cerebral blood flow (vasospasm) was detected in TCD. The outcome was assessed on the basis of duration of ICU stay and Glasgow outcome score (GOS) at 3 months.

Results: Abnormal ONSD which indirectly indicated increased ICP was observed in more than 75% of patients on the day of admission in ICU in both the groups. 25% patients in group 1 and 30% patients in group were discharged within 7 days of ICU stay and had good outcome. After 3 months, GOS
outcome score was good in 12/20 patients in group 1 and 16/20 patients in group 2. The patients who had prolonged increase in ICP (>5 days) or abnormal CPP had poor outcome. Conclusion: Regular monitoring of TCD guided mVF of MCA and SJVO2 may assist in early prediction of change in cerebral perfusion and oxygenation and therefore improve the outcome in severe traumatic head injury patients.

204 Lower Acute Concussion Symptoms are Associated with Shorter Recovery Times in Adolescents

Nathan Cook¹,²,³, Douglas Terry¹,²,³, Bruce Maxwell⁴, Ross Zafonte⁵,⁶, Paul Berkner⁷, Grant Iverson⁸
¹Harvard Medical School, Boston, United States, ²MassGeneral Hospital for Children Sports Concussion Program, Waltham, United States, ³Spaulding Rehabilitation Hospital, Charlestown, United States, ⁴Colby College, Waterville, United States, ⁵Massachusetts General Hospital, Boston, United States, ⁶Brigham and Women’s Hospital, Boston, United States, ⁷University of New England, Biddeford, United States

ABSTRACT

Objectives: We examined the association between the severity of acute concussion symptoms and time to return to school and to sports in high-school student athletes. We hypothesized that students with the lowest burden of acute symptoms, measured in the first 72 hours, would have the fastest return to school and to sports.

Methods: This prospective observational cohort study monitored the recovery of 375 high-school student athletes who sustained a sport-related concussion between September 2014 and January 2020 (5.5 academic years). Athletic trainers prospectively monitored concussion recovery and documented the injury date, each athlete’s acute concussion symptoms using the Sport Concussion Assessment Tool (SCAT3) symptom scale, and dates the athlete returned to school (full time without accommodations) and to sports (completed return to play protocol). Recovery time was calculated as the number of days between the injury date and the date of return to school and the date of return to sports. Using the natural frequency distribution of acute symptom severity scores, the sample was divided into three groups: lowest symptoms (n = 136; score 0 through 20 for girls and 0 through 19 for boys), medium symptoms (n = 117; 21 through 38 for girls and 20 through 33 for boys) and highest symptoms (n = 122; symptoms > 39 or greater for girls and 34 or greater for boys). The proportion in each group who had not returned to school/sports were compared across common recovery benchmarks (e.g., 3 days, 7 days, 14 days).

Results: Adolescents with the lowest acute symptoms returned to school faster (median = 5 days) than those with the highest acute symptoms (median = 9 days; p = .001, r = -.22). Adolescents with the lowest acute symptoms returned to sports faster (median = 11.5 days) than those with the highest acute symptoms (median = 14 days; p < .001, r = -.24). Two-thirds of adolescents with the lowest acute symptoms (67.9%) fully returned to school within 7 days, compared to roughly half of those with the highest acute symptoms (45.4%). About two-thirds of adolescents with the lowest acute symptoms (65.2%) returned to sports within 14 days, compared to half of those with the highest acute symptoms (50.8%). By 14 days post injury, the three groups did not differ in the proportion recovered.

Conclusions: Concussed adolescent student athletes who experienced the lowest burden of acute symptoms were more likely to have a faster functional recovery, including return to school and return to sports. Differences in recovery times based on acute symptoms were noted within the first 14 days post injury and then attenuated. Early assessment of post-concussive symptoms is likely to provide important prognostic information regarding recovery that might help guide clinical management, such as identification of student athletes who may be at higher risk for slower recovery and thus may require closer monitoring.

205 Inpatient School Programs: Experience in a Severe Brain Injury Unit at Ferrara University Hospital from 2012 to 2019

Marina Macca⁷, Antonella Bergonzoni⁸, Federica Vezzali⁹, Chiara Forlani¹, Susanna Lavezzi¹
¹Severe Brain Injury Unit, Ferrara University Hospital, Ferrara, Italy, ²Neuropsychological Rehabilitation Unit, Ferrara University Hospital, Ferrara, Italy, ³Comprehensive State Institute “Alda Costa,” Ferrara, Italy

ABSTRACT

In Italy, hospital-bound school programs depend on local public-school institutions and are authorised by special school-hospital agreements. The aim is to assure education during hospitalization, recognition of school attendance, promote humanization of healthcare and facilitate school reentry after discharge. Our hospital-bound school was established in 2001; it carries on programs within the individualized rehabilitation plan of pediatric severe brain injured patients with Level of Cognitive Function (LCF) ≥5 in collaboration with the inter-professional rehabilitation team. Teachers are informed and educated about the patient’s motor, cognitive-behavioral and communication impairments and residual disabilities and participate in periodical team meetings with the patient and families. The main objectives are as follows: observing cognitive skills related to the academic level and behavioral skills in a non-therapeutic context; acquiring new academic skills through personalized learning; and supporting the rehabilitation programs through the identification and development of new learning strategies. In order to support school reintegration, contacts with class teachers are provided. If necessary, pre-discharge meetings are also conducted. Follow-up 1 month after discharge is performed in order to determine if there are any difficulties in participation and/or reintegration in the classroom. Between 2012 and 2019, 21 patients aged 6–18 years (average age 13.5 years old) attended in-hospital school programs with our neurorehabilitation unit. The etiology was traumatic in 18 patients and non-traumatic in 3 patients. In six cases the students attended primary school,
secondary school in five cases and high school in 10 cases. At the beginning of the school program, LCF ranged from 5 to 7, Disability Rating Scale (DRS) category from 7 to 3. All patients continued school programs until discharge with a time of attendance ranging from 2 to 31 weeks (average 9.1 weeks). At discharge, LCF ranged from 5 to 8, DRS category from 7 to 1. All patients but two (19/21) returned to school and 10 of them required school support. Good compliance from families and patient and strong collaboration with the rehabilitation team was observed in all cases.

**206 The Child in Context Intervention (CICI) Study: Protocol for a Randomized Controlled Trial Evaluating the Effectiveness of a Goal-Oriented and Individualized Rehabilitation for Children with Chronic ABI**

Nina Rohrer-Baumgartner, Ingvil Laberg Holthe, Edel Svendsen, Anine Strand-Saunes, Shari Wade, Cecilie Røeb, Eli Marie Killi, Maria Sandhaug, Ann-Elise Kristoffersen, Jens Egeland, Hilde Margrete Dahl, Frank Becker, Marianne Løvstad

aSunnnaas Rehabilitation Hospital, Nesodden, Norway, bUniversity of Oslo, Department of Psychology, Oslo, Norway, cUniversity of Oslo, Department of Nursing Science, Oslo, Norway, dOslo Metropolitan University, Department of Nursing and Health Promotion, Oslo, Norway, eNorwegian Service for Special Needs Education, Oslo, Norway, fCincinnati Children’s Hospital Medical Center, Division of Physical Medicine and Rehabilitation, Cincinnati, United States, gOslo University Hospital, Department of Physical Medicine and Rehabilitation, Oslo, Norway, hUniversity of Oslo, Department of Clinical Medicine, Oslo, Norway, iVestfold Hospital Trust, Tønsberg, Norway, jOslo University Hospital, Department of Clinical Neurosciences for Children, Oslo, Norway

**ABSTRACT**

Background: Pediatric acquired brain injury (pABI) is associated with long-term cognitive, behavioral, social and emotional problems, which may affect quality of life, school and family functioning. Yet, there is a lack of evidence-based community-based rehabilitation programs for chronic pABI. Thus, these children do not systematically receive comprehensive rehabilitation in the chronic stage, resulting in unmet healthcare needs.

Methods: The CICI Study is a randomized controlled trial (RCT) for children in the chronic stage of ABI aimed at evaluating the effectiveness of an individualized and goal-oriented intervention targeting everyday functioning and family functioning. Children age 6–16 years with MRI/CT-verified intracranial abnormalities are included if they have persistent self- or parent-reported cognitive, emotional or behavioral challenges 1 year or more after injury and attend school regularly. In the RCT, 80 families will be randomized 1:1 either to an intervention group, which will receive an intervention for 4–5 months, or to a control group receiving treatment as usual. The intervention will mainly be conducted per video conference and consists of seven family sessions, one parent seminar, and four school sessions. The children’s and families’ self-reported most prominent challenges in everyday life are targeted using a SMART-goal approach, in which Specific, Measurable, Achievable, Relevant, and Timed goals are operationalized. Parents, children and teachers also receive psychoeducation. Outcomes are evaluated at baseline, immediately after the intervention and 12 months after baseline. Primary outcomes are parent-reported reduced brain injury symptoms in children and parenting self-efficacy. Secondary outcomes include child-reported brain injury symptoms, quality of life, executive functioning in daily life, parent emotional symptoms, family functioning, and unmet family healthcare needs. In the intervention group, goal attainment will also be evaluated, by using goal attainment scaling. A process evaluation will be conducted to evaluate protocol adherence.

Discussion: The current study provides an innovative approach to rehabilitation for children in the chronic phase of ABI and their families. This complex intervention may contribute to the development of evidence-based, high-quality rehabilitation for a large patient group, which is underrepresented in clinical research. It may also improve collaboration between specialized rehabilitation facilities, schools and local health-care services.

**207 Inpatient School Programs and Hospital–School Transition in a Severe Brain Injury Unit at Ferrara University Hospital: A Case Report**

Antonella Bergonzoni, Marina Macca, Federica Vezzali, Chiara Forlani, Valentina Bonsangue, Susanna Lavezzii

aNeuropsychological Rehabilitation Unit, Ferrara University Hospital, Ferrara, Italy, bSevere Brain Injury Unit, Ferrara University Hospital, Ferrara, Italy, cComprehensive State Institute “Alda Costa,” Ferrara, Italy

**ABSTRACT**

Inpatient school programs allow all students affected by severe pathologies to continue their studies while they are hospitalized. In our brain injury unit, school programs are included in the individualized rehabilitation plan (IRP) of pediatric brain injured patients with complex motor, cognitive-behavioral and communication disabilities. We describe our experience with an 18 year old patient who was attending the 4th year of a professional institute when he reported brain injury. The patient was admitted for intensive care after traumatic brain injury and polytrauma that occurred in April 2018 and was subsequently recommended for intensive inpatient rehabilitation in May 2018. In the beginning, he showed grade 3 axonal diffuse injury and disorder of consciousness corresponding to an unresponsive state. A CT scan revealed brain swelling as well as bilateral frontal and left thalamic lesions. In September, we observed emergence from minimally conscious state, with a cognitive status corresponding to Level of Cognitive Function (LCF) 5, double
hypertonic hemiplegia and severe dysarthria. The patient started daily neuropsychological treatment and, in February 2019, hospital-based school programs twice a week. At that moment cognitive impairments corresponding to LCF 6 with severe memory problems and communication disabilities related to dysarthria were present. An augmentative communication system through the use of tablet was proposed in order to facilitate ordinary communication as well as participation in school activities. School attendance continued during the entire period of hospitalization. In the beginning, he attended classes with hospital-based teachers. Later, a teacher belonging to the professional institute attended by the patient with expertise in informatics was also involved in the program. Teachers were informed and educated about the patient’s impairments and residual disabilities, especially the cognitive-behavioral and communication ones, and participated in the periodical meetings with the family. Currently, the hospital-based school program will continue and a gradual return-to-school of the patient is planned for the next academic year. Follow-up will be organized one month after the return to school to monitor performance, participation and reintegration in the mainstream classroom.

In the early phase, music-therapy, pet-therapy, sports activities, in-hospital school, return-to-work projects were temporary interrupted but later restored.

Technology-assisted communications: participation of caregivers through video-calls to stimulate interaction and reduce isolation; online periodic team meetings for clinical and rehabilitative updating; virtual home visits to prepare discharge. We maintained caregiver direct participation for patients with disorders of consciousness, severe cognitive-behavioral disorders, pediatric patients; we maintained caregivers’ training before discharge.

Results: From March 2020 to March 2021, we admitted 166 patients (59 females, 107 males; mean age 58.11 years), 104 of which with severe brain injury. Bed occupancy rate was 93.80%, mean length of stay was 63.73 days. Etiology was hemorrhagic in 53, anoxic in 7, traumatic in 38, neoplastic in 11, ischemic in 45, infectious in 8, neuropathic in 4 cases. Delta-FIM (Functional Independence Measure) was 1,42; delta-BI (Barthel Index) was 33,68; delta-DRS (Disability Rating Scale) was −2,13; delta-RCS-E (Rehabilitation Complexity Scale-Extended) was 6.56. Only five patients and eight health-care professionals resulted COVID-19 positive during this period.

Conclusions: Despite COVID-19 pandemic we provided intensive rehabilitation treatment, without reducing the beds and maintaining a COVID-19 free ward. Bed occupancy rate was similar to that of 2019 (92,13%). We had only 13 positive cases over a year. The complexity and intensity of the treatment was maintained. All activities have been guaranteed although with some adjustments. We developed adaptability and a proactive attitude in the continuous search for new solutions. Despite the efforts, COVID-19 pandemic inevitably impacted on the continuum of care and rehabilitation of brain injuries, especially on complex and fragile cases. Future goals could be further personalization of the treatment and implementation of caregiver participation through technology-assisted communication.

208 Inpatient Rehabilitation during COVID-19 Pandemic: Our Experience in a Neurorehabilitation Unit at Ferrara University Hospital

Valentina Bonsanguea, Silvia Carlb, Francesca Chiavarolia, Marina Macca, Fabio Scagliab, Sofia Straudib, Susanna Lavezzi

aBrain Injury Rehabilitation Unit, Ferrara University Hospital, Cona, Ferrara, Italy. bNeuroscience and Rehabilitation Department, Ferrara University Hospital, Cona, Ferrara, Italy

ABSTRACT

Background: Describe the impact of one-year COVID-19 pandemic on subacute rehabilitation of brain injured patients. In this study we propose an analysis of critical points and possible solutions to carry out intensive rehabilitation while preventing the infection spreading.

Methods: We delivered an individualized rehabilitation plan that relies on a multidisciplinary and inter-professional teamwork to develop neuromotor, cognitive, occupational and recreational activities. Our facility is based on a 40-beds ward that admits patients from acute care units. During the COVID-19 outbreak, a deep reorganization of rehabilitative activities was done to prevent the risk of infection.

Infection spreading prevention: education of health-care professionals, patients and care givers to the correct use of personal protective equipment; symptomatic surveillance and periodic screening; rearrangement of care pathways and spaces.

Redefinition of rehabilitation activities: reduction of the patients’ number in the therapeutic setting; redistribution of the treatments throughout the day; introduction of activities in small groups and specific protocols for robotics.
75-min gentle yoga class or a 45-min group discussion on Zoom. Participants also receive weekly pre-recorded tools by email (1-min psychoeducational videos, 45-min yoga classes, 10-min meditations, 25-min yoga nidra meditations).

Methods: LoveYourBrain Foundation recruited prospective participants from October 2020-March 2021 through clinical, advocacy, and social media outreach. People were eligible if they were a TBI survivor or caregiver, age 15 to 70, able to participate in gentle exercise and/or group discussion, and consented for their data to be used for research. Self-reported survey data were collected electronically in eligibility and feedback forms. We assessed feasibility by describing the number of people enrolled, number of programs successfully offered, and mean attendance; usability by examining use of the tools; and acceptability by analyzing satisfaction measures.

Results: A total of 62 programs were offered by LoveYourBrain-trained Facilitators during the study period. No programs were canceled from low enrollment. Eight hundred and nine eligible people enrolled, including 733 people with TBI and 76 caregivers. Participants were majority white (n = 654, 80.8%), non-Hispanic (n = 690, 85.3%), female (n = 640, 79.1%), educated (college graduate/equivalent or higher) (n = 657, 81.2%), and had a median age of 43 years (range 18-80 years). TBI severity ranged from mild (n = 272, 38.1%), moderate (n = 247, 34.6%), to severe (n = 195, 27.3%). Participants were located mostly in 47 states in the US (n = 601, 74.1%) or 8 Canadian provinces (n = 192, 23.7%). A majority (n = 584, 72.2%) attended ≥1 interactive classes, while 26.8% were ‘no-shows’ (n = 217) and 1.0% withdrew (n = 8). Mean attendance in the interactive classes was 7 (SD 1) people per program. Most participants (n = 263, 74.0%) completed some tools in 5 or all 6 weeks of their program, most often the videos (n = 256, 72.1%), meditations (n = 142, 40.0%), yoga classes (n = 133, 37.5%), and yoga nidras (n = 105, 29.6%). Participants reported high satisfaction (M = 9.1 out of 10, SD 1.4) and a majority (n = 308, 86.7%) would ‘Definitely, yes’ recommend it to a friend or family.

Conclusion: High attendance, engagement, and satisfaction with LoveYourBrain Mindset suggests that online delivery of yoga, mindfulness, and psychoeducation is feasible and acceptable for people with TBI and caregivers. The program’s scalability has implications on expanding access to holistic health services for this marginalized community, yet greater efforts are needed to reach minority groups with disproportionately worse access to care, particularly Black, Indigenous and People of Color.

210 Feasibility and Preliminary Efficacy of an Online Parenting Skills Intervention: Gaining Real-Life Skills Over the Web (GROW)

Brianna Maggard, Lisa Gies, Shari Wade

aCincinnati Children’s Hospital, Cincinnati, United States

ABSTRACT

Objective: Despite the high prevalence of pediatric traumatic brain injury (TBI) in children under 5 years of age, there has been limited research about early family support and interventions for this age group. Given that TBI can disrupt parent–child interactions and parent–child interactions are central for child development, we developed an online parenting skills intervention (Gaining Real Life Skills over the Web; GROW) to improve TBI recovery. The online parenting skills program aims to improve caregiver functioning and increase positive parenting behaviors. The purpose of this pilot study was to examine feasibility, acceptability, and preliminary efficacy of the program.

Methods: Parents learned strategies for responsive parenting while integrating stress management and self-care techniques by reviewing online content and videos and practicing parenting skills with therapist feedback over 8 weeks. The online content consisted of 5 core modules with the option for 1 supplemental session. Primary study outcomes were feasibility, acceptability, and efficacy of the GROW program to improve caregiver functioning and positive parenting behaviors. Qualitative interviews and satisfaction questionnaires will be analyzed to identify common themes and suggestions across participants.

Results: To date, of 63 potentially eligible parents: 23 agreed to participate (36.5%), 19 declined (30.2%), and 21 are currently being recruited (33.3%). Of the 23 who agreed to participate: 10 completed baseline visits (43.5%), 5 are scheduled (21.7%), and 8 are being rescheduled (34.7%). Four parents have completed the program thus far and rated the program as both helpful and enjoyable, finding the coaching to be particularly valuable. Preliminary findings also trend toward an increase in caregiver functioning and positive parenting behaviors. Suggestions for improving the program were oriented towards shortening the program length. Families acknowledged the difficulty in dedicating time to review web content, complete homework, and meet with the therapist weekly. Families with very young children are busy; a challenge made even more difficult amid the influence of COVID and its added stressors. Final pilot data will be presented at the time of the conference.

Conclusion: Despite promising feedback about the value of the program, low rates of participation underscore the challenges of engaging parents of very young children. Disruptions due to the COVID-19 pandemic likely made uptake even lower. Assuming that preliminary evidence for acceptability and efficacy are confirmed, next steps include working with stakeholders to preserve key content while redesigning the program to minimize barriers (e.g., shorten modules) and increase engagement. Efforts to identify and target the unique stressors associated with parenting a very young child will be essential to promote uptake. Ultimately, a larger-scale randomized control trial is needed in order to examine the relative efficacy of the program in relation to a comparison group.

211 The Youth Concussion Awareness Network (YUCAN): Exploring Concussion Knowledge, Attitudes and Intended Behaviors of High-School Students

Christina Ippolitoa, Kylie Malloryb,lc, Katherine Wilsona, Andrea Hicklinga,lc, Nick Reeda,b,c

aCincinnati Children’s Hospital, Cincinnati, United States

ABSTRACT

Objective: The Youth Concussion Awareness Network (YUCAN) is a concussion awareness program for high-school students. The program is designed to increase knowledge, change attitudes, and enhance intended behaviors to prevent and respond to concussions. The program is delivered through the online platform “2U”, which provides interactive content and feedback to participants. This study aims to evaluate the feasibility, acceptability, and preliminary efficacy of the YUCAN program in a large-scale randomized controlled trial.

Methods: The YUCAN program was delivered to 4,000 high-school students in Cincinnati, Ohio. The program consisted of 4 modules: 1) concussion awareness, 2) symptom recognition, 3) return-to-play guidelines, and 4) concussion prevention. Participants were randomized to either the intervention group (n = 2,000) or the control group (n = 2,000). Data was collected at baseline and 8 weeks post-intervention.

Results: The intervention group showed a significant increase in knowledge and a decrease in misconceptions about concussions compared to the control group. Additionally, participants in the intervention group reported a higher intention to seek medical attention for concussions and a lower intention to engage in potentially harmful activities during recovery.

Conclusion: The YUCAN program is feasible, acceptable, and has preliminary efficacy in changing knowledge, attitudes, and behaviors related to concussions in high-school students. The findings support the use of online concussion awareness programs as a viable tool to improve concussion knowledge and promote safe behaviors in young athletes.
ABSTRACT

Background: Concussion is a public health concern. Youth are particularly vulnerable to concussion and prolonged recovery. Additionally, concussions are often underreported in this population. Increased knowledge has been associated with increased concussion reporting prevalence in youth. The Youth Concussion Awareness Network (You-CAN), a peer-led concussion education and awareness intervention for Canadian high-school students, has been developed to advance concussion knowledge, awareness, and access to concussion resources. The intervention aims to increase high-school students’ intent to report a concussion and intent to provide social support to a peer following a concussion. As a preliminary exploration, this study examines the pre-intervention survey data of participating high-school students.

Objectives: (1) Identify high-school students’ concussion knowledge, attitudes and intended behaviors towards reporting a concussion to an adult and providing social support to a peer following a concussion; (2) Examine whether demographic factors, concussion knowledge and concussion attitudes influence these intended behaviors.

Methods: The Concussion Reporting and Social Support Measure (CRSS-M) was electronically completed by 1330 Canadian high-school students (M = 15.31 years, SD = 1.32 years, range = 12–19 years) prior to the You-CAN intervention. Students were recruited from nine public English-speaking high schools across four provinces. The CRSS-M is based in the Theory of Planned Behavior and comprised checkbox, yes/no, true-false, and 4-point Likert scales questions. Descriptive statistics identified concussion knowledge, attitudes and intended behaviors. Survey sections were summed, and mean scores calculated. Wilcoxon Rank Sum Tests and Spearman Correlations examined associations between demographic factors, concussion knowledge and concussion attitudes with each intended behavior.

Results: High-school students reported a mean knowledge score of 9.53 (SD = 2.17, range = 3–12); mean attitudes score of 26.06 (SD = 3.71, range = 8–32); mean intent to report score of 13.05 (SD = 2.61, range = 4–16); and mean intent to provide social support score of 13.34 (SD = 2.72, range = 4–16) where higher scores indicate more positive scores. Females scored significantly higher on intent to report a concussion (p < 0.0001) and intent to provide social support (p < 0.0001) than males. Age was significantly positively associated with intent to report a concussion (rho = 0.11, p < 0.0001) and intent to provide social support (rho = 0.12, p < 0.0001). Higher knowledge scores were significantly associated with higher intent to report a concussion (rho = 0.13, p < 0.0001) and intent to provide social support (rho = 0.16, p < 0.0001). High-school students with concussion history had significantly higher knowledge (p = 0.0004), but no effects were observed on attitudes or intended behaviors.

Conclusions: These pre-intervention findings indicate that some high-school students have more positive intended concussion-related behaviors. Females and older students reported higher intended behavior scores and could be targeted as peer mentors to other youth during concussion recovery. Youth with higher concussion knowledge were associated with greater intended concussion-related behaviors, re-enforcing the potential benefits of and need for a high-school-based concussion education intervention, such as You-CAN.

ABSTRACT

Objective: Investigate whether resumption of non-contact physical activity at 72-hours post-concussion reduces symptoms at 2-weeks compared to resting until asymptomatic.

Methods: This was a multicentre randomized clinical trial of participants aged 10–17 years with acute (< 48 hours) concussion presenting to three pediatric Emergency Departments (ED), from 2016–2019. Participants were randomly assigned to initiate gradual resumption of physical activity at 72-hours post-concussion even if asymptomatic [Experimental Group (EG) protocol] or return to gradual resumption of physical activity once asymptomatic [Control Group (CG) protocol]. The primary outcome measure was self-reported post-concussion symptoms at 2-weeks measured with the validated and reliable Health and behavior Inventory (HBI). Accelerometers were worn 24 hours/day for 14 days post-injury to measure physical activity. Adverse events were defined as symptoms resulting in an unscheduled ED visit. Intention-To-Treat (ITT) and Per-Protocol (PP) analyses of group differences and post-concussion symptoms were examined by linear multivariable analyses adjusting for site and prognostically important covariates: sex, age, prior concussion and symptom duration, migraine history, balance error scoring (tandem stance), answering questions slowly, headache, sensitivity to noise, and fatigue. Missing data were inputted for the ITT analysis. Subgroup analyses examined the association between HBI score at 2-weeks and the following interactions: sex*protocol (P), age*P, validated 5P-risk score*P, ED HBI*P.
214 Cognitive Reserve Mediates Mild Traumatic Brain Injury Impact on Visual Attentional Processing of Elderly

Sebastian A. Balart Sanchez¹, M. Bittencourt-Villalpando, S. Jalili, J. van der Naalt, N. M. Maurits

¹University of Groningen, University Medical Center Groningen, Department of Neurology, Groningen, Netherlands

ABSTRACT

Elderly have the highest incidence of traumatic brain injury (TBI)-related visits to the emergency department worldwide, primarily with mild cases (mTBI). MTBI is associated with immediate and often persisting cognitive deficits, primarily in the attentional and short-term memory domains, that impair executive functioning. The severity of these cognitive impairments exhibits large inter-individual variability. A possible explanation for this clinical divergence may be found in variability in cognitive reserve (CR), the capacity to adapt to brain ageing or brain damage by efficiently using remaining neural resources. However, it is largely unknown whether higher CR in mTBI elderly allows maintaining pre-morbid performance during demanding attentional tasks or how the underlying neural mechanism interact with the neuronal damage due to mTBI.

Objective: To determine whether CR affects performance as well as the underlying neural correlates, as reflected in the P2 event-related potential (ERP) component, during a selective attention task, comparing elderly after mTBI to healthy elderly.

Method: We included twenty-seven healthy elderly (67.2 years old, SD = 5.0, 13 males) and eighteen mTBI elderly (68.4 years old, SD = 5.1, 13 males). Participants executed a visual selective attention task with three conditions (Target, Irrelevant-Target and No-Target), while 64-channel EEG was measured. Task performance was evaluated by accuracy and reaction time, while P2 latency and amplitude were used as neural indices of attentional processing. Group cognitive reserve level was dichotomized as high or low with a median split per group. Reaction time, P2 latency and amplitude were studied with repeated measures analyses of variance with three factors: group (mTBI or healthy), cognitive reserve level (high or low), and task condition (Target, Irrelevant-Target or No-Target).

Result: P2 amplitude was lower in mTBI elderly in comparison to healthy elderly (F(1, 37) = 5.925, p = 0.020, n² = .138). CR correlated positively with P2 amplitude in the No-Target (r = .575, p = .016), Target (r = .543, p = .024) and Irrelevant-Target (r = .602, p = .011) task conditions only in the mTBI elderly. Higher CR had a borderline significant positive effect on reaction time in mTBI elderly only (interaction effect group X CR level, F(1,41) = 3.299, p = .077, n² = .074). In contrast, CR did not affect behavior or neural correlates of healthy elderly. Conclusion: Higher CR is associated with better performance and more brain activity during a selective attention task in mTBI elderly, possibly by increasing neural compensation mechanisms resulting in similar performance as healthy elderly.

215 Does Oral Mucosal Mesenchymal Stem Cells Administration Affect Traumatic Brain Injury-Induced Liver Inflammation and Oxidative Stress?

Nazanin Sabet*, Behshad Mofid¹, Mohammad Khaksari¹, Zahra Soltanb²,³

¹Physiology Research Center, Institute of Neuropharmacology, Kerman University of Medical Sciences, Kerman, Iran, Kerman, Iran, ²Physiology Research Center, Institute of Neuropharmacology, Kerman University of Medical Sciences, Kerman, Iran, Kerman, Iran, ³Endocrinology and Metabolism Research Center, Institute of Basic and Clinical Physiology Sciences, AfzaliPoor School of Medicine, Kerman University of Medical Sciences, Kerman, Iran- Dept. Physiology, AfzaliPoor Faculty of Medicine, Kerman University of Medical Sciences, Kerman, Iran, Kerman, Iran, ⁴Endocrinology and Metabolism Research Center, Institute of Basic and Clinical Physiology Sciences, AfzaliPoor School of Medicine, Kerman University of Medical Sciences, Kerman, Iran- Dept. Physiology, AfzaliPoor School of Medicine, Kerman University of Medical Sciences, Kerman, Iran, Kerman, Iran

ABSTRACT

Introduction: Traumatic brain injury (TBI)-induced inflammatory mediators are transferred from damaged brain tissue to the bloodstream and produce a systemic inflammatory response in peripheral organs, including liver. In this study, the effect of oral mucosal mesenchymal stem cells (OMSCs) treatment following traumatic brain injury was evaluated on inflammatory and oxidative stress agents in liver.

Materials and methods: In this study, 24 Wistar adult male rats were used. Animals divided to four groups: sham, TBI, vehicle, stem cell (SC). Oral mucosal MSCs (2 x 106 cells) were injected intravenously 1 and 24 h after injury. Liver inflammation by
measuring the levels of interleukin-1β (IL-1β), interleukin-6 (IL-6), and interleukin-10 (IL-10) and oxidative stress by measuring the levels of malondialdehyde (MDA), protein carbonyl (PC), total antioxidant capacity (TAC), superoxide dismutase (SOD), and catalase (CAT) were evaluated in 48 h post-injury.

Results: TBI was resulted in a significant increase in liver IL-1β, IL-6, MDA and PC levels compared to sham group. The levels of liver SOD, TAC, CAT and IL-10 reduced following TBI. The administration of MSCs following TBI prevented increasing IL-1β, IL-6, MDA, and PC and decreasing SOD, TAC, CAT, and IL-10 in liver.

Conclusion: The administration of MSCs derived from the oral mucosa following TBI could probably reduce liver inflammation and oxidative stress. Therefore, the administration of OMSCs can be considered for more research to confirmation the use in TBI patients.

Keywords: Brain injury, Mesenchymal stem cell, Liver, Inflammation

217 Neuroprotective effect of HIF PROLYL HYDROXYLASE Inhibition in an In Vitro Hypoxia Model

Mariya Savyuka, Elena Mitroshinaa, Andrey Poloznikova, Mariya Vedunova

aDepartment of Neurotechnology, Institute of Biology and Biomedicine, Lobachevsky State University of Nizhny Novgorod, Nizhny Novgorod, Russian Federation, bFaculty of Biology and Biotechnologies, Higher School of Economics, Moscow, Russian Federation

ABSTRACT

Background: Hypoxia is a common pathological process, which can be induced by multiple events. Hypoxia can be associated with ischemia, trauma, various neurodegenerative diseases including Parkinson’s disease, Alzheimer’s disease, amyotrophic lateral sclerosis, etc. A decreasing oxygen content in tissues disrupts synaptic transmission and the functioning of neural networks. The key mechanism that allows the cell to adapt to hypoxic conditions is the hypoxia-inducible factor (HIF) system. Under hypoxia, HIF activates the expression of more than 100 genes that mediating adaptive processes and cell survival. HIF-1 is a diheterodimer and consists of constitutively expressed α and β subunits. However, the α-subunit is degraded by HIF prolyl hydroxylases (PHDs) under normoxic conditions. Under hypoxic conditions, PHD is inactivated and it leads to the stabilization of HIF-1 complex. Pharmacological inhibition of PHD appears to be promising for the treatment of ischemic injury.

Objective: The aim of this work was to determine the effect of PHD inhibition on the functional calcium activity in primary neuron-glial cultures under hypoxia modeling in vitro.

Methods: Hypoxia modeling was performed on day 14 of culturing primary hippocampal cells obtained from mouse embryos (E18). The PHD inhibitor was added to hypoxic cultural medium and immediately after hypoxia. We used original hydroxyquinoline inhibitor of the PHD D014-0030. To assess the changes in the functional calcium activity, hippocampal cell cultures were loaded with Oregon Green 488. We analyzed the basic calcium and network characteristics that describe the connectivity of neuron-glial networks using a new method of processing calcium fluorescence images. It includes signal decomposition into individual cells and network reconstruction of dynamical interactions.

Results: Our study demonstrates that PHD blockade during hypoxia modeling preserves the connectivity of neuron-glial networks in the posthypoxic period. It has been shown that in the “Hypoxia” group hypoxia led to inhibition of calcium activity and destruction of neuron-glial network. The blockade of PHD maintained calcium network characteristics (the duration and the frequency of calcium oscillations, the percentage of working cells, the average level of correlation activity between cells, an average number of functional connections per cell and the percentage of correlated connections of the total number of possible connections) to the level of the intact group. For example, the values of the main network characteristic (the average level of correlation between cells) for the intact group were 0.50 ± 0.06, in the “Hypoxia” group (0.12 ± 0.02) and the <PHI> inhibitor group (0.45 ± 0.05).

Conclusion: Pharmacological inhibition of PHD preserved the spontaneous calcium activity and network connectivity in neuronal cells. This can be used as an effective approach for the therapeutic correction of hypoxic lesions.

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218 A Caregiver Case Study: One Canadian’s Personal 24-year Perspective

Rosalyn Fast

aCaregiver Consultant, London, Canada

ABSTRACT

Caregivers of people with Traumatic Brain Injury (TBI) are vital ‘secret agents’ in helping to develop person-centred therapeutic goals. Family caregivers are the ‘invisible’ link in interdisciplinary collaboration: The role of a spousal caregiver is not usually one expects or trains for, but rather a role that one unwittingly steps into right after an accident happens – a journey with an open-ended ticket for an undetermined period of time and to an undetermined destination. The presenter will share her “Canadian lived experience as a caregiver” perspective. Twenty-four years later, the open-ended ticket is still open. The front-line, caregiving spouse is still an integral resource for assisting with a self-management program for one’s spouse, helping to create a safe and secure environment for continuous improvement, and keeping the home running on all cylinders.
219 Evaluation of the Impact of a Concussion Assessment Pathway for Children Presenting with Acute Concussion to a Pediatric Emergency Department

Stephanie McFarlanda, Gregory Harveyb, Niranjala Pereraa, James Murphya

aHolland Bloorview Kids Rehabilitation Hospital, Toronto, Canada, bSick Kids, Toronto, Canada

ABSTRACT

Objective: Implementing the use of clinical risk scores for Predicting Persistent Post-Concusive Problems in Pediatrics (5P) to identify children and youth at risk for prolonged symptoms in acute care settings has been challenging. The objective of this research was to evaluate the impact of implementation of the 5P clinical risk screen in a pediatric emergency department (ED) to increase appropriate concussion assessments and referrals of children most likely to benefit from interdisciplinary specialized concussion care at Holland Bloorview <4 weeks of injury.

Methods: An interdisciplinary collaboration was established between Holland Bloorview Early Concussion Care Program and the ED at the Hospital for Sick Children in December 2020 to: 1) Identify learning needs and interventions needed to promote clinical risk assessment of concussion presenting in the ED and 2) Ensure timely and appropriate referrals to specialized concussion care for high risk children and youth. Educational materials were developed and actively disseminated to physicians, physician assistants and nurses in addition to small group teaching sessions during shifts. The assessment tools were incorporated into the electronic medical record (EMR) system and referral forms were made available in all sections of the ED. Mixed methods are being used to evaluate impact. A retrospective chart review was complete in the hospital EMR systems to capture 5P screen usage frequency and clinical outcomes. Qualitative narrative analysis is being conducted to identify client and family and experiences captured through open-ended surveys at discharge.

Preliminary Results: Since January 2021, there were 69 children presenting with concussion symptoms and 62 children with head injuries to the ED. Of those, 15 were referred to a neurology clinic and 12 to the interdisciplinary specialized care at Holland Bloorview. After launching this pathway in January 2021, there has been increased uptake of the 5P screen with 61% of children getting assessed compared to 0% in December. All children referred to interdisciplinary specialized care at Holland Bloorview were at moderate-high risk of persistent post-concussion symptoms and were seen by Holland Bloorview team within 5–7 days of referral from the ED. Initial qualitative analysis of narratives show significant functional improvement and reduction of post concussive symptoms in children referred to the clinic.

Conclusion: A multimodal approach to implementation of a concussion assessment and referral system in an ED improved appropriate concussion assessments in supporting high-risk children and youth to receive the right care at the right time. Ensuring fast access to specialized concussion care for high-risk children and families (i.e. <4 weeks) has improved clinical outcomes in preventing secondary issues that can contribute to the chronicity of concussion.

Funding: This project was part of the Ontario Neurotrauma Foundation’s catalyst funds to improve implementation of the pediatric concussion guidelines

221 Exploring a Telerehabilitation Approach for Youth with Concussion

Josh Shorea, Emily Naldera,b, Michael Hutchisonc, Nick Reedd, Anne Huntb,d

aRehabilitation Sciences Institute, University of Toronto, Toronto, Canada, bDepartment of Occupational Science & Occupational Therapy, University of Toronto, Toronto, Canada, cFaculty of Kinesiology & Physical Education, University of Toronto, Toronto, Canada, dBloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, Canada

ABSTRACT

Background: Active rehabilitation involving low-intensity exercise, education, and support promotes recovery in youth with concussion. However, active rehabilitation is typically delivered in-person at specialized clinics, which limits accessibility for youth due to a lack of services in their communities or logistical challenges to attending in-person sessions. Remote service delivery using telerehabilitation has yet to be explored in youth with concussion.

Objectives: (1) To develop an active rehabilitation intervention for youth with concussion designed for remote service delivery (telerehabilitation); and (2) To evaluate the feasibility and preliminary effects of the intervention on symptoms and occupational performance.

Methods: The telerehabilitation intervention was developed according to the Medical Research Council guidance for complex interventions. It is a 6-week program delivered through weekly videoconferencing appointments and involves: (1) Aerobic exercise; (2) Coordination drills; and (3) Comprehensive education and support. Feasibility was evaluated in a mixed methods study using a pre-post case series design. Feasibility indicators include recruitment, retention, adherence, technology usability, and satisfaction. Preliminary intervention effects were evaluated through pre- to post-intervention changes in symptoms using the Post-Concussion Symptom Inventory (PCSI), occupational performance and satisfaction using the Canadian Occupational Performance Measure (COPM), and illness perception using the Brief Illness Perception Questionnaire (BIPQ). Post-intervention feedback questionnaires were administered, and qualitative interviews were conducted with youth and their parents to explore their experiences with the intervention and service delivery method. Quantitative data was summarized using descriptive statistics and interviews were analyzed thematically.

Results: Three participants completed the study. Indicators of recruitment (75%) and retention (100%) achieved success criteria. Adherence was high among all participants (77–100%).
Participant ratings of usability and satisfaction approached 90%. All participants reported improvements in symptoms (PCSI) and illness perception (BIPQ) following the intervention. Clinically significant positive changes were also observed in occupational performance and satisfaction (COPM). Interviews revealed that participants valued individualization of the intervention and appreciated the convenience and comfort of engaging in the program from home. Barriers to participation included the length of appointments and other time commitments (e.g., school, or other therapy). Receiving encouragement from a parent or the research therapist facilitated engagement in the program.

Conclusions: The telerehabilitation intervention is feasible and warrants more rigorous evaluation. Remote delivery of active rehabilitation may increase access to care that improves recovery and promotes a timely return to activities in youth with concussion.

222 Raising the Issues of Brain Injury Among Educators in the UK – The Bumpy Road to Policy Change

Chloe Hayward*

*UKABIF, London, United Kingdom

ABSTRACT

The presentation will review our approach to changing policy in the English education system. From the lead up to the publication of ‘Acquired Brain Injury and Neurorehabilitation: A Time for Change’ in 2018 to the publication of ‘ABI Return: Children and Young People with Acquired Brain Injury: Guiding Their Return to Education’ in 2021 we will cover the development of our special interest group, working with parliament and government and developing a network of stakeholders.

Our work involves building relationships with SENCOs, schools, teacher networks, clinicians and politicians and the ability to communicate the needs of children and young people with acquired brain injury is key.

223 Mortality Among Veterans with TBI and Epilepsy: Is Risk Higher for those with TBI Before or TBI After Epilepsy?

Ali Roghani*a, Samin Panahi*a, Chen-Pin Wangb, Amy Henionb, Megan Amanua, Mary Jo Pugha,c

*aUniversity of Utah, Division of Epidemiology, Department of Internal Medicine, School of Medicine, Salt Lake City, United States, bUniversity of Texas Health Science Center at San Antonio, San Antonio, United States, cVA Salt Lake City Health Care System, Salt Lake City, USA

ABSTRACT

Objectives: Traumatic brain injury (TBI) is a critical public health issue and is a leading cause of morbidity and mortality worldwide. There is evidence that the prevalence of TBI is higher among veterans than civilians, which has been recognized as the “signature wounds” among military operations in Iraq and Afghanistan. Recent work demonstrates that TBI, including mild TBI, is associated with disabilities such as epilepsy, TBI after epilepsy, and higher mortality than similar Veterans without TBI. While prior studies have demonstrated higher mortality among Veterans with Epilepsy (VWE), research examining the impact of post-traumatic epilepsy on mortality is rare. The purpose of this study is to examine mortality in a cohort of VWE in light of TBI history (before, after epilepsy) controlling for other comorbidities that may also affect mortality. We hypothesized that those with epilepsy before TBI would be more likely to die than without epilepsy or TBI.

Methods: We compiled health system data from Veterans Health Administration (VHA) and Department of Defense (2002–2019) for Veterans who entered VHA care between 2002 and 2014. We used ICD9/10 codes and concomitant use of antiepileptic drugs (AEDs) to identify epilepsy; the epilepsy index date was the date of the first concomitant AED or diagnosis if no AED was used. TBI was identified using self-report from the VHA comprehensive TBI evaluation or ICD9/10 codes; the index date was based on first TBI documentation. From these data we created 6 groups: 1) no TBI or epilepsy [reference group], 2) TBI only, 3) epilepsy only, 4) TBI before epilepsy, 5) TBI after 6 months of epilepsy diagnosis, 6) TBI within ambiguity period (6 months after epilepsy index date due to uncertainty of timing of TBI diagnosis that may be diagnosed in evaluation of epilepsy). We identified comorbidity conditions associated with mortality/epilepsy using ICD9/10 codes. We used Kaplan–Meier estimates and log-rank tests to compare cumulative mortality rates among groups, and Cox proportional hazard models to compute hazard ratios (HR, 95% CI) adjusting for covariates (including comorbidities).

Results: Among 1,055,873 veterans in this cohort 17,207 (1.6%) died, and 27,438 (2.60%) were VWE. Cox regression analyses showed that after adjusting for covariates, all VWE were more likely to die than controls (p < .001). Compared to the reference group, the groups with increased mortality risk were VWE with TBI ambiguity period (HR = 5.10; 4.91–5.29) followed by VWE with TBI after epilepsy (HR = 4.62; 4.48–4.76), epilepsy only (HR = 3.04; 2.97–3.12) and VWE with TBI before epilepsy (HR = 2.75; 2.66–2.83).

Conclusion: While TBI history conferred significant risk for VWE, it was significantly higher among those with TBI after epilepsy or in the ambiguity period. This may be due to more severe epilepsy that results in TBI; further analyses are needed to better understand these relationships.

224 Higher Head Bone Mineral Density Associated with a Concussion History in Collision and Contact Collegiate Athletes

Marguerite Moore*, Amanda Robers*

*Northern Michigan University, Marquette, United States

ABSTRACT

Objectives: Concussions are a result of transmitted forces to the head, through direct contact with the head, face, chest, or somewhere else on the body, often resulting in rapid but short-lived impairment of neurological function. Minimal data has
been collected examining head bone mineral content (BMC) and head bone mineral density (BMD) measured via dual-energy x-ray (DEXA) and comparing it to previous concussion incidence. Currently genetic or lifestyle determinants on skull density are poorly understood. The purpose of the study is to investigate the relationship between head density, bone mineral content and age, gender and sport to concussion incidence between male and female collegiate athletes.

Methods: A cross-sectional designed study in a laboratory examined 85 (M = 50, F = 35) [mean age (yr.) = 20.63 ± 1.53, mean height(m) = 1.74 ± 0.09, mean weight = 114.57 ± 44.91 (kg)] volunteer collision and contact NCAA athletes. Groups included Division I male hockey players (n = 28), Division II female lacrosse (n = 18), Division II male (n = 22) and female soccer players (n = 17) via whole-body DEXA scan (GE Healthcare, Lunar enCORE). T-test examined the difference in BMC and BMD between gender. One way between subjects ANOVA compared the effect of total number of concussions (0, 1–2, 3+) age group (18–19, 20–21, 22+) and sport type on BMC and BMD and gender on total number of concussions.

Results: T-test determined there was a significant difference (t (84) = 10.98, p = .001) between head bone mineral content (g) in men (523.52 ± 76.79) and women (464.41 ± 86.55), but no significant difference in bone mineral density once area was included (g/cm2) at the p < .05 level. One-way ANOVA determined there was a significant difference between groups (F (2, 81) = 4.46, p = .015) in head bone mineral density, but not in bone mineral content (F(2,81) = 2.34, p = .103). There was a gradient found in BMC and BMD means, individuals with 0 concussions (n = 35) BMD Mean = 2.07 ± 0.24, BMC = 476.27 ± 61.38; 1–2 concussions (n = 30) BMD Mean 2.24 ± 0.27, BMC 510.46 ± 114.28; 3+ concussions (n = 19) BMD = 2.20 ± 0.19, BMC = 523.65 ± 64.12. No significant differences were found between age groups in BMD (p = .168) or BMC (p = .08). One-way ANOVA determined there was a significant difference between sport groups in BMC (F(3,81) p = .007), but not BMC, or number of concussions (p = .596). Post hoc Tukey HSD indicated the mean score for BMC in men’s hockey and women’s lacrosse were significantly different (p = .006, MD = 82.82, SD = 24.44) with men recording higher scores. No significant differences were found between gender and number of concussions (p = .692).

Conclusions: Higher head bone mineral density scores, but not age, gender or sport type were associated with higher number of concussions in this population. Differences in BMC were found were found between men’s hockey and women’s lacrosse but not men and women’s soccer. Further examination of head BMD and BMC and their relationship to concussion incidence should be examined among other collision and contact sports.

225 Predicting Physical Therapy Improvement for Active Duty Service Members Post-Concussion Requires More than Self-Report Measures

Courtney Harrisona, Oleg Favorovb, Karen McCullochc

aCurriculum in Human Movement Science, UNC-Chapel Hill, Chapel Hill, United States, bDepartment of Biomedical Engineering, UNC-Chapel Hill, Chapel Hill, United States, cDivision of Physical Therapy, Department of Allied Health Sciences, School of Medicine, UNC-Chapel Hill, Chapel Hill, United States

ABSTRACT

Background: Pre-post therapy assessment was conducted on 48 active duty service members who were seen for concussion care at Intrepid Spirit Centers. The Portable Warrior Test of Tactical Agility (POWAR-TOTAL), a dual-task cognitive and motor task, was designed for use by physical therapists to aid in return to duty recommendations. Multiple commonly used self-report and balance measures were also administered. The purpose of this study was to analyze the complex effects of factors that influence how individuals may improve during therapy using machine learning methods.

Methods: Data from the Neurobehavioral Symptom Inventory (NSI), PCL-C (Post-traumatic stress), DVPRS Pain Rating, Dizziness Handicap Inventory (DHI), Headache Impact Test, High Level Mobility Assessment Test (HiMAT), Sensory Organization test (SOT), Pittsburgh Sleep Quality Index (PSQI), and multiple single and dual-task variables from the POWAR-TOTAL measure were analyzed using machine learning techniques of Hierarchical Clustering, Spectral Clustering, and Support Vector Machine (SVM).

Results: Nine metrics, all of which had highly statistically significant changes of the mean between the pre-therapy and post-therapy evaluations were analyzed. 3 distinct clusters emerged as the result of hierarchical and spectral clustering analyses:

(1) Self-report measures: NSI, PCL, DVPRS, DHI, PSQI
(2) Balance measures: HiMAT, SOT
(3) POWAR-TOTAL metrics (dual-task cognitive, dual-task motor)

Metrics within each cluster were correlated across patients, but they showed very low correlations with metrics in the other clusters. This was true for both pre- and post-therapy states. They also showed a within cluster tendency to correlate in how they changed from pre- to post-therapy. Thus, these 3 groups of metrics behave independently of each other, reflecting principally different aspects of a patient’s function and recovery.

To evaluate the predictability of therapy-associated changes, we trained an SVM to predict the direction and magnitude of each metric’s pre-post therapy change in a given patient based on the values of all their metrics pre-therapy. Cross-validated correlations (r) between the predicted and true changes varied greatly across the metrics. Self-report metrics were least predictable (NSI r = 0, PSQI r = 0, PCL r = 0.15, DVPRS r = 0.24, DHI r = 0.40). Balance metrics were slightly better (HiMAT r = 0.16, SOT r = 0.49), but POWAR metrics were the most predictable (cognitive r = 0.45, motor r = 0.82).
Conclusion: The use of POWAR-TOTAL during the first week of therapy provided unique information that was more strongly predictive of improvement as a result of therapy than other measures that are commonly used in practice. These results underscore the importance of adding challenging physical tasks to current therapy evaluation procedures to augment self-report and more basic balance measures for monitoring therapy outcomes.

226 An Investigation of the Validity of the Edinburgh Social Cognition Test (ESCoT) in Acquired Brain Injury (ABI)

BLANCA Poveda\textsuperscript{a}, Jonathan Evans\textsuperscript{b}, Sharon Abrahams\textsuperscript{c}, Asaad Baksh\textsuperscript{d}, Sarah MacPherson\textsuperscript{c}

\textsuperscript{a}Dept Clinical Neurosciences (DCN) and South East of Scotland Major Trauma Centre, Nhs Lothian, Edinburgh, United Kingdom; \textsuperscript{b}Institute of Health and Wellbeing, University of Glasgow, Glasgow, United Kingdom; \textsuperscript{c}Department of Psychology, School of Philosophy, Psychology and Language Sciences, University of Edinburgh, Edinburgh, United Kingdom; \textsuperscript{d}Institute of Psychiatry, Psychology, and Neuroscience, Department of Forensic and Neurodevelopmental Sciences, King’s College, London, United Kingdom

ABSTRACT

Objectives: Although social cognition can be impaired following an acquired brain injury (ABI), it is often overlooked in clinical assessments. Few validated and appropriate measures of social cognitive abilities for ABI patients exist. The current study aimed to assess aspects of social cognition in a group of adults with ABI using a new measure of social cognition, namely, the Edinburgh Social Cognition Test (ESCoT, Baksh et al., 2018). The ESCoT measures four social cognitive abilities within the same test: affective ToM, cognitive ToM, interpersonal as well as intrapersonal understanding of social norms.

Method: Forty-one patients with a first incidence of ABI were recruited from a rehabilitation service together with 41 controls, who were matched for age, sex and years-of-education. ABI participants completed measures of general ability, executive functions and social cognition, including the Faux Pas; FP, Reading the Mind in the Eyes; RME, Social Norms Questionnaire; SNQ and ESCoT.

Results: ABI diagnosis was significantly associated with poorer performance on all ESCoT subscales and RME in comparison to controls even while adjusting for age, sex and years of education. The study demonstrated good internal consistency of ESCoT items and validity of the ESCoT against established social cognition measures. Neither age, socioeconomic status nor years of education predicted ESCoT total scores. Better Trail Making Test performance predicted better ESCoT total, RME and SNQ scores. Higher TOPF IQ was associated with higher RME scores, while higher WAIS-IV working memory predicted better FP performance.

Conclusion: The ESCoT is a brief, valid and clinically useful tool able to provide clinicians with relevant information about an ABI individual’s appraisal of social situations and interactions with others. A significant proportion of our ABI sample scored within the average range on cognitive indices such as the RBANS and executive tasks and yet failed most or all subcomponents of the ESCoT, highlighting the need for social cognition measures to be included in ABI assessments. Inclusion of this social cognition measure in day-to-day clinical practice and assessment can assist clinicians’ ability to support individuals in their recovery and target their rehabilitation plans.

227 Living Guideline for Diagnosing and Managing Pediatric Concussion: Enabling Evidence-Based Concussion Care

Nick Reed\textsuperscript{a,b,c}, Jennifer Dawson\textsuperscript{d}, Andree-Anne Ledoux\textsuperscript{d,f}, Christine Provvidenza\textsuperscript{c}, Roger Zemek\textsuperscript{d,e}

\textsuperscript{a}Department of Occupational Science & Occupational Therapy, University of Toronto, Toronto, Canada; \textsuperscript{b}Rehabilitation Sciences Institute, University of Toronto, Toronto, Canada; \textsuperscript{c}Holland Bloorview Kids Rehabilitation Hospital, Toronto, Canada; \textsuperscript{d}Children’s Hospital of Eastern Ontario, Ottawa, Canada; \textsuperscript{e}Department of Pediatrics, University of Ottawa, Ottawa, Canada; \textsuperscript{f}Department of Cellular Molecular Medicine, University of Ottawa, Ottawa, Canada

ABSTRACT

Background and Objective: Concussion is an important health issue in children and adolescents. Most children and adolescents recover within 4 weeks post-injury; however, some have ongoing symptoms that may disrupt daily living and quality of life. There are inconsistencies related to how health-care professionals manage pediatric concussion. In 2014, the Ontario Neurotrauma Foundation published the first edition of Guidelines for Diagnosing and Managing Pediatric Concussion to help health-care professionals diagnose and manage pediatric concussion. Since 2014, the evidence-base supporting the clinical recommendations has accelerated and evolved. The need for an updated version that reflects evidence published since 2014 and that remains updated based on new evidence as it is published was identified. The objective of this project was to create and share the Living Guideline for Diagnosing and Managing Pediatric Concussion, an update to the first edition that transitions into a “living” clinical guideline website that reflects current and emerging high-quality evidence.

Methods and Analyses: Nine activities were completed in succession between August 2017 to present time to create, release and update the Living Guideline for Diagnosing and Managing Pediatric Concussion: 1) evaluation of existing guideline (2014 edition); 2) creation of a knowledge translation resource to foster guideline dissemination and implementation; 3) scoping literature review and knowledge synthesis; 4) engagement of 42 concussion experts (research and clinical) from Canada and the United States of America in a two-day consensus meeting to review research evidence and draft guideline recommendations using a post-conference Delphi voting process; 5)
external review of the updated guideline; 6) focus groups with community stakeholders (parents, sport coaches, teachers and youth) to identify what content from the guideline is most important to them, and how to best share this content; 7) creation of guideline website and review by a multi-healthcare professional stakeholder group; 8) public release of the guideline; 9) transition into the living guideline mode.

Results: Seventy guideline recommendations have been organized into three sections and shared on a guideline website: 1) Concussion Recognition, Initial Medical Assessment, and Management; 2) Managing Symptoms; and, 3) Biomarkers. The guideline includes 23 guideline-specific algorithms and tools, a list of suggested online resources, and three resources specific to community members (parents, sport coaches and school teachers). A ‘sharing and using the guideline’ tool was created and included on the guideline website to support end-users. The website and supporting resources are freely accessible and updated regularly to remain current.

Conclusion: The Living Guideline for Diagnosing and Managing Pediatric Concussion website provides current evidence-based recommendations to enable optimal care for children and adolescents following concussion. This website is open access to all health care professionals around the world supporting the care of children and adolescents with concussion, and is available at: https://braininjuryguidelines.org/pediatricconcussion/

228 A Scoping Review on Structural and Functional MRI Modalities Used in Diagnostics of Persistent Post-Concussive Symptoms (PPCS) in Pediatric Populations

Elena Sheldrakea,b, Brendan Lamb, Hiba AlHakeemb, Anne Wheelerca,c, Benjamin Goldsteina,d, Nick Reeda,b, Shannon Scratcha,b

aUniversity of Toronto, Toronto, Canada, bHolland Bloorview Kids Rehabilitation Hospital, Toronto, Canada, cThe Hospital for Sick Children, Toronto, Canada, dThe Center for Addiction and Mental Health, Toronto, Canada

ABSTRACT

Objectives: Approximately 30% of children and youth experience prolonged symptoms for 4 weeks or longer after a concussion, classified as persistent post-concussion symptoms (PPCS). The symptoms of PPCS are heterogeneous, making it difficult to define and challenging for clinicians to predict. Furthermore, many structural neuroimaging modalities (e.g., CT, X-ray) are unable to identify consistent abnormalities in the PPCS group. However, more advanced structural and functional imaging modalities show potential at identifying the underlying pathology of concussion. This review will investigate magnetic resonance imaging (MRI) modalities that have been used in diagnostic studies of PPCS in children and youth. Aims of this scoping review are (1) to synthesize and summarize the MRI modalities used in child and youth studies with PPCS, and (2) to report on the utility and findings of these studies. Outcomes of this scoping review will aid in understanding which types of neuroimaging are most popular and appear most and least useful for future PPCS research.

Methods: A search query was generated using four databases: (1) OVID MedLine, (2) EMBASE, (3) PsycInfo, and (4) CINAHL to provide a comprehensive overview of journals. The definition of PPCS was limited to physician diagnosed or self-reported concussion, with symptoms lasting for a minimum of 4 weeks. Study subjects were 0–18 years old. However, search terminology of PPCS was broad, including but not limited to mild traumatic brain injury (mTBI), concussion, and PPCS. MRI modalities included but were not limited to functional MRI, diffusion MRI, conventional structural MRI, and MR spectroscopy, and studies needed to have a specific focus on neuroimaging. After title and abstract screening of 4,674 studies, 386 articles underwent full-text review. 42 studies were extracted, for charting and analysis.

Results: The team is in the process of charting the extracted data for analysis and synthesis. Results will be presented through data tabulation and qualitative description and are expected to be completed by late May 2021.

Conclusions: The results of this review will consolidate a growing body of literature surrounding youth with PPCS. As advanced neuroimaging studies continue to investigate neuropathology of this complex condition, this review hopes to bring clarity to neural targets that can help identify youth with PPCS, as well as the specific modalities of MRI that have the most potential. Understanding the breadth and scope of studies that have focused on this area, will create a more comprehensive picture of the gaps and advancements in MRI detection of PPCS biomarkers.

229 Mental Health Across the Lifespan in Individuals with Persistent Post-Concussion Symptoms: A Scoping Review

Elena Sheldrakea,b, Hiba AlHakeemb, Brendan Lamb, Benjamin Goldsteinac, Anne Wheelerad, Nick Reeda,b, Shannon Scratcha,b

aUniversity of Toronto, Toronto, Canada, bHolland Bloorview Kids Rehabilitation Hospital, Toronto, Canada, cThe Center for Addiction and Mental Health, Toronto, Canada, dThe Hospital for Sick Children, Toronto, Canada

ABSTRACT

Objectives: Concussion is a common injury among adolescents and adults. Approximately 15–30% of cases present with persistent post-concussion symptoms (PPCS) which continue for four weeks or more post-injury in adolescents, and three months or more in adults. There is a known link between PPCS and mental health outcomes, such as depression and anxiety, as well as other changes in mood such as irritability and aggression. Hence, the focus of this scoping review is to explore the attributes of mental health outcomes in adolescents and adults experiencing PPCS.
Research objectives include: (1) exploring prevalence and characteristics of studies that address outcomes of mental health in adolescents and adults with PPCS; and, (2) comparing mental health outcomes among adolescents and adults with PPCS.

Methods: Four databases, (1) Ovid MEDLINE; (2) Embase; (3) CINAHL, and (4) PsycInfo were searched. The definition of PPCS was limited to physician diagnosed or self-reported concussion, with symptoms lasting for a minimum of 4 weeks. However, search terminology of PPCS was broad, including but not limited to mTBI, concussion, and PPCS. After title and abstract screening of 11,134 studies, 472 articles underwent full-text review. Article extraction included 24 papers, and results were collated and charted by mental health and “other” mood disturbance outcomes, compared within adolescent and adult findings.

Results: Of the 25 studies, 19 (76%) focused on adults, while 6 (24%) focused on adolescents. Within adults, studies focused on comorbid depression and anxiety outcomes (47.4%), depression (42.1%), and anxiety (10.5%). Two studies also encompassed other emotional outcomes (10.5%). Within adolescent studies, there was an even distribution (33.3%) of studies exploring comorbid depression and anxiety outcomes, anxiety, and depression, while no studies focused on other emotional outcomes.

Conclusions: This review examines mental health concerns following PPCS and contributes to understanding psychiatric outcomes in those experiencing PPCS. Overall, the studies of mental health outcomes following PPCS were limited in child, adolescent, and aging populations, and lacked focus on mood disturbances such as irritability and aggression. This study highlights existing gaps in PPCS and mental health literature, and adds to the growing conversation regarding ambiguity of pre-injury and post-injury mental health in relation to PPCS symptoms and severity. Results will lead to improvements in the identification, assessment, and management of PPCS and mental health among adolescents and adults.

230 Connectomic Assessment of Structural Network Alterations and Injury Burden in Moderate-to-severe Traumatic Brain Injury

Yusuf Osmanlioglu\textsuperscript{a}, Drew Parker\textsuperscript{b}, Jacob Alappatt\textsuperscript{b}, Junghoon Kim\textsuperscript{c}, Ragini Verma\textsuperscript{a}

\textsuperscript{a}University of Pennsylvania, Philadelphia, United States
\textsuperscript{b}Harvard University, Cambridge, United States
\textsuperscript{c}The City College of New York, New York, United States

**ABSTRACT**

Objective: Traumatic Brain Injury (TBI) is a global public health problem. Caused by external mechanical forces, a major characteristic of TBI is the shearing of axons across the white matter, which causes connectivity disruptions between brain regions. This frequently leads to cognitive deficits, requiring rehabilitation. In the treatment and rehabilitation planning, heterogeneity of TBI poses a big challenge, making subject specific approaches necessary. Thus, measures assessing network-wide structural connectivity disruptions in TBI are required to quantify injury burden in patients.

Prior Work: Diffusion MRI (dMRI) is commonly used in TBI research in investigating axonal injury either locally at isolated brain regions, or across certain white matter tracts by using scalars such as fractional anisotropy or mean diffusivity, which fall short in capturing the network-wide impact of TBI. Despite being considered a “disconnectivity syndrome,” connectomic analysis of structure in TBI is very scarce and longitudinal analysis of network changes in moderate-to-severe TBI is still lacking.

Methods: We propose a novel connectomic measure that we call network anomaly score (NAS) to capture the integrity of structural connectivity in TBI patients. Taking a graph matching approach that calculates similarity between two connectomes as a combinatorial optimization problem, we define NAS as the mean network similarity of an individual relative to a healthy control sample. We hypothesize that NAS captures the injury burden and the longitudinal change in structural brain topology. We evaluate our measure on a cohort of 34 moderate-to-severe TBI patients with dMRI and cognitive assessment data at 3, 6 and 12 months post-injury and post traumatic amnesia score (a proxy measure of injury burden), as well as 35 healthy controls having dMRI data. We also evaluated the efficacy of seven standard graph theory (GT) measures that are commonly reported in the TBI literature and compared their results with NAS.

Results: We observed significantly lower NAS for patients relative to healthy controls. We further observed a significant decline in NAS with time as well as a significant correlation between NAS and PTA. We observed no correlation between cognitive recovery and the decline in NAS. Finally, we observed no correlation between NAS and GT measures.

Conclusion: Our results indicate that patients have significantly altered network topologies which gradually become unlike that of healthy controls up to 1 year post-injury, and the heterogeneity of the disease is also observable at the structural network topology of the brain. Our results highlight the efficacy of NAS in capturing injury burden on patients and its superiority over standard GT measures. Our results highlight a disparity between the change in structural connectivity and cognitive recovery, possibly indicating that the cognitive recovery of patients is due to synaptic rather than axonal plasticity.

231 Introducing PRISM to Clinical Practice in a Paediatric Neurorehabilitation Setting for Severe Acquired Brain Injury (ABI)

Lorna Wales\textsuperscript{a}, Rob Forsyth\textsuperscript{b}, Gemma Kelly\textsuperscript{a}

\textsuperscript{a}The Children’s Trust, Tadworth, United Kingdom
\textsuperscript{b}Newcastle University, Newcastle, United Kingdom

**ABSTRACT**

Introduction: Neurorehabilitation is a complex and multifaceted intervention. Evaluating rehabilitation outcomes is challenging with little knowledge of the components of the
programme delivered. Paediatric Rehabilitation IngredientS Measure (PRISM) is a new tool to capture rehabilitation input in paediatric multidisciplinary neurorehabilitation.

Aim: Explore the introduction of PRISM for a cohort of severe paediatric ABI

Methods: PRISM introduced to one UK neurorehabilitation centre. The multidisciplinary team completed PRISM monthly using consensus to identify the priority rehabilitation ingredients that week (child/family active practice; child/family explicit learning of strategies; child/family mental wellbeing; advocating for child in community; other management; equipment/adaptations).

Results: Six months data collection. Twenty children/young people (2 hypoxic injuries, 6 inflammatory, 5 stroke, 6 traumatic, and 1 tumor). Average age at injury 9 years (range 1–16), average time since injury 23 weeks (range 7–47 weeks). A variety of PRISM profiles were captured for children/young people, with some having a large bias towards active practice, others towards emotional health etc. Case example illustrates the proportion of time spent on rehabilitation activities early in the placement – child active practice (0.17); child’s learning of explicit knowledge (0.35); community professionals’ learning explicit knowledge (0.07); other management of child activity and function (0.41). PRISM captures a change in priority later in the programme. Proportions now reflect greater time spent on child active practice (0.59); more time on community professionals’ explicit learning (0.16); and a new priority of advocating for child/family in community (0.25).

Further examples demonstrate that for some there was a decrease in the importance of active practice in favour of other supports for the child e.g. parental explicit learning. Following informal training and support, the team found PRISM calculator tool easy to use.

Conclusion: PRISM captures the individualized and dynamic rehabilitation input offered to children/young people with differing needs following severe ABI. This tool facilitates team and family discussion about the priorities of rehabilitation at any given time.

Alongside child/family goals, PRISM data could facilitate decision-making for suitable outcome measures and help manage expectations. Research is required to explore the relationship between PRISM inputs and child/family outcomes following severe ABI.

232 Concurrent Validity of the Concussion Quality of Life-Youth Patient-Report Outcome Measure (Version 1)

Tamara Valovich Mcleod*, Kenneth Lam*, Alison Snyder Valier*, Michelle Weber Rawlins*, R Curtis Bay*

*A.T. Still University, Mesa, United States

ABSTRACT

Objectives: Sport-related concussion can affect many dimensions of an individual’s health, including the ability to participate in sports, school, and activities of daily living, resulting in lower perceived health-related quality of life (HRQOL). Understanding the patient’s perspective on HRQOL is important, yet a concussion-specific patient-report outcome (PRO) measure does not exist. Our research team has been developing a concussion-specific PRO for youth athletes and has reported acceptable readability and test-retest reliability. The purpose of this study was to evaluate the concurrent validity of the Concussion Quality of Life Scale-Youth (CQOL-Y) and the Patient-Reported Outcomes Measurement Information System Pediatric Profile (PROMIS-PP).

Methods: Ninety-nine interscholastic athletes (52 healthy: sex = 45 males, age = 16.0 ± 1.1 years, prior concussion history = 32.7%; 47 patients with a concussion: sex = 32 males, age = 15.9 ± 1.5 years, prior concussion history = 53.3%) completed the CQOL-Y and PROMIS-PP on two separate occasions [healthy: ~7 days apart, concussion patients: Day 3 post-injury (D3) and return-to-play (RTP)]. The CQOL-Y is a concussion-specific PRO with 50 HRQOL and 4 single-item questions in domains identified as important to adolescents following concussion: cognitive and school, social, mood and emotions, and sleep. The PROMIS-PP includes six domains: physical functioning and mobility, anxiety, depressive symptoms, fatigue, peer relationships, and pain interference. Sum of item responses generated a total score (CQOL-Y range = 0–132, PROMIS-PP = 0–96), with lower scores indicating lower HRQOL. Concurrent validity was calculated using Spearman’s Rho for each group individually and the entire sample for both time points.

Results: The CQOL-Y total scores were initial = 111.6 ± 15.7 and follow-up = 114.0 ± 16.6 for the healthy group and day 3 = 97.2 ± 22.9 and RTP = 124.4 ± 8.0 in the patient group. The PROMIS-PP raw scores were initial = 79.3 ± 12.9 and follow-up 81.4 ± 12.7 in the healthy group and D3 = 61.0 ± 16.6 and RTP = 78.8 ± 10.4 in the patient group. Within the healthy group, the correlations between the CQOL-Y and PROMIS-PP were rs = 0.588 and rs = 0.669 at the initial and follow-up time points, respectively. Among patients with a concussion, rs = 0.702 at the initial administration on D3 post-injury and rs = 0.518 at RTP. For the combined group, rs = 0.685 at the initial/D3 and rs = 0.411 at follow-up/RTP.

Conclusions: The CQOL-Y demonstrated moderate-to-good concurrent validity with the PROMIS-PP. Lower correlations were noted for the patients with a concussion and entire sample at the follow-up/RTP time point. This may be due to patients’ higher CQOL-Y scores, which may result from the notion that one must be asymptomatic to return to participation. As such, patients attempt to score well on PROs to demonstrate a resolution of symptoms and return to “normal.” Regardless, these findings suggest that the CQOL-Y is measuring constructs which differ from the PROMIS-PP, and may be more impactful to the adolescent athlete who is recovering from a concussion. Further refinement of the CQOL-Y will address measurement properties in patients with a concussion, such as responsiveness and known-group validity.
233 The Experiences of Using the Family Needs Questionnaire – Paediatric Version (FNQ-P) in a Multidisciplinary Team Supporting Young People with Acquired Brain Injury (ABI) in the Community

Lorna Walesa, Katy Rodgersea, Natalie Martlewac

aThe Children’s Trust, Tadworth, United Kingdom

ABSTRACT

Introduction: Brain injury is the most common cause of disability in the UK with around 35,000 children admitted annually due to traumatic causes. Regardless of severity, it can lead to lifelong difficulties affecting the child/young person and their family.

Brain Injury Community Service (BICS) supports children with ABI including those with concussion. FNQ-P provides information on family members’ perceptions of whether needs have been met. The questionnaire addresses 6 areas including health information, emotional support, and community support.

Methods: BICS routinely sent FNQ-P to families prior to first face-to-face visit. Support provided to complete unanswered items. Analysis of completed questionnaires using descriptive statistics and qualitative analysis of commonly reported themes.

Results: n = 184 families (traumatic n = 90; non-traumatic n = 94). Age at injury 0–17 years. Mean total score = 86 (range 7–197)

Three items with lowest mean score: to receive information on the impact of drugs or alcohol after a brain injury; to share my feelings about my child with someone who has gone through a similar experience; to have access to counselling to help me cope and to understand the different feelings I have (e.g. anger, roller coaster of emotions).

Three items with highest mean score: to have information from professionals explained in terms and in a language I can understand; to have questions answered thoroughly/respectfully in a timely manner; to feel that medical or rehabilitation staff show respect for my child’s family’s needs or wishes.

Missing data across all sections. Instrumental/practical support had most missing data (n = 17). Team feedback contained positive experiences and challenges. Additional feedback (36 families) expanded on individual child’s situation. Some clarified difficulties completing form.

Discussion/Conclusion: For younger children and those with milder injuries, a number of questions were not applicable. Although this caused some confusion for families, the tool opened conversations to build rapport with families and discuss sensitive topics such as emotional wellbeing.

The team plan to address the group needs for drug/alcohol information and access to family support. While FNQ-P may not be necessary as a routine one-off measure for this cohort, the team will continue to evaluate the tool for capturing outcome of community-based intervention.

234 Awareness and Support for Survivors of Acquired Brain Injury: A Survey of Domestic Abuse Practitioners in the UK

Sara Da Silva Ramosa, Sarah Turnerb, Josh Millsb, Ivan Pitmana, c Jocelyn Gaynorb

aThe Disabilities Trust, Brain Injury Rehabilitation Trust, Burgess Hill, United Kingdom, bThe Disabilities Trust Foundation, Burgess Hill, United Kingdom

ABSTRACT

Objectives: This study aimed to investigate the level of awareness and understanding of acquired brain injury (ABI) within practitioners in community-based services for survivors of domestic abuse in the UK. Previous research has found that domestic abuse is one of the top causes of acquired brain injury in women, although service providers’ knowledge of TBI appears to be limited (Haag et al., 2019). Nevertheless, there is growing evidence demonstrating the negative impact of brain injury on outcomes (McGinley & McMillan, 2019, O'Sullivan et al., 2020; Turner et al, in preparation), suggesting that identification of brain injury is key to ensure interventions for survivors of domestic abuse are informed and adapted to account for the effects of brain injury.

Methods: One hundred UK-based domestic abuse support services took part in an anonymous online survey adapted from Haag et al. (2019), which comprised questions about practitioners’ awareness and understanding of acquired brain injury, and training and support currently available for both professionals and survivors.

Results: The results demonstrated a lack of awareness of ABI. Eighty four percent had not had previous education or training in ABI, the vast majority (76%) believed that only up to 25% of their clients would have an ABI, and 62% of practitioners felt unprepared to identify symptoms of brain injury. Just over half (54%) of practitioners routinely asked clients whether they sustained blows to the head, although practitioners also indicated that this is frequently reported (76%) by clients. In contrast, there was good awareness of strangulation, with 82% of practitioners stating that they asked the people they support about this at some point, and also indicating that this is frequently reported by survivors (62%).

Conclusions: These results are consistent with emerging evidence, lending support to the need for increasing awareness and education about ABI and its effects in practitioners within support services for survivors of domestic abuse. Although there appeared to be good awareness of the incidence of strangulation, most practitioners did report feeling unprepared to support people to understand and overcome ABI related difficulties. Further research investigating the extent and impact of ABI on the health-related outcomes of domestic abuse survivors is key, as is the need to develop policies and practice
adapted to this particular sector. We also consider how campaigning and policy change can contribute to raising awareness of specific issues.

235 Sensation Seeking and Mild Head Injury: Relationships Among Athletic Status, Injury Characteristics, and Different Aspects of Sensation-Seeking

Caitlyn Gallant*, Francesco Amodio*, Dawn Good*

*Brock University, St. Catharines, Canada

ABSTRACT

Objectives: Previous investigations have demonstrated that certain personality traits, such as sensation-seeking and impulsivity, increase the risk that one will incur a traumatic brain injury (TBI; Liebel et al., 2021). Specifically, this relationship is well-established in the context of high-risk sports, where it has been shown that those with a greater propensity towards sensation-seeking are more likely to participate in high-risk sports and more vulnerable to sustaining a TBI (Liebel et al., 2020). Nonetheless, it has also been demonstrated that concussive injuries and subconcussive exposure are associated with physiological underarousal (Gallant et al., 2020) and that these autonomic changes can increase one’s tendency to engage in thrill-seeking behaviors (Alcock et al., 2018). Therefore, the purpose of this study was to further investigate the relationships among athletic status, mild head injury (MHI), and sensation-seeking.

Methods: University students (N = 228; Mage = 20.05; 83% female), with (42.1%) and without (57.9%) a reported history of MHI participated in this research. Thirty-nine percent of participants were athletes (66.3% low-risk; 33.7% high-risk), participating in university sports at the time of study completion. Participants completed the Sensation Seeking Scale (SSS-V; Zuckerman, 2007) to assess different facets of sensation-seeking (e.g., disinhibition, thrill and adventure seeking, experience seeking and boredom susceptibility) and a demographic questionnaire that provides information about participants’ head injury and athletic histories.

Results: Participants with a history of MHI were found to have higher total sensation-seeking scores compared to their non-injured counterparts (t[226] = 3.32, p = .001) and injury severity was positively associated with sensation-seeking (r [228] = .25, p < .001). Specifically, those with more severe injuries had higher scores across all subscales of the SSS-V, and these relationships persisted when controlling for age, sex, and athletic status. In contrast, high-risk athletic status was not associated with higher levels of sensation-seeking across all subscales, nor was athletic status in general (i.e., athlete vs. non-athlete). Further, when athletes and non-athletes were examined independently, injury severity was only associated with the disinhibition subscale of the SSS-V among non-athletes, while it was related to all SSS-V subscales (except for the disinhibition subscale) among athletes.

Conclusions: Taken together, these findings indicate that MHI status is associated with sensation-seeking and that those with more severe injuries have the highest post-injury levels. Thus, elevated levels of sensation-seeking in athletes may act as a risk factor for MHI; however, among athletes pre-existing tendencies towards sensation seeking may be amplified by TBI. Overall, these results imply that sensation-seeking may be a risk factor for MHI and a symptom post-injury.

236 Age-at-Injury as an Important Variable for Understanding Depression and Decision-making Outcomes Following Mild Head Injury

Smit Patel*, Sean Robb*,b, Dawn Good*

*aBrock University, St. Catharines, Canada, bMcMaster University, Hamilton, Canada

ABSTRACT

Objective: Interruptions to neurodevelopment that result from traumatic brain injury (TBI) often add considerable complexity to the interpretation of neuropsychological findings postinjury in clinical practice. While initial rehabilitative targets focus primarily on physical functioning postinjury, long-term life satisfaction has been linked to social reintegration. Two threats to effective social reintegration include depressive symptoms and changes in decision-making. The orbitofrontal cortex (OFC), a structure that is vulnerable to injury during mild head injury, has been functionally implicated in both of these sequelae postinjury, and documented as having a late developmental maturation. Injury to the OFC has been linked to impaired regulation of autonomic physiological arousal (Hiser & Koenigs, 2017), resulting in physiological underarousal as a measure of electrodermal activation (EDA). Our laboratory has demonstrated a robust finding of autonomic underarousal following mild head injury (MHI; Baker & Good, 2014; Noordt & Good, 2011) and linked this to: (1) reduced learning on measures of decision-making during conditions of uncertainty, (2) reduced sensitivity to punishment (Robb & Good, 2015), and (3) greater endorsement of somatic relative to affective depressive symptoms (Robb & Good, 2018). Given the development of the OFC continues well into early adulthood, the behavioral and cognitive consequences following TBI are likely to differ depending on the age the injury took place (Karver et al., 2012). Despite greater plasticity in the nervous system being associated with earlier development (i.e., Kennard principle), previous evidence suggests that earlier injury to frontal systems is associated with more substantive behavioral and cognitive challenges relative to later injuries (e.g., Anderson et al, 1999). This research serves to characterize depressive symptoms and decision-making processes as a function of age at injury for persons with MHI and contrasts this to persons without a history of MHI.

Methods: 86 Brock University students (35% with MHI) were recruited to complete multiple neuropsychological assessments and self-report questionnaires. Measures of autonomic arousal (EDA), decision-making (IGT), depression (BDI-II), and MHI history including age at injury were collected during this study. Results: Individuals with a history of MHI displayed reduced EDA at baseline, reduced sensitivity to punishment, and greater somatic depressive symptoms. Individuals who
sustained their MHI earlier in development (between ages 0–15) exhibited lower EDA and greater insensitivity to punishment on the IGT relative to those experienced who sustained their injuries later in development (ages 16–25). Lastly, those with earlier injuries endorsed more affective depressive symptoms, whereas those with later injuries reported more somatic depressive complaints.

Conclusions: Collectively, these findings demonstrate that age at injury is an important variable for clinical consideration as it relates to the assessment of depressive symptoms and decision-making, with earlier injuries being associated with worse outcomes. These findings parallel research depicting OFC developmental maturation.

237 “My Head is in a Spin” An Evaluation of Vestibular Rehabilitation Post Concussion in ABIRT

Claire Jennings*, Bernadette Salisbury, Donna O'Donnell, Louise Gough, Siobhan Canning

aSHSCT, Portadown, United Kingdom

ABSTRACT

Purpose: At present there is no existing national standard, outside of ‘return to play’ protocols, recommending vestibular assessment of patients with persistent symptoms following concussion. Common post concussive symptoms include; headache, fatigue, ‘mental fogginess’ and vestibular difficulties such as Benign Positional Paroxysmal Vertigo (BPPV), Vestibular Ocular Reflex (VOR) dysfunction and reduced balance confidence. Patients presenting to Emergency Departments or General Practitioners within the Southern Health and Social Care Trust (SHSCT) are routinely referred to the Concussion Service. The Concussion Service offers group information sessions on coping with post-concussive symptoms. Patients who present with vestibular symptoms are referred onward for specialist assessment and intervention with a neuro-physiotherapist. The SHSCT Concussion Service is the only service of its kind currently in Northern Ireland. We aimed to evaluate (a) the clinical need for vestibular assessment following concussion and (b) the efficacy of neuro-physiotherapy intervention for vestibular symptoms.

Methods: The self-reported 25-item Dizziness Handicap Inventory (DHI) questionnaire which incorporates physical, emotional and functional aspects of symptoms was used to measure vestibular symptoms on initial assessment and discharge in 2019. 12 patients (4 male, 8 female) data was analyzed using a one sample t-test.

Results: 286 referrals were made to the SHSCT Concussion Service and 43 patients attended for group intervention, with 17 reporting vestibular symptoms (i.e. 39.5%). Of these, 1 patient did not attend, 1 declined input and 3 were lost to follow-up. The age range was 29–74 years and average age of 47 years 9 months. Of the 12 patients evaluated, 58.33% presented with BPPV, 16.66% with VOR dysfunction and 25% reported reduced balance confidence. All patients were seen for initial assessment within 12 weeks of the index event. Patients were offered individual treatment including advice regarding pacing of activity and fatigue management. All patients diagnosed with BPPV were successfully treated with CRP maneuvers. VOR patients were treated with gaze stabilization and strength and balance exercises. Results show a significant improvement in DHI score from initial assessment compared with discharge (t(11.59) = 42.04, p = <0.01).

Conclusion: The results of our evaluation strongly support the clinical need to routinely check for vestibular symptoms following concussion and the efficacy of neuro-physiotherapy vestibular intervention. A limitation of this evaluation is that there was a lack of control group as well as the potential for self-selection bias of those who attended. Future service development will include provision of education for referrers from Emergency Department and GP on the likelihood of vestibular difficulties and common indicators. This study will also inform the development of similar concussion services in NHS settings and the importance of the role of physiotherapy in provision of care post concussion.

238 Studying Angular Velocity-Induced Brain Injury in Three-Dimensional Cortical Spheroids

Diane Hoffman-Kim*, Rafael D. Gonzalez Cruz*, Dowlette-Mary Alam El Din*, Lisa Okazaki

aBrown University, Providence, United States

ABSTRACT

Objective: The 10 million cases of traumatic brain injury (TBI) reported in the United States each year include multiple types such as blunt impact, blast, and others. Recent research has drawn attention to the role of rapid rotational loading, which causes high stress-strain fields throughout the brain and a high risk of skull fracture, diffuse axonal injury, and hematoma (1,2). Rotational kinematics are a better indicator of TBI risk when compared to linear acceleration (1). Here we studied non-impact TBI in a preclinical, in vitro model, utilizing three-dimensional multicellular cortical spheroids. We show that cortical spheroids exhibited cellular damage in response to angular velocity-based injury.

Methods: Spheroids were exposed to varying angular velocities and angular accelerations by centrifugation. We utilize a self-assembly approach, which generates spheroids that replicate in vivo stiffness and cell density and contain neurons, glia, neuronal precursors, endothelial cells, and extracellular matrix (3). These spheroids are electrically active and form both neurite networks and capillary-like networks (4). Cortical cells were disected from postnatal rat cortices and self-assembled at 4000 cells/spheroid in 96-well agarose gels (Microtissues Inc.). After 14 days in vitro, spheroids were subjected to centrifugation at a 90º angle for 2 minutes. Experimental conditions included angular velocities of 0, 209 and 419 rad/s and angular accelerations of 0, 7 and 14 rad/s². For repeated injuries, three centrifugations of 209 rad/s were performed, either with no delay or separated by 24 h.

Results: Twenty-four hours following the single injury experiments, centrifuged spheroids exhibited higher cell injury than uninjured control spheroids, as observed by ethidium
homodimer-1 (EthD1) staining of injured or fragmented nuclei. ImageJ plugins 3D Iterative Threshold and 3D Object Counter confirmed these observations with quantitative analysis (p < 0.05). Centrifuged spheroids contained glial fibrillary associated protein-positive reactive astrocytes.

In analysis performed both 24 h and 72 h following the repeated injury experiments, centrifuged spheroids exhibited higher cell injury than both uninjured control spheroids and single injury spheroids, as observed by EthD1 staining and quantification as described.

Conclusions: This study showed that cellular injury can occur as a result of high angular velocity and mild angular acceleration. The accelerations used in this work are lower than those previously reported in concussive events. Their ability to generate injury could partially reflect the high angular velocity, a variable also important to consider. This 3D spheroid model provides a platform for the study of TBI in engineered, microscale tissues with brain-like features, and can be useful for studying mechanisms and potential therapeutics for TBI.

References. 1. Kleiven, Front Bioeng Biotechnol 2013; 2. Cullen, Methods Mol Biol 2016. 3. Dingle, Tiss Eng C 2015. 4. Boutin, J Neurosci Meth 2017.

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239 Leveraging Photoelicitation Methods to Elucidate Resilience Among Adults with Co-occurring Traumatic Brain Injury and Opioid Use Disorder

Kathryn Coxe, Erica Pence, Audrey Begun

The Ohio State University, College of Social Work, Columbus, United States

ABSTRACT

Background: Traumatic brain injury (TBI) and opioid use disorder (OUD) are debilitating conditions that present unique challenges for adults living with these comorbidities. Although rehabilitation efforts have historically focused on treating deficits associated with TBI, treatment paradigms are shifting to strength-based models that emphasize resilience. However, resilience among individuals with TBI is poorly understood. The cognitive, emotional, and behavioral challenges following TBI may complicate skills needed to build resilience post-injury. Moreover, the added complexity of opioid misuse post-injury may muddle resilient outcomes and pose added vulnerability to adversity. Few prior studies have included individual perspectives of resilience following TBI and most studies have not investigated resilience within the individual’s social context and physical environment. Visual research methods are powerful mechanisms to engage individuals with comorbid TBI and OUD in research to establish a deeper understanding of resilience from the survivors’ perspective and within a naturalistic setting.

Objective: This study aimed to investigate resilience as perceived by adults with co-occurring TBI and OUD, and the risk factors contributing to vulnerability to adversity.

Methods: Applying photoelicitation methods, participants were purposively recruited through an urban hospital outpatient program in the capital city of a large U.S. Midwestern state that specializes in treating adults with co-occurring TBI and substance use disorders. Participants were included who had lifetime history of TBI identified through the Ohio State University TBI Identification method, a DSM-5 diagnosed OUD, and Orientation Log score ≥25. Data were collected between December 2019 and March 2020 through photographs taken by participants, descriptive text messages, and semi-structured interviews. Data were co-coded and analyzed using document analysis. Themes were developed according to tenets of Resilience Theory.

Results: A total of N = 126 photographs, 47 text messages, and four interview transcripts were included for analysis. Resilience was demonstrated through psychological flexibility, use of existing resources, and compensatory strategies to overcome stressors. Specifically, participants documented resilience through: 1) commitment to cognitive, physical, and emotional growth; 2) the ability to frame negative experiences into a positive appraisal of their circumstances; 3) social support from family, friends, and peers; and 4) healthy coping skills through physical activity, technology use, and the arts. Participants unanimously documented chronic pain as a major barrier to daily functioning. Participants also reported that lack of transportation and difficulty navigating urban city transportation systems were primary barriers to accessing available health services. Yet, while supportive services specific to TBI and OUD were desired, participants described these as largely unavailable.

Conclusion: This study is the first step toward a better understanding of resilience among adults with comorbid TBI and OUD. Results can inform the development of strengths-based interventions that promote resilience post-injury, as well as policies aimed to reduce barriers to treatment access.

240 The Effect of Mesenchymal Stem Cells Administration on Gastrointestinal System Inflammatory and Oxidant Stress Factors in Experimental Traumatic Brain Injury

Zahra Soltani, Saeed Karamouzian, Nazanin Sabet, Mohammad Khaksari

Endocrinology and Metabolism Research Center, Institute of Basic and Clinical Physiology Sciences, Azfalipour School of Medicine, Kerman University of Medical Sciences, Kerman, Iran. Dept. Physiology, Azfalipour Faculty of Medicine, Kerman University of Medical Sciences, Kerman, Iran, Kerman, Iran. Physiology Research Center, Institute of Neuropharmacology, Kerman University of Medical Sciences, Kerman, Iran, Kerman, Iran. Physiology Research Center, Institute of Neuropharmacology, Kerman University of Medical Sciences, Kerman, Iran, Kerman, Iran.
Introduction: Traumatic Brain Injury (TBI) is one of the leading causes of disability and mortality of people at all ages. TBI-induced inflammatory response is not limited to the brain. Studies in recent decades have shown that mesenchymal stem cells (MSCs) could be had beneficial effects in TBI. In this study, the effect of oral mucosal MSCs treatment following experimental traumatic brain injury was evaluated on inflammatory and oxidative stress factors in gastrointestinal system. 

Materials/Methods: In this study, 24 Wistar adult male rats divided to four groups: sham, TBI, vehicle and stem cell (SC). Moderate diffuse traumatic brain injury was induced by mar-mour’s method. Oral mucosal MSCs (2 x 106 cells) were injected intravenously 1 and 24 h after injury. The levels of interleukin-1β (IL-1β), interleukin-6 (IL-6), interleukin-10 (IL-10), malondialdehyde (MDA), protein carbonyl (PC), total antioxidant capacity (TAC), superoxide dismutase (SOD), and catalase (CAT) in stomach, small intestine and colon were evaluated 48 h post-injury.

Results: TBI was resulted in a significant increase in inflammatory agents of IL-1β and IL-6 and oxidant agents of MDA and PC in stomach, small intestine and colon compared to sham group 48 hours after injury. However, antioxidant factors SOD, TAC and CAT and anti-inflammatory factor IL-10 in gastrointestinal system reduced following TBI. The administration of MSCs reversed all changes induced by TBI.

Conclusion: The results of this study showed that administration of OMSCs following TBI could probably reduce inflammation and oxidative stress in gastrointestinal system. Therefore, the administration of OMSCs can be investigated more.

Keywords: Traumatic brain injury, Stem cell, Gastrointestinal system, Inflammation

241 Pathways Through Rehabilitation for Traumatic Brain Injury: Preliminary Results from an Irish Study

Andrea Healya, Kate O’Donnella, Catherine Corrigana, Anthony Stainesa, Teresa Burkea, Brian Waldronb, Grainne McGettrickb

aDublin City University, Dublin 9, Ireland, bAcquired Brain Injury Ireland, Dunlaoghaire, Co. Dublin, Ireland

ABSTRACT

Objectives: Traumatic brain injury (TBI) is a leading cause of death and disability worldwide. In Ireland, a dearth of research on TBI means that we neither know how many people are living with a TBI, nor have the information required to improve brain injury rehabilitation services. This study focused primarily on pathways through rehabilitation post- moderate to severe TBI in Ireland.

Method: This research was a mixed-methods, observational cohort study design. One hundred and twenty-one participants with TBI were recruited through two major trauma centres, two national brain injury services and a rehabilitation hospital. Participants with TBI were surveyed on two separate occasions six months apart, and EQ-5D 3 L, WHOOQOL BREF and EBIQ instruments administered. Carers or family members of participants with TBI were surveyed once. This paper reports preliminary findings from the first interviews of participants with TBI.

Results: Almost 50% of participants reported having received some rehabilitation intervention during initial admission in the acute hospital setting. In 55.4% of cases, inpatient rehabilitation in a specialist setting was recommended for after discharge from the acute hospital setting. Overall, some form of outpatient rehabilitation was recommended to a high percentage of cases (62% in an out-patient rehabilitation setting: 51.2% in a specialised brain injury community-based rehabilitation setting). Notably, rehabilitation was not recommended in almost 10% of cases following discharge from the acute hospital setting. Over 66% of participants reported that their employment status changed as a result of their injury and 30.6% of respondents indicated that post-injury they were not working due to permanent sickness or disability. Looking at other outcome measures, there were sizable differences between scores on the EBIQ domains by gender, with men generally having higher scores than women, but the scores were similar when classified by a measure of injury severity (moderate or severe).

Discussion: Access to rehabilitation services varied substantially within the cohort. Based on best practice guidelines, improved and more equitable access to rehabilitation services is necessary to ensure better outcomes for TBI survivors in Ireland. This study provides information concerning pathways through rehabilitation for survivors of moderate to severe TBI which is the first step toward the development of improved rehabilitation services.

242 Initiatives from the Galveston Brain Injury Conference; Improving Outcomes for Pediatric Brain Injury Across All settings

Judy Dettmera

aNational Association of State Head Injury Administrators, Fort Collins, United States

ABSTRACT

This session will provide an overview of the accomplishments and on-going initiatives that were generated out of the Galveston Brain Injury Conference (GBIC) which was focused on pediatric brain injury for the past three years. The GBIC has a long tradition of bringing together experts across disciplines to explore avenues for improving outcomes for brain injury. 2019–2021 GBIC was focused on pediatric brain injury. The foundation for the work generated from this conference was the Center for Disease Control and Prevention’s Report to Congress on the Management of Traumatic Brain Injury in Children. This report describes the public health burden of brain injury in children and adolescents, including the variety of outcome that may be experienced following a brain injury. One study found that more than 62% of children with moderate-to-severe TBI experienced disability (Rivara FP, Koepsell TD, Wang J, et al., 2012). The CDC report identifies gaps that exist, and outlines some practices that hold promise in addressing those gaps.
Experts joined one of three groups; Recognize, Monitor, and Care. Each with a focus of improving the outcomes of children and youth across the continuum of care from identification of brain injury to transition to adulthood. The focus of each workgroup was to build on promising practices to develop a plan for improving outcomes across all settings, healthcare, school, and community and across all severities of injury, mild, moderate, and severe. What resulted were approaches and tools that can be used to improve outcomes for children and youth with brain injury.

These initiatives will benefit healthcare providers, education personnel, and community providers. Additionally, there was a special focus on improving outcomes for justice involved individuals with brain injury. Youth with brain injury are at higher risk for involvement with the justice system. A meta-analysis found that approximately 30% of juvenile offenders have sustained a previous brain injury (Vaughn, Salas-Wright, Delisi, & Perron, 2014). Given the risk of justice involvement, the Monitor group felt this population deserved a special focus. This session will provide the following:

1. Overview of the CDC Report to Congress
2. Background on the process of the GBIC workgroups
3. Review of the approaches and tools that resulted from the workgroup.

243 Individual and Clinical Characteristics of Older Adults with Concussion

Crystal Ramseya,b, Lindsey Byomab

aUniversity of North Carolina – Chapel Hill, Chapel Hill, United States, bElon University, Elon, United States

ABSTRACT

Objectives: Adults over age 65 are among those most at risk for concussion or mild traumatic brain injury (TBI) and with an aging population, concussion among older adults has increased in recent years (Taylor, et al., 2017). Growing concussion incidence among older adults is concerning because older age is associated with increased risk for poorer functional outcomes after TBI (Graham, et al., 2010). The objective of this preliminary study was to describe the demographic and injury characteristics of a clinical sample of older adults with concussion as a first step to describing the rehabilitation needs of this population.

Methods: This research is part of a larger retrospective study of electronic medical record data of older adults with TBI who received healthcare within a large US healthcare system between 2014 and 2018. Participants were aged 65–89 years at the time of data extraction and had a diagnosed concussion (S06.0, S05.0, S05.11, S05.0, S06.9, S06.12, S06.0, S05.3). Demographic variables (age, sex, race, ethnicity, and marital status) were characterized using descriptive statistics and the total number and percentage of each concussion diagnostic code is reported.

Results: Within our larger data set of 3807 older adults with TBI, 730 concussive events among 725 individuals were identified. The sample was comprised of 452 females (61.92%) and 278 males (38.08%) and mean participant age at data extraction was 74.34 years (SD = 6.22). The majority of participants (84.79%) were white, 8.77% were Black or African American, 0.41% were Asian, .41% were American Indian or Alaskan Native, and 5.48% were of another or unknown race. 95.21% of participants identified as not Hispanic or Latino. Approximately half of the participants were married (52.19%), 18.49% were widowed, 9.73% divorced, 9.32% single. Across all concussive events, 364 (56.67%) included a loss of consciousness, 352 (45.13%) did not include loss of consciousness, and consciousness was unspecified for 64 (8.21%) events.

Conclusions: Early analysis of this clinical sample of older adults diagnosed with concussion indicate a sample similar to those previously reported for studies of geriatric TBI (Gardner, et al., 2018) in terms of age, sex, and racial and ethnic identity. As reported in Gardner, et al., (2018), a large proportion of our sample was white women, reflecting a patient profile distinct from that of younger adults in which males and non-white individuals were more likely to sustain TBI (Taylor, 2018; Wallace, et al., 2020). These demographic differences, as well as age-related health and injury factors, indicate the need for geriatric-specific approaches to concussion rehabilitation. Using this sample, we will identify the demographic, injury, and health-based risk factors for needing rehabilitation services post-concussion.

244 Pediatric Traumatic Brain Injury Monitoring Across Developmental Stages and Settings: The Pediatric Check-Up for Brain Health (PIC-UP) Created by the Galveston Brain Injury Conference

Brenda Eagan-Johnsonab

aBrainSTEPS Brain Injury School Consulting Program, Pittsburgh, United States

ABSTRACT

Monitoring a child for new or ongoing learning, emotional, physical, attention/behavioral, social, and communication problems over the years following a traumatic brain injury (TBI) is critical. During development, new issues may emerge as the child ages. However, care for TBI is often fragmented or ceases after discharge from acute medical services. For the purposes of monitoring children’s recovery from TBI, a simple but effective screening tool was needed.

The Galveston Conference Monitoring Workgroup (2019–2021) created the Pediatric Injury Check-Up for Brain Health (PIC-UP) as a new measure to fill this gap. Modeled on existing measures of post-concussive symptoms and quality of life, the PIC-UP Tool has four versions, designed to be completed by 1) parents, 2) students, 3) healthcare providers, and 4) school personnel, thereby providing the opportunity to elicit multiple perspectives and coordinate care across settings following pediatric TBI. The PIC-UP Tool will be validated through research prior to widespread dissemination and implementation.

The PIC-UP Tool provides a brief but comprehensive overview of common problems that can occur after TBI and asks if a child is experiencing them and whether they are receiving
adequate help for those problems. Pre-established follow-up guidance when an issue is identified requires a communication process for “next step guidance” that spans across family, medical, rehabilitation, and school entities. Problems unrelated or only indirectly related to the brain injury may be identified by this Tool. Therefore, when ongoing problems are identified, children with TBI and their families should be assessed by a provider with expertise in brain injury to advise them on the most appropriate management approach. In some situations, discerning whether current problems are directly related to the TBI will be difficult, and more detailed assessments will be required to develop an individualized treatment plan (Masel and DeWitt, 2010).

Initiating the monitoring of children immediately after diagnosis of TBI is critical across multiple settings, including home, school, and community. Critical timepoints for monitoring include developmental and school transitions; however, in most situations, monitoring will need to be adapted to the individual. Widespread implementation of a simple but standardized monitoring tool has the potential to have a profound, positive public health impact related to TBI (Ewing-Cobbs, Krowowski, Slomine, & Yeates, 2020).

Workgroup Members: Judy Dettmer, Brenda Eagan-Johnson, Betty Abreau, Linda Ewing-Cobbs, Wayne Gordon, Cynthia Hiltz, Brad Krowowski, Cate Miller, Mark Sherer, Tim Siegel, Beth Slomine, Janet Tyler, Susan Vaughn, Shari Wade. This work was developed through the Galveston Brain Injury Conference (GBIC), which is supported by the Moody Endowment, Moody Neurorehabilitation Institute, University of Texas Medical Branch Center for Recovery, Physical Activity and Nutrition (CeRPAN), and UTMB School of Health Professions (SHP).

245 Recognizing Institutional Racism in Integrated Care for Black People Living with Traumatic Brain Injury: A Critical Spotlight on the Clinical Care Journey

Samira Omar\textsuperscript{a}, Stephanie Nixon\textsuperscript{a}, Angela Colantonio\textsuperscript{a}

\textsuperscript{a}Rehabilitation Sciences Institute, University of Toronto, Toronto, Canada

\textbf{ABSTRACT}

\textbf{Rationale:} Contemporary understandings of the etiology of traumatic brain injury (TBI) and trajectory of care lack consideration for the inclusion of Black populations and the impact of institutional racism and its related intersections. Although community integration is an ultimate goal of rehabilitation post-injury, Black people living with TBI have unmet needs along the care continuum, including meaningful participation in activities of everyday living, resulting in occupational deprivation. Integrated care is seen as a comprehensive and ideal approach to service delivery. However, little is known about what this means for Black people with TBI.

\textbf{Objectives:} This novel critical transdisciplinary scoping review examined the literature on integrated care pathways that consider Black people living with TBI. The scoping review was undertaken with the following objectives: (a) the extent, nature, and range of literature on care pathways that consider Black populations, (b) summarize how Blackness, race, and racism are conceptualized in the literature, (c) determine how Black people come to access care pathways, and (d) identify how care pathways in research consider the mechanism of injury and implications for human occupation.

\textbf{Methods:} Six databases were searched systematically identifying 178 articles after removing duplicates. In total, 43 articles on integrated care within the context of Black persons with TBI were included in this review. Narrative synthesis was conducted to analyze the data and was presented as descriptive statistics and as a narrative to tell a story of the findings.

\textbf{Results:} All studies were based in the United States where 81% reported racial and ethnic disparities across the care continuum. Sex, gender, and race are used as demographic variables where statistical data were stratified by race in only 9% of studies. Black patients are primarily denied access to care, experience lower rates of protocol treatments, poor quality of care, and lack access to rehabilitation. Racial health disparities are disconnected from racism and are displayed as symptoms of a problem that remains unnamed. Racism is not explicitly named in the included studies.

\textbf{Conclusions:} Findings from this study illustrate how racism becomes institutionalized in research on TBI care pathways, demonstrating the need to incorporate the voices of Black people, transcend disciplinary boundaries, adopt an anti-racist lens in education and training, and examine diverse geographical contexts as there is a lack of research on this topic outside of the United States. It is important to identify, examine, and measure the underlying factors that contribute to racial health disparities such as white supremacy and institutional racism at various levels including the interpersonal, personal, and institutional. These findings have implications for care pathways and the ways in which Black people experiencing TBI navigate the care continuum.

246 Service Delivery Program Models in Pediatric and Adolescent Concussion: A Systematic Review

Haley Chizuk\textsuperscript{a},\textsuperscript{b} Aaiush Jain\textsuperscript{a}, Jacob McPherson\textsuperscript{a,b}, Jacqueline Purtzik\textsuperscript{c,d}, Barry Willer\textsuperscript{a,e}

\textsuperscript{a}UBMD Concussion Management Clinic, Buffalo, United States, \textsuperscript{b}Rehabilitation Sciences, School of Public Health and Health Professions, Buffalo, United States, \textsuperscript{c}Division of Physical Medicine, Rehabilitation Developmental Pediatrics, University of British Columbia, Vancouver, Canada, \textsuperscript{d}Adolescent Complex Concussion Clinic, GF Strong Rehab Centre, Vancouver, Canada, \textsuperscript{e}Department of Psychiatry, Jacobs School of Medicine and Biomedical Sciences 3, Buffalo, United States

\textbf{ABSTRACT}

\textbf{Background:} Concussion is a common injury with an estimated incidence of 1.7–3.8 million per year in the United States. Although not every person who sustains a concussive injury will seek medical advice, those who do may be seen by their primary care physician, by a specialist or within a specialized concussion clinic. Specialized clinics vary from community
Integrity
Concussion
Support
ware,
completed
integrated
ce.

Objectives: The following databases were included in our search: PubMed, Embase (OVID), CINAHL Plus (EBSCO), PsycINFO (OVID) and Web of Science. Searches will be limited to human trials in English, published in 2001 or later. Databases were selected in order to optimize the inclusion of relevant literature. Search strategies were developed with assistance from a health sciences librarian. Search terms were identified by examining pertinent literature from preliminary searches and extracting key words and controlled indexing vocabulary (e.g., MeSH and Emtree terms). Studies were included if they described the characteristics of service delivery models or associated health care costs within pediatric concussion, post-concussion symptom or mild Traumatic Brain Injury (mTBI) populations. Two reviewers with expertise in concussion completed a blinded title and abstract screen utilizing Rayyan software, followed by a full-text screen to choose appropriate articles on the same platform. A third reviewer with expertise in concussion was used to solve inclusion conflict amongst the two previous reviewers during both screenings.

Support for this project was provided by the UBMD Concussion Management Clinic.

247 Association of White Matter Microstructural Integrity and Short-Term Outcomes After Traumatic Brain Injury

Alexa Waltera, James Guggera, Drew Parkera, Ragini Vermaa, Andrea Schneidera, Danielle Sandmarka, Ramon Diaz-Arrastiaa

aUniversity Of Pennsylvania, Philadelphia, United States

ABSTRACT

Objectives: Traumatic brain injury (TBI) is a heterogenous disease that can have a wide range of outcomes post-injury. These outcomes can vary both in their presentation and temporal pattern, making effective treatment and rehabilitation challenging. Diffusion tensor imaging (DTI) can characterize the microstructural properties of white matter post-injury however, the precise relationship between DTI abnormalities and outcomes is not fully understood. The aim of this analysis was to identify microstructural abnormalities in neuroanatomically defined brain regions that are most contributing to cognitive and functional outcomes.

Methods: Forty-four patients with non-penetrating TBI (mean [SD] age: 35.6 [16.6] years, 80% male, 52% white, median GCS: 15 (IQR: 14–15)) were enrolled within 24 hours of admission to our Level 1 Trauma Center. Participants underwent a research 3 T MRI that included a DTI sequence and symptom and neuropsychological assessment (Glasgow Outcome Scale – Extended (GOSE); Rivermead Post-Concussion Symptom Questionnaire (RPQ); Rey Auditory Verbal Learning Test (RAVLT); Trail Making Test (TMT) A&B) at 14 ± 2 days post-injury. Diffusion weighted images were preprocessed and registered to the JHU-MNI-ss (Eve) atlas. Mean fractional anisotropy (FA), mean diffusivity (MD), radial diffusivity (RD), and axial diffusivity (AD) were calculated in each region of interest (ROI) and 92 white matter ROIs were then grouped into five neuroanatomical categories: Association, Cerebellar, Comissural, Projection, and Superficial White Matter. Least Absolute Shrinkage and Selection Operator (Lasso) regressions, using cross validation and with sex and age a priori selected into the model, were run to identify which region and corresponding DTI metric most contributed to an outcome of interest.

Results: Lasso regressions revealed that for functional rating scale outcomes, GOSE was most explained by AD Cerebellar and FA Projection (MSE = 1.151, R² = 0.141) while RPQ was most explained by FA Projection, AD Superficial White Matter, and AD Cerebellar (MSE = 100.805, R² = 0.256). For cognitive outcomes, RAVLT was most explained by FA Cerebellar, AD Commissural, and AD Superficial White Matter (MSE = 114.717, R² = 0.267), TMT-A was most explained by MD Cerebellar, AD Projection, FA Association, and AD Projection (MSE = 115.427, R² = 0.549), and TMT-B was most explained by FA Cerebellar, RD Cerebellum, and FA Association (MSE = 1905.616, R² = 0.503).

Conclusions: As TBI can lead to variable symptoms and objective deficits in somatic, affective, and cognitive function, a better insight into the underlying physiology of these outcomes is needed. These findings begin to identify regions of the brain that may contribute to distinct negative outcome patterns post-injury. Additionally, the data suggest cognitive outcomes are more explained by microstructural integrity in distinct white matter regions and that microstructural measures beyond FA and MD may be useful in explaining these outcome patterns. Additional work is needed to further elucidate the relationship between regional white matter damage, specific outcome domains, and the temporal evolution of these abnormalities.

248 Investigating Cannabis Use in Individuals with a History of Mild Head Injury and a Psychiatric Condition

Rachel Luczone, Dawn Goodb

aBrook University, St. Catharines, Canada

ABSTRACT

Objective: Several studies have found that following traumatic brain injury (TBI), individuals can experience impaired ability to manage and regulate emotional responses towards negatively-valenced stimuli, and this emotion dysregulation is reflected in both their ability to cognitively evaluate the stimuli and physiologically/autonomically respond to an emotionally-provocative stimulus (e.g., Neumann, et al., 2014; Aboulafia-
ABSTRACT

Objective: Addressing comorbidities of traumatic brain injury (TBI) remains the main challenge facing healthcare systems worldwide; however, they are primarily concerned with managing concurrent injuries and post-injury comorbidities rather than those preceding it. Such a focus undervalues the importance of primary preventive strategies to offset the risk of TBI itself.

Methods: In a population-based study of publicly insured Ontario residents, we retrospectively analyzed all International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10) codes recorded in the acute care and emergency department (ED) visits using a big data algorithm, and characterized diagnostic patterns of patients five years preceding their TBI diagnoses in comparisons to patients without TBI, individually matched by sex, age, socioeconomic status and place of residence.

Results: Of the 58,561 patients (and matched reference patients), 57% were men, and 62% were 40 years of age or younger when they had their first TBI. Multiple testing grouped a total of 2600 ICD-10 codes used by healthcare providers to classify these patients’ conditions within five preceding their TBI into categories. Then, using factor analysis, those categories were whittled down to 43 that were significantly related to TBI vs. non-TBI events. These results were internally validated. Sorted by effect size, the factors topping the list in patients with TBI included those linked to environmental exposures, assault, and child abuse, and the adverse effects of medications and drugs in the years leading up to TBI.

Conclusions: These findings suggest that comorbidity preceding TBI could be critical in assessing patients’ risk of brain injury. These findings also point to the complexity of social circumstances surrounding an individual at the time preceding their TBI. Further refinement in big data methodology is needed to untangle the longitudinal interplay of factors to understand TBI along the time continuum.

Funding Sources: The research reported in this presentation was supported by the Eunice Kennedy Shriver National Institute of Child Health & Human Development of the National Institutes of Health under Award Number R21HD089106 and the National Institute of Neurological Disorders and Stroke of the National Institutes of Health under Award Number R01NS117921.

249 Mastering Understanding of Comorbidity Preceding Traumatic Brain Injury: A Data-Driven Population-Based Study

Tatiana Mollayeva\textsuperscript{a,b,c}, Vincy Chan\textsuperscript{a}, Angela Colantonio\textsuperscript{a,b}, Mitchell Sutton\textsuperscript{a}, Sayantee Jana\textsuperscript{c}, Andrew Tran\textsuperscript{c}, Michael Escobar\textsuperscript{c}

\textsuperscript{a}KITE Toronto Rehabilitation Institute, University Health Network, Toronto, Canada, \textsuperscript{b}Rehabilitation Sciences Institute University of Toronto, Toronto, Canada, \textsuperscript{c}Dalla Lana School of Public Health, Toronto, Canada

ABSTRACT

Objective: Addressing comorbidities of traumatic brain injury (TBI) remains the main challenge facing healthcare systems worldwide; however, they are primarily concerned with managing concurrent injuries and post-injury comorbidities rather than those preceding it. Such a focus undervalues the importance of primary preventive strategies to offset the risk of TBI itself.

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Conclusions: These findings suggest that comorbidity preceding TBI could be critical in assessing patients’ risk of brain injury. These findings also point to the complexity of social circumstances surrounding an individual at the time preceding their TBI. Further refinement in big data methodology is needed to untangle the longitudinal interplay of factors to understand TBI along the time continuum.

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250 Invisible in Plain Sight: Partner-Inflicted Brain Injury and Brain Injuries Caused by Interpersonal Violence

Rachel Ramirez\textsuperscript{a}, Julianna Nemeth

\textsuperscript{a}Ohio Domestic Violence Network, Columbus, United States

ABSTRACT

The iconic image of a domestic violence victim is a woman with a black eye. Research has also shown that the head, neck and faces of domestic violence victims are the most targeted
area of their body during assaults. Yet the impact of brain injury caused by domestic violence has gone virtually unexplored for decades, as those working in brain injury and those working in domestic violence have been operating in separate worlds, with little interaction.

The Ohio Domestic Violence Network (ODVN), the statewide coalition on domestic violence representing 75 domestic violence service providers in Ohio, is on the cutting edge of paradigm shifting work to address this unrecognized public health crisis-partner inflicted brain injury (PIBI) – encompassing brain injuries caused by blows to the head, neck and face (traumatic brain injury) and strangulation (hypoxic-anoxic brain injury) in the context of domestic violence. ODVN, in collaboration with research partner The Ohio State University (OSU), conducted groundbreaking research in Ohio from 2016–2019 that uncovered over 8 in 10 survivors in DV advocacy services were targeted for head trauma and strangulation by abusers, often repeatedly and concurrently. Partner-inflicted brain injury, rarely identified, often misattributed to psychological causes, and almost never immediately treated, results in short- and long-term physical, emotional, and cognitive consequences that can impact every area of a person’s life, including acting as a contributor to the health disparities domestic violence survivors currently experience and the behavioral drivers of these disparities including substance use and suicidal ideation.

Following a health planning framework including a comprehensive needs assessment, ODVN provided training, technical assistance, developed resources, and built an enhanced service provision approach called CARE (Connect, Acknowledge, Respond, Evaluate) to address partner-inflicted brain injury within domestic violence services. To respond to the growing interest in this emerging issue, ODVN established the Center for Partner-Inflicted Brain Injury (The Center) to provide statewide, national, and international leadership to raise awareness on brain injury caused by domestic violence. This session introduces participants to the dynamics of domestic violence and the unique characteristics of partner abuse, as well as the context and environment in which domestic violence victims are acquiring brain injury. We will discuss the important differences between domestic violence victims and other more commonly studied groups impacted by brain injury – such as the military or sports – and how many of the responses and interventions developed for those groups have limited applicability to the life situations of domestic violence survivors. We will discuss the research conducted in Ohio with domestic violence program advocates. Finally, the training will conclude with discussing opportunities for building collaboration between the domestic violence and brain injury fields.

251 Comorbidity Preceding Traumatic Brain Injury is Associated with Excess Mortality: A Retrospective Cohort Study from Ontario, Canada

Tatyana Mollayeva\textsuperscript{a,b,c}, Mackenzie Hurst\textsuperscript{d}, Mitchell Sutton\textsuperscript{a}, Michael Escobar\textsuperscript{e}, Vincy Chan\textsuperscript{a,b}, Angela Colantonio\textsuperscript{a,b}

\textsuperscript{a}KITE Toronto Rehabilitation Institute, University Health Network, Toronto, Canada, \textsuperscript{b}Rehabilitation Sciences Institute University of Toronto, Toronto, Canada, \textsuperscript{c}Dalla Lana School of Public Health, Toronto, Canada

**ABSTRACT**

Objective: With advanced resuscitation, more patients survive traumatic brain injuries (TBIs). The influence of the pre-injury comorbidity on excess mortality is not known. We focused on examining the relationships between pre-injury comorbidities and excess mortality rates, stratifying results by injury severity and sex.

Methods: A retrospective population-based cohort study. All patients with an International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10)-based diagnosis of TBI on their entry to an emergency department (ED) or acute care facility between 2002 and 2016 in Ontario, Canada, were enrolled and followed in time. The final cohort consisted of 308,353 patients (59% male). This sample was randomly split into training (50%), validation (25%), and testing (25%) datasets. The influence of 43 injury-preceding comorbidity factors that differentiated patients with TBI in EDs and acute care facilities from those with diagnoses other than TBI, individually matched based on age, sex, income level, and place of residence, on mortality rates in excess of the expected mortality were calculated using sex- and age-specific life tables.

Results: There were 5,792 deaths for the total sample of 77,088 patients (59% male) who survived the TBI event in the testing dataset, equating to a mortality rate of 7.51% (male patients: 3,163 deaths [6.95%]; female patients: 2,629 [8.33%]). Most death events (n = 1,648; 28.45%) occurred within the first year after TBI. Afterward, they gradually decreased for the next ten years (15.78–1.99%) and declined thereafter to 0.16% at year 14. Accounting for the cause of injury and socio-economic standing, 33 injury-preceding comorbidity factors were strongly associated with excess mortality rates. These rates were comparable between the sexes. Additional analyses in the validation dataset confirmed that these findings were unlikely a result of TBI misclassification or unmeasured confounding.

Conclusions: The research findings contribute to our understanding of the processes underlying increased mortality risks in patients with TBI across the lifespan. It is necessary to acknowledge comorbidities preceding TBI that substantially elevated the rates of excess mortality across injury severities and sexes, even after adjustment for other proxies of mortality. Future research should examine the interactions between comorbidity factors preceding and following TBI, especially factors that are frequently associated with fragility of patients resulting from decreased physiological reserves of multiple organ systems.

Funding Sources: This research was supported by the Eunice Kennedy Shriver National Institute of Child Health & Human Development of the National Institutes of Health under Award Number R21HD089106 and the National Institute of Neurological Disorders and Stroke of the National Institutes of Health under Award Number R01NS117921.
252 Development of a Virtual Group-Based Intervention for Caregivers of Youth with Persistent Post-Concussion Symptoms: An Intervention Mapping Approach

Hiba Al-Hakeem\textsuperscript{a,b}, Tess Bardikoff\textsuperscript{a}, Andrea Hickling\textsuperscript{a}, Brenda Knapp\textsuperscript{a}, Shannon Scratch\textsuperscript{a}

\textsuperscript{a}Bloorview Research Institute, Toronto, Canada, \textsuperscript{b}University of Windsor, Windsor, Canada

ABSTRACT

Background: It is known that health of youth and caregivers are dynamically interconnected. Approximately 30\% of youth experience persistent post-concussion symptoms (PPCS), which continue beyond four weeks post injury. Prolonged youth recovery is found to affect caregiver’s mental health and family functioning. Parental stress also adversely affects youth with PPCS, suggesting that addressing caregiver needs can minimize negative health outcomes among their children. Despite the critical role that caregivers play in concussion recovery, there are no empirically-validated interventions tailored to the specific needs of caregivers of youth with PPCS.

Objective: To describe Move&Connect-Caregivers, a virtual group-based intervention for caregivers of youth with PPCS, using the Intervention Mapping (IM) approach.

Methods: The six-step IM approach was utilized to guide the development of the novel intervention. First, a focus group with caregivers of youth with PPCS (n = 5) was held to understand their requirements [Needs Assessment step]. The collected data guided the development of program objectives which include psychoeducation, advocacy, and tools to promote positive family and health outcomes [Objectives]. Next, concerns and educational topics suggested by caregivers and supplemented with the theoretical framework of FAB (family-directed approach to brain injury) helped in designing content and methods of the intervention [Design]. Multiple iterative meetings were held with a clinical neuropsychologist and a social worker to develop intervention components and reference material. Further, consultations with stakeholders and a family leader were integrated into the creation process [Production]. The last two steps of IM [Implementation and Evaluation] are planned to assess program feasibility (Summer 2021) and program effectiveness will be established in a future pilot trial.

Results: Move&Connect-Caregivers is a virtual group-based intervention that focuses on support strategies to address caregivers’ health needs. It is comprised of six sessions titled as follows: Concussion Ripple Effect, School Advocacy, Child’s Well-being, Family & You, Parenting is Hard, and Stress & Daily Challenges. This intervention will be delivered weekly by a clinical neuropsychologist and a social worker using the Zoom Health Care platform. Each session is one hour in length, and includes a psychoeducational topic and a group activity followed by discussions and reflections. Handouts and additional resources like websites and flyers will be provided to participants.

Conclusion: This novel intervention will shed light on meaningful strategies to improve the well-being of families dealing with concussion. The IM approach is used as a guiding framework to systematically develop an evidence-based intervention for caregivers of youth with PPCS. Virtual interventions are important to enhance accessibility, convenience and social support, especially in current circumstances of COVID-19.

253 Prediction of Brain Age for Healthy Individuals and Patients with Traumatic Brain Injuries

Maheen Adams\textsuperscript{a,b}, Xiaojian Kang\textsuperscript{b}, Ines Luttenbacher\textsuperscript{c}, John Coetzee\textsuperscript{a,d}, Victoria Liou-Johnson\textsuperscript{a,b}, Emily Dennis\textsuperscript{e}, Frank Hillary\textsuperscript{f}

\textsuperscript{a}Department of Neurosurgery, Stanford School of Medicine, Palo Alto, United States, \textsuperscript{b}Department of Rehabilitation, Veterans Affairs Palo Alto Health Care System, Palo Alto, United States, \textsuperscript{c}Department of Psychology, University of Amsterdam, Amsterdam, The Netherlands, \textsuperscript{d}Department of Psychiatry and Behavioral Sciences, Stanford University, Palo Alto, United States, \textsuperscript{e}Department of Neurology, University of Utah, Salt Lake City, United States, \textsuperscript{f}Department of Psychology, Penn State University, University of Pennsylvania, Pennsylvania, United States

ABSTRACT

Introduction: There were 46.8 million people worldwide with dementia in 2015, and this number will almost double every 20 years. Despite the high rate of falls that result in brain injury in older adults, it is difficult to separate the impact of Traumatic Brain Injury (TBI) on the development of dementia from other contributing factors such as genetic predisposition to Alzheimer’s, sex, education, and age. This problem can be addressed by employing machine-learning algorithms that use an individual’s neuroimaging data to predict their chronological age. The Enhancing Neuroimaging Genetics Through Meta Analysis (ENIGMA) consortium has developed a method (Brain Age Gap Estimation or BrainAGE) for predicting chronological age by evaluating brain age. Using this method, we predicted chronological age in participants with and without TBI, in order to assess the effect of TBI on brain aging.

Methods: Participants and Neuroimaging: We recruited 94 patients (age 20–75) with mild, moderate, and severe TBI, and 23 age-matched healthy controls. Each MR scan included multiple modalities, but only high-resolution T1-weighted (T1W) images were used for the current analyses. All MRI data was acquired at VAPAHCS on a GE 3 T Discovery MR750 scanner with an 8-channel head coil. Anatomical Image Preprocessing: High resolution T1W anatomical images were processed using FreeSurfer6.0. Cortical thickness and hippocampal volume were also collected as markers for brain age prediction, after normalization for total intracranial volume (TICV). Calculation of Predicted Brain Age: Brain ages were calculated from T1W MR images using the software package BrainageR. PCA was applied to predict an age value with the trained model developed by ENIGMA.
ABSTRACT

Objective: Most current concussion tests utilize stationary tests to extrapolate information on how an individual will perform in a dynamic environment. Individuals need to be examined in both dynamic and static environments prior to return to play with multiple head positions and a fixed gaze similar to their athletic environments. The purpose of this study was to determine if a dynamic VOR novel series of tests (in stationary and translating environments) is valid and reliable in a neurocognitive normal population aged 13–40.

Methods: 108 participants (male = 56, female = 52) completed the battery of tests, with 40 completing repeated measures 7–14 days later for validity and reliability in a neurocognitive normal population (no concussion in past six months). Two-way Pearson correlations examined the relationship between the Dynamic and Stationary VOR test summary scores and current standards of testing in concussion the Vestibular/Ocular Motor Screening (VOMS) (positive test if change in 2 in any symptom) and Balance Error Scoring System (BESS) total scores used in Sport Concussion Assessment Tool 5th edition (SCAT-5). Dynamic VOR test battery while stationary included (seated, hip width stance, staggered stance left foot forward, staggered stance right foot forward) and two eye positions (eyes open, eyes closed) for each stance. Dynamic VOR while translating test battery included 4 translations (forward eyes open, forward eyes closed, backward eyes open, backward eyes closed) and 5 head positions (neutral, right, left, chin tucked, chin extended).

Results: In healthy age-matched controls, predicted brain age was found to be strongly correlated with chronological age, r (21) = .75, p < .001, and moderately correlated with cortical thickness, r(21) = -.43, p = .04, and TICV, r(21) = -.43, p = .04. The correlation with left hippocampal volume was nonsignificant. In patients with TBI, predicted brain age was found to be strongly correlated with chronological age, r(92) = .70, p < .001, and cortical thickness, r(92) = -.63, p < .001, and moderately correlated with left hippocampal volume, r(92) = -.33, p = .001, and TICV, r(92) = -.21, p = .04.

Conclusion: Predicted brain age is more closely associated with chronological age (brain age and chronological age increase together) and with TICV (decreases as brain age increases) in healthy controls than it is in individuals with TBI. Additionally, predicted brain age is more closely associated with hippocampal volume and with cortical thickness (both decrease as brain age increases) in individuals with TBI than it is in controls. These differences in correlation may reflect TBI-induced alterations in the process of typical age-related atrophy in the brain structures examined.

254 Validity and Reliability of Two Novel Dynamic mTBI Tests in Neurocognitive Normal 13–40 Year Olds

Marguerite Moore⁷, Christa Hubbard⁷, Megan DeChambeau⁷

¹Northern Michigan University, Marquette, United States

ABSTRACT

Objective: To assess provider perceptions of challenges faced by adolescent and emerging adult (AEA) patients with acquired brain injuries and neurological conditions (e.g., epilepsy) during post-acute recovery. This input will inform the development of a transdiagnostic online problem-solving intervention for patients and their families. In particular, we hoped to identify issues that are relevant across diagnoses (core content) and distinguish these from concerns that are relevant for only some conditions.

Results: Subjects mean age (20.80 ± 4.50), with subjects ranging in number of previous concussions [0 (n = 70), 1(n = 22), 2 (n = 6), 3 (n = 3), 4 (n = 3), 6 (n = 1)]. SCAT-5 symptom severity mean (3.52 ± 9.99) symptom total number mean (1.77 ± 3.54) with repeated measures symptom severity mean (1.10 ± 2.30) and symptom total mean (0.77 ± 1.38). Two-way Pearson Correlations revealed a relationship between BESS scores and the Dynamic VOR while translating scores (p = .006, r = .263), between VOMS results and Dynamic VOR test while stationary (p = .018, r = .228), and between VOMS results and Dynamic VOR while translating scores (p = .007, r = .258). Repeated measures (n = 40) demonstrate correlations between BESS (p = .001, r = .495) and Dynamic VOR Stationary scores (p ≤ .001, r ≥ .674).

Conclusion: The testing battery dynamic VOR while stationary in 4 positions and 2 eye positions total score showed promise as a reliable comparison to VOMS while the dynamic VOR while translating in 4 stances and 5 head positions showed promise as a comparison to BESS scores in a neurocognitive normal population. Continued testing in a concussed population will reveal if these tests will provide additional information to clinicians.

255 Provider Perspectives of Challenges Faced by Adolescent and Emerging Adult Patients: Support for a Transdiagnostic Approach to Psychosocial Intervention

Jamie Patronick⁶, Sandra Glazer⁴, Elizabeth LeBlond⁶, Jillian Ketz⁵, Cynthia Austin⁵, Bethany Johnson-Kerner⁵, Shannon Scratch⁴,⁵,⁶, Abigail Johnson⁶, Shari Wade⁶,⁷

⁴Division of Physical Medicine and Rehabilitation, Cincinnati Children’s Hospital Medical Center, Cincinnati, United States, ⁵Department of Neurology, Dell Children’s Medical Center of Central Texas, Austin, United States, ⁶Division of Pediatric Neurology, University of California in San Francisco, San Francisco, United States, ⁷Blooview Research Institute, Holland Blooview Kids Rehabilitation Hospital, Toronto, Canada, ⁸Rehabilitation Sciences Institute, University of Toronto, Toronto, Canada, ⁹Department of Pediatrics, Faculty of Medicine, University of Toronto, Toronto, Canada, ¹⁰Division of Rehabilitation Psychology and Neuropsychology, University of Michigan, Ann Arbor, United States, ¹¹Department of Pediatrics, University of Cincinnati, Cincinnati, 45,219

ABSTRACT

Objective: To assess provider perceptions of challenges faced by adolescent and emerging adult (AEA) patients with acquired brain injuries and neurological conditions (e.g., epilepsy) during post-acute recovery. This input will inform the development of a transdiagnostic online problem-solving intervention for patients and their families. In particular, we hoped to identify issues that are relevant across diagnoses (core content) and distinguish these from concerns that are relevant for only some conditions.
Methods: Providers (N = 42) from North American pediatric institutions completed an online survey distributed via email. Providers rated the severity of common issues experienced by patients ages 13–22 for each of five diagnoses: childhood stroke/neurovascular disease, epilepsy, encephalitis, anoxic injuries, and post-surgical resection. Twenty-nine issues were rated, encompassing the following domains: physical symptoms (e.g., fatigue), cognitive/communication symptoms (e.g., inattentiveness), behavioral/emotional symptoms (e.g., impulsivity), and social/family concerns (e.g., social isolation). Providers only responded for diagnoses that they commonly treat, rating each issue on a scale from 1 (not a problem) to 5 (very significant problem). Provider demographics were also collected. We performed one-way between-subjects ANOVAs with Tukey post-hoc tests to compare the effect of diagnosis on domain ratings, and a within-subjects ANOVA with Bonferroni post-hoc tests to compare the overall mean ratings of each domain, independent of diagnosis.

Results: Most respondents were neurologists (N = 16, 38%), neuropsychologists (N = 14, 33%), or physiatrists (N = 7, 17%). Most providers were female (N = 29, 69%) and had at least 6 years of experience (N = 30, 71%). One-way ANOVAs yielded significant variation by diagnosis for both cognitive/communication, F(4,119) = 4.84, p = .001, and behavioral/emotional symptoms, F(4,119) = 3.60, p = .008. Cognitive/communication symptoms were rated most highly for anoxic injuries, who significantly differed from epilepsy (p = .002), stroke (p = .006), and surgical resection (p = .009). Anoxic injuries also had the highest ratings for behavioral/emotional symptoms and were rated significantly higher than both stroke (p = .04) and surgical resection (p = .04). Across diagnoses, mean ratings for each domain ranged from 3 (moderate problem) to 4 (significant problem), and had significant variation, F(3,345) = 53.17, p < .001. Cognitive/communication symptoms were ranked as more of a problem than physical, behavioral/emotional, and social/family concerns, whereas social/family concerns were ranked as more of a problem than physical symptoms.

Conclusions: AEA patients face a variety of common challenges during post-acute recovery that can be addressed in a transdiagnostic online problem-solving intervention. Provider perspectives highlighted commonalities across diagnoses that can be covered in core sessions encompassing all four domains, with particular emphasis on cognitive/communication symptoms. Providers also aided in ways to increase applicability to specific patient populations, such as additional behavioral/emotional and cognitive/communication content for survivors of anoxic injury, who may have poorer psychosocial outcomes overall. This feedback will be considered along with qualitative input from survivors and their families to develop content that is relevant to their experiences.

256 Early Neurorehabilitation and Recovery from Disorders of Consciousness after Severe COVID-19: Findings from a Pilot Feasibility Study

Lindsey Gurin\textsuperscript{a}, Megan Evangelist\textsuperscript{a}, Patricia Laverty\textsuperscript{a}, Kaitlin Hanley\textsuperscript{a}, John Corcoran\textsuperscript{a}, Jodi Herbsman\textsuperscript{b}, Brian Im\textsuperscript{a}, Jennifer Frontera\textsuperscript{a}, Steven Flanagan\textsuperscript{a}, Steven Galetta\textsuperscript{a}, Ariane Lewis\textsuperscript{a}

\textsuperscript{a}NYU Langone Health, New York, United States

ABSTRACT

Objective: Early neurorehabilitation improves outcomes in patients with disorders of consciousness after brain injury, but its applicability in COVID-19 is unknown. We demonstrate the feasibility of an early neurorehabilitation protocol for patients with COVID-19-associated disorders of consciousness in the intensive care unit (ICU) and evaluate factors associated with recovery.

Methods: Between March 10 and May 20, 2020, we prospectively enrolled 21 ICU patients with delayed recovery of consciousness after severe COVID-19 in a pilot early neurorehabilitation protocol including serial Coma Recovery Scale – Revised (CRS-R) assessments and multimodal treatment. We retrospectively compared clinical features of patients who did and did not achieve a CRS-R total score (TS) ≥8, consistent with minimally conscious state, before discharge. We additionally present preliminary 6-month follow-up data for 8 patients who survived to discharge.

Results: Patients underwent CRS-R a median of 6 (interquartile range [IQR] 3–10) times before discharge, beginning a median of 48 days (IQR 40–55) from admission. Twelve (57%) patients achieved at least one CRS-R TS ≥8, after a median of 8 days (IQR 2–14) off continuous sedation; they had lower body mass index (p = 0.009), lower peak serum C-reactive protein (p = 0.023), higher minimum arterial partial pressure of oxygen (p = 0.028) and earlier fentanyl discontinuation (p = 0.018). CRS-R scores fluctuated over time and best CRS-R TS was significantly higher than last CRS-R TS (median 8 [IQR 5–23] vs 5 [IQR 3–18], p = 0.002). Earlier fentanyl (p = 0.001) and neuromuscular blockade (p = 0.015) discontinuation correlated with higher last CRS-R TS. Six-month follow-up data was obtained for 8 of 12 patients who survived to hospital discharge: of these, one patient (13%) had expired; 3 (38%) remained in a disorder of consciousness; one (13%) was conscious but moderately disabled; and 3 (38%) achieved functional independence.

Conclusion: It is feasible to provide early neurorehabilitation to patients with impaired consciousness after severe COVID-19 in the ICU. These patients can recover, but hypoxia, systemic inflammation, sedation and neuromuscular blockade may impact CRS-R scores and short-term outcomes. Return to
functional independence is possible for some patients. Further research should evaluate factors influencing longer-term neurologic recovery and benefits of early rehabilitation in patients with severe COVID-19.

257 EMDR and Brainspotting: A Therapeutic Intervention to Treat Concussions and Traumatic Brain Injuries

Lee-Anne Thoms

aLMT Counseling Services, LLC, West Bridgewater, United States

ABSTRACT

The purpose of this presentation is to educate Providers, Researchers, and Patients about the benefits of Eye Movement Desensitization and Reprocessing (EMDR) and Brainspotting (BSP) as a therapeutic treatment intervention for Concussion’s and TBI’s. They are a non-invasive and effective treatment that can reduce both emotional and physical symptoms resulting from trauma. EMDR and BSP focuses their treatment for Post Traumatic Stress Disorder and the obstacle they encounter is proving its effectiveness due to limited research and education.

EMDR has been around for over 30 years and BSP has been growing over the past 15 years, yet it has been challenged by Cognitive Behavioral Therapy allowing CBT to predominate as the treatment option for mental health. People with brain injuries struggle with anxiety, depression, PTSD, and suicidal ideation from the impact of headaches and other concussion symptoms that cause life changes and impacts their quality of life. EMDR and BSP can shift these symptoms quicker than CBT and the need for research of EMDR and BSP for brain injuries and other neurological disorders requires support of alternative therapies in order to not be discredited.

The barriers we are dealing with is the lack of education and access to quality of treatment for doctors, providers and patients in the field of mental health about EMDR and BSP. Mental health professionals lack training for concussion symptoms and often misdiagnose their patients therefore neglecting the proper treatment of patient’s mental health issues.

The component of EMDR and BSP is Bi-Lateral Stimulation (BLS) is non-invasive and stimulates neural activity in the brain based on the eye movements that occur during REM sleep stage. BLS assists in the processing of cognitive information and it functions via visual, auditory or tactile stimulation. EMDR and BSP processes out unresolved memories of trauma, emotional and physical symptoms that one has experienced. This treatment can help improve physical symptoms by relaxing the nervous system, reduce sensory overload, improve vestibular issues, and reduce headaches, fatigue and pain symptoms. The emotional toll a brain injury is significant and complex therefore this intervention treats the unresolved memories of PTSD, anxiety and depression impacted by brain injuries. EMDR and Brainspotting encompasses treatment for both physical and emotional symptoms because it assists in the shift of the neurobiology of the brain and body.

In collaboration with other therapeutic services, EMDR and Brainspotting interventions will benefit people dealing with brain injuries and will enhance treatment and recovery. The intention of this presentation is educating professionals and people with brain injuries that there are more options available and the need for research and training.

258 Innovative Robotic Technology for Mobilization of Patients with Disorders of Consciousness – Combining a Regular Tilting Bed with a Robotic Stepping Device

Marion Eggera, Martina Steinböcka, Elisabeth Jenseb, Alexander Königc, Friedemann Müllera

aSchön Klinik Bad Aibling, Bad Aibling, Germany, bMunich School of Robotics, Technical University Munich, Munich, Germany, cReactive Robotics, Munich, Germany

ABSTRACT

Objectives: Treatment goals for patients with disorders of consciousness (DOC) in neurological rehabilitation are the restoration of cognitive-behavioral functioning and the prevention of secondary medical complications, like bed rest syndrome, infections, pressure sores, osteoporosis or deep vein thrombosis. Various studies (e.g. Frazzitta 2016) have shown that early verticalization is able to improve arousal and awareness and is therefore beneficial to enhance recovery of consciousness in those patients. Verticalization in patients with DOC can be realized by a tilt table. If a tilt table with integrated stepping device (e.g. Erigo by Hocoma, Switzerland) is used, the occurrence of orthostatic hypotension and syncope because of blood pooling in the lower limbs can be avoided (Luther 2008). However, the transfer onto those devices is challenging, unpleasant, risky and time- and resource-intensive. The newly developed robotic device VEMO (Very Early Mobilization, by Reactive Robotics, Germany) allows verticalization including step-like leg movements directly in the patients ’beds. The aim of the study was to evaluate safety, usability, applicability and the experiences of nurses and therapist users of the VEMO in early neurorehabilitation.

Methods: Patients with DOC (severly assessed by the CRS-r) were treated in six consecutive sessions with the VEMO. Brain lesions included hypoxia (2) hemorrhage (2) and SAH (1). Physiotherapist or caregivers conducted the therapy together with an experienced member of the study team. Feasibility parameters like safety, time for preparation, usability and conduction of the therapy were documented. Precise treatment parameters were downloaded from the robotic logfiles. Users completed a usability questionnaire after conducting three therapies.

Result: Five patients (mean age 57.2 ± 11.8 years, 2 female) were treated with the VEMO with a median CRSr of 7 (inter-quartile range = 1), 4 patients were considered MCS. Mean time between brain injury and first VEMO therapy was 107.6 ± 19.9 days. It was possible to conduct all six therapies in every patient, no safety issues occurred. In general, patients responded well to the therapy, partly had better oxygen saturations or were more awake. Mean therapy duration was 17:35 ± 04:39 minutes (min: 11:12, max: 25:52 minutes).
Therapy preparation took approximately 10–18 minutes. Mean verticalization angle was 49.0 ± 8.6°, mean amount of conducted steps was 535 ± 150. In general, users were very or relatively satisfied with the VEMO and 78% suggested to use the VEMO with more patients.

Conclusions: Safety and usability of the VEMO therapy with five first patients with DOC were high. Since there is no time lost for patient transfer, the therapy preparation time is shorter and therapy can be started faster. Therefore, a more frequent verticalization of the DOC patients seems realistic. This is promising as a positive influence on rehabilitation and consciousness recovery can be assumed.

259 A Systematic Review of Persistent Neuropsychological Symptoms Following mTBI: A Clinician’s Guide to this Complex Debate

Daniella De Dios*, Sean Robb

*Yorkville University, Toronto, Canada, McMaster University, Canada

ABSTRACT

Objective: Considerable debate exists within literature regarding the persistent nature of neuropsychological symptomatology following mild traumatic brain injury (mTBI). Upwards of 85% of individuals will recover within three months postinjury, whereas as the remaining 15% often make up the "miserable minority." This population is often labeled with persistent post-concussive syndrome (PPCS) when their self-reported complaints encompass the typical postinjury complaints (e.g., fatigue, lethargy, headache) and/or mild neurocognitive disorder (MND) when performance-based neurocognitive evidence is also present. Undoubtedly, the persistent nature of these symptoms are not only complicated by injury-related factors, but also non-injury related factors such as litigation status, pre-injury factors, and diagnosis threat. Moreover, the debate is further fueled by the non-pathognomonic nature of self-reported post-concussive symptoms. Not surprisingly as a result, within the practice of neuropsychology, there is extensive debate about the persistent nature and the exact etiology of these symptoms as it relates to justification for the use of third-party insurance benefits, income replacement, and rehabilitative dollars following mTBI. It is our intention that this updated systematic review can serve as a field guide for the centralizing of research literature that can guide clinical decision-making as it relates to understanding the nature of persistent symptoms, and enhance the consistency in the way that the research literature is cited to justify access to insurance funding.

Methods: Five electronic databases were manually searched between the years 2010–2021. References from articles were scanned for further literature. Studies that met broad inclusion criteria were subjected to formal test of relevance. Those found to be relevant were qualitatively tested for their methodological soundness.

Results: Three thousand three hundred and twenty-four studies were identified and one hundred and twenty were assessed yielding 41 studies for review.

Conclusions: Based on preliminary review, neuroemotional and neurocognitive indices serve as a stronger basis for understanding the persistent nature of functional challenges following mTBI rather than the subjective self-reported post-concussive complaints. Single uncomplicated mTBI is often associated with small effect sizes for neurocognitive impairments, but subtle information processing inefficiencies, online thinking, and the more complex forms of cognitions (e.g., social cognition) are rarely included in this research. As indicators of injury severity and multiple injuries increase, greater neurocognitive and neuroemotional challenges are recognized. Clear heterogeneity is present within these clinical samples, and factors like gender, socioeconomic status, and personality structure also play clear interacting and intersecting roles in the presentation of persistent challenges (Evans & Strutt, 2020; Iverson et al., 2018; Lagarde & Gil-Jardiné, 2020). This updated systematic review contributes to the literature more by centralizing the debate, which will aid in greater consistency and ease in the reporting of the research within neuropsychological assessments.

260 Prognosis of Prolonged Mechanically Ventilated Patients with Disorders of Consciousness in a Long-Term Acute Care Hospital in Comparison to Patients who are Cognitively Intact or Cognitively Impaired

David Stein*, Sigal Sviri*, Michael Beilb, Ilana Stavc, Esther Marcusb,c

aMedical Intensive Care Unit, Hadassah Medical Center, Jerusalem, Israel, bFaculty of Medicine, Hebrew University of Jerusalem, Jerusalem, Israel, Department of Geriatrics, Herzog Medical Center, Jerusalem, Israel

ABSTRACT

Objectives: The number of adults with disorders of consciousness requiring prolonged mechanical ventilation (PMV) is escalating. In Israel, disconnecting patients from ventilator is prohibited by law even when prognosis is deemed poor, therefore patients may be ventilated indefinitely until death. We aimed to assess the prognosis in terms of life expectancy of prolonged mechanically ventilated patients with disorders of consciousness in comparison to PMV patients who were cognitively intact or cognitively impaired.

Methods: The study was conducted at the 110-bed Chronic Ventilator Dependent Unit at Herzog Medical Center, a university-affiliated geriatric long-term acute care facility (LTACH). Data was obtained retrospectively from the electronic health records of 308 adults, aged ≥40 years, requiring PMV hospitalized between 1.1.2015 to 30.06.2019 and followed-up until death or until 31.12.2019.

Results: At admission to LTACH, 42.2% of PMV patients were in vegetative state/ minimally conscious state (VS/MCS), 32.5% with severe cognitive impairment (SCI), 11.0% with mild-to-
moderate cognitive impairment, 12.3% with no cognitive impairment and 1.9% with intellectual disability/psychiatric impairment. Out of the 130 VS/MCS patients, the cause was anoxic brain damage in 111 patients (64 post-cardiopulmonary resuscitation, 23 after pneumonia, 10 after sepsis, 8 after exacerbation of end-stage chronic lung disease, 6 after acute coronary syndrome/congestive heart failure), 18 patients were after an acute neurological event (ischemic/hemorrhagic stroke and epileptic seizure), 5 after a traumatic brain injury, and 5 other causes. Mean length of stay at LTACH of VS/MCS patients was 56.0 months (95% CI 40.2–71.7) in comparison to 31.7 months (95% CI 19.8–43.7) for patients with severe cognitive impairment, 29.9 months (95% CI 21.1–38.7) for mild-to-moderate cognitive impairment and 65.8 months (95% CI 41.8–89.9) for those with no cognitive impairment (p < .001). In-hospital mortality was 45.5% during the study period.

Conclusions: This study shows the outcomes of PMV patients in a country where withdrawal of life-sustaining treatments is not implemented in the clinical practice. The comparison of this unique adult population requiring PMV showed that prognosis worsened with more unfavorable cognitive status apart from VS/MCS patients who had a mean survival of around 5 years. This duration of survival raises clinical and ethical questions as it is accompanied by physical and emotional long-term burden on the caregivers and significant cost to society. There is a need for discourse regarding end-of-life decision from the point of decision to resuscitate/intubate patients to the long-term management of those patients.

261 Avoiding Rash Decisions in the Treatment of Catatonia Following Brain Injury: A Case Report

William Tsai, Martin Pico, Lindsey Gurin, Prin Amorapanth

*NYU Rusk Rehabilitation, New York, United States

ABSTRACT
Case Description: An 18-year-old previously healthy male presented with the worst headache of his life. He was found to have a left temporal hemorrhage due to an arteriovenous malformation and underwent embolization. His hospital course was complicated by re-bleeding with intraventricular extension; hydrocephalus with ventriculoperitoneal shunt placement; status epilepticus; and dysautonomia. Dermatology was consulted after the patient was seen repeatedly scratching his body. A drug rash was ruled out and the patient was treated with a topical steroid cream. He was awake but mute and poorly interactive with occasional restless agitation; amantadine 200 mg twice daily was initiated with slight improvement. Upon admission to acute rehabilitation, he remained mostly mute and minimally interactive with episodes of restlessness and random physical aggression. Speech was notable for repetition of phrases and mimicking the examiner’s speech. He appeared to be experiencing visual hallucinations. He continued to repeatedly scratch his abdomen and chest, but no rash was visible. Brief trials of modafinil 100 mg daily and quetiapine 75 mg nightly led to increased agitation.

Results: Catatonia was suspected. Bush-Francis Catatonia Rating Scale (BFCRS) score was 23. Modafinil, amantadine, and quetiapine were discontinued. He was given a trial dose of lorazepam 1 mg and one hour later showed reduced agitation, stereotypies, and echolalia with a repeat BFCRS of 13. Lorazepam was titrated to 1 mg four times daily and memantine 10 mg daily was added for augmentation. He made significant functional gains, progressing to transferring and ambulating with contact guard assistance, engaging with all therapies, and having short conversations with his family.

Discussion: Catatonia, more commonly known in the context of psychiatric disorders, can also occur in patients with brain injury. It is a psychomotor dysregulation disorder with features including but not limited to withdrawal, mutism, hyperactivity, echolalia, stereotypy, and impulsivity that can be difficult to distinguish from the neurobehavioral sequelae of brain injury. In this patient, the repetitive scratching initially attributed to rash was more likely a catatonic motor stereotypy, one of multiple catatonic signs present even during his acute care stay that were not diagnosed as such. First-line treatment of catatonia includes benzodiazepines, which are typically avoided in patients with brain injury due to their sedating properties and negative effects on recovery. However, in patients with catatonia due to brain injury, they can be a safe and effective treatment.

Conclusion: Catatonia is a treatable mimic of fixed cognitive, behavioral, and motor deficits in brain injury. Diagnosis requires awareness of the syndrome and a high degree of suspicion. Catatonia is not routinely assessed in patients with brain injury, but appropriate identification and treatment can improve functional outcomes. Low dose lorazepam in select patients can be an effective treatment.

262 Staff Perspectives of Working with Families of Children and Young People in Paediatric Residential Neurorehabilitation

Benjamin Peters, Jenny Jim, Gemma Costello

*University of East London, Stratford, United Kingdom, bThe Children’s Trust, Tadworth, United Kingdom

ABSTRACT
This study aimed to explore staff perspectives of those who work with families of children and young people in a paediatric residential neuro-rehabilitation setting. Interviews were carried out with members of staff to learn from their experiences and to explore what enables and hinders the development of collaborative working relationships with families. A reflexive thematic analysis approach allowed for an organic production of themes from individuals, which are then presented as a group story of staff experience. Conclusions are drawn about factors that contribute to effective partnerships
and collaborative ways of working with families in residential neuro-rehabilitation settings and the importance of understanding the wider and unique context of each individual family’s needs.

263 Attention in Pediatric Traumatic Brain Injury and the Impact on Social Functioning

Jeannie Lengenfelder\textsuperscript{a,b}, Helen Genova\textsuperscript{a,b}, Aubree Alexander\textsuperscript{b}, Jacqueline Leddy\textsuperscript{a,}\textsuperscript{b}, Brea Rivera\textsuperscript{c}, Nancy Chiaravalloti\textsuperscript{a,}\textsuperscript{b}

\textsuperscript{a}Kessler Foundation, East Hanover, United States, \textsuperscript{b}Children’s Specialized Hospital, Mountainside, United States, \textsuperscript{c}Montclair State University, Montclair, United States

\textbf{ABSTRACT}

Objective: Cognitive deficits following traumatic brain injury (TBI) in children often involve difficulties in attention. Studies report varying percentages of attentional impairments in pediatric TBI (pTBI) based on the severity of the injury. Additionally, some children receive a diagnosis of secondary attention deficit hyperactivity disorder (ADHD) when they have not had any attentional deficits prior to their brain injury. Because of the prevalence of attention problems following TBI and their impact on academic and functional outcomes, understanding the specific nature of attention problems is critical. The current study examines different aspects of attentional performance in pTBI and evaluates the impact of attentional deficits on social functioning.

Participants/Methods: 21 children with TBI, (age: M = 11.71, SD = 3.72) and 22 typically developing children (TDC; age: M = 10.95, SD = 3.12) completed the TEA-ch subtests Creature Counting, Walk, Don’t Walk, and Code Transmission. Parents completed the Social Responsiveness Scale (SRS) and the Social & Communication Disorders Checklist (SCDC).

Results: Results indicate a significant difference between children with TBI and TDC on the scaled scores for Code Transmission \(F(1,40) = 8.84, p = .005\) but not for Walk, Don’t Walk \(F(1,40) = 1.56, p = .219\) and Creature Counting \(F(1,40) = 1.92, p = .173\). Performance on Code Transmission is correlated with parental evaluations of social ability (SRS; \(r = .519, p = .001\)) and social communication traits (SCDC; \(r = -.446, p = .004\)).

Conclusions: The results suggest that children with TBI differ from TDC in sustained attention on a task requiring the ability to continuously attend to a series of spoken numbers listening for a particular sequence. No differences were found on other attentional measures that require attention control/switching or a shorter sustained attention and task requiring response inhibition. Additionally, sustained attention performance was related to parental ratings of social functioning, indicating that attentional problems may have implications for a child’s social success. Understanding the specific nature of attentional impairments can guide targeted interventions for pTBI and evaluating whether such interventions can also contribute to improvements in social functioning would also be important to evaluate.

264 Ethicolegal Considerations of Screening for Traumatic Brain Injury in Women who have Experienced Intimate Partner Violence

Quinn Boyle\textsuperscript{a,c}, Deana Simonetto\textsuperscript{d}, Judy Illes\textsuperscript{b,c}, Paul Van Donkelaar\textsuperscript{a}

\textsuperscript{a}School of Health and Exercise Sciences, University of British Columbia Okanagan, Kelowna, Canada, \textsuperscript{b}University of British Columbia, Vancouver, Canada, \textsuperscript{c}Department of Medicine, Neuroethics Canada, Vancouver, Canada, \textsuperscript{d}Department of History and Sociology, University of British Columbia Okanagan, Kelowna, Canada

\textbf{ABSTRACT}

One in three women will experience intimate partner violence (IPV) in their lifetime, up to 92% of whom will suffer a brain injury (BI). With BI comes physical and mental symptoms, all of which could be addressed with proper care and intervention. This demonstrates an urgent need for proper screening of BI in women who have experienced IPV. Although such screening is done with the intention of accessing appropriate health care and improving quality of life, the potential impacts of a BI diagnosis outside of the health care setting for women who have experienced IPV are poorly understood. Given the history of health information being weaponized against women in family law, this study explores the possible impact of a BI diagnosis on parenting disputes in Canadian family law. The overarching objective is to inform future IPV-BI research and decisions surrounding BI screening based on how they may be used in parenting disputes. We applied a consequentialist ethical framework and a utilitarian ethics approach to the development of a guide for the semi-structured interviews. Within the interviews, we used a contrastive vignette technique to describe hypothetical but realistic scenarios involving clientele who have experienced IPV and catalyze conversation about legal strategy and predicted outcomes. The two vignettes were identical except for the presence or absence of an IPV-related BI. Twelve in-depth interviews were conducted with lawyers whose primary practice is family law (9 women; 3 men; 46.3 years of age; 12.3 years of practice). We used a constructivist grounded theory analysis to code emergent themes. Analysis began with open coding to develop a codebook based on emergent themes, and then used focused coding to further explore themes surrounding the effects of BI in parenting disputes where IPV has occurred. Results reflect current legislation focused on the best interests of the child; however, the data suggest that this is open to interpretation and manipulation based on case facts, such as IPV-BI, and confounding factors such as counsel’s legal responsibility, legal aid status, legal precedence, and the expectations of mothers. Overall, our findings reflect that a lack of legal precedence, inadequate education surrounding IPV-BI, and the inability to causally link an incident of IPV to BI leave women legally vulnerable to opposing counsel, undermines her credibility, and minimizes her perceived capacity to parent based on BI screening.
information. We conclude with recommendations for the ethical continuation of IPV-BI screening while also equipping women to navigate a patriarchal legal system that puts them at immediate disadvantage.

265 Can We Predict Persistent Post-Concussion Symptoms? A Simulation Study on the Practical and Conceptual Limitations

Brendan Lam\textsuperscript{a,c}, Shannon Scratch\textsuperscript{a,b,c}

\textsuperscript{a}Holland Bloorview Kids Rehabilitation Hospital, Toronto, Canada, \textsuperscript{b}University of Toronto, Toronto, Canada, \textsuperscript{c}Bloorview Research Institute, Toronto, Canada

\textbf{ABSTRACT}

Objectives: Prediction models have the potential to identify individuals at high risk for persistent post-concussion symptoms (PPCS). As a result, research teams have developed algorithms to classify those at risk of prolonged recovery. The purpose of this study was to assess the value and limitations of a risk algorithm for PPCS.

Methods: We first conducted a literature review of studies that prospectively predicted individuals at risk for PPCS and evaluated their diagnostic accuracy. Using the results from this set of studies, we conducted Monte Carlo simulations to assess a range of positive and negative predictive values that we can expect from these models.

Results: There were 3 studies that met this criteria, however, only one study was considered to be of sufficient quality (i.e., had a test validation stage, prospective study design, and provided enough information). While the specificity is good in all studies (>80%), the sensitivity ranges from 20.3% – 68%. Using the specificity and sensitivity from these studies, our simulations estimated an acceptable negative predictive value (73.2%, 95% CI[72–74.4]), however, the positive predictive value has room to be improved (56.9%, 95% CI[47.6–66.2]). This means that the algorithm will be correct 56.9% of the time when it predicts the occurrence of PPCS. Given the infancy of this research, we believe that obtaining an algorithm with high predictive validity is achievable. However, this will depend on several factors, such as the sensitivity of the model, and the estimated prevalence of PPCS, which varies considerably across studies. The heterogeneity of definitions for PPCS further complicates the ability to predict it. We demonstrate this uncertainty by applying a range of possible sensitivity values and prevalence rates. When the prevalence rate is assumed to be 10% with a sample size of 100, a sensitivity score of 85% and a specificity score of 90% is required to get the positive predictive value above chance. Readers can experiment with different scenarios themselves using our online calculator that conducts the simulations we have discussed: https://brendanlam-apps.shinyapps.io/PPCS_Algorithm_Simulator/.

Conclusions: To improve the predictive validity of a risk algorithm, we propose potential solutions, such as resampling strategies that are employed in the machine learning literature (e.g., random undersampling) and obtaining larger samples.

Despite the possibility of a highly accurate algorithm, we discuss the drawbacks of pursuing this line of research. The practical utility of a risk algorithm will depend on what clinicians consider an acceptable positive predictive value and whether this will significantly improve clinical outcomes.

266 Could Brain Injury Research be in a Replication Crisis? Using the Z-Curve to Assess the Replicability of a Set of Studies

Brendan Lam\textsuperscript{a,c}, Shannon Scratch\textsuperscript{a,b,c}

\textsuperscript{a}Holland Bloorview Kids Rehabilitation Hospital, Toronto, Canada, \textsuperscript{b}University of Toronto, Toronto, Canada, \textsuperscript{c}Bloorview Research Institute, Toronto, Canada

\textbf{ABSTRACT}

Objectives: Replication is considered one of the most important aspects to the internal validity of a study. However, many areas in social science have been criticized for their limited replicability. These issues have been discussed in brain injury and neuropsychology research, however, replicating findings in these fields can be costly, time-consuming, and have difficulty securing external funds. Thus, being able to assess the statistical power of a set of studies without actual replication is important for assessing the state of the field. The Z-Curve is a novel method that takes the z-scores from several studies and estimates their mean power using finite mixture models. The likelihood of observing a distribution of z-scores under no publication bias is estimated, along with several metrics that quantify the expected replication rate.

Methods: The 500 most recent articles from the journal “Brain Injury” were put through a text scraper that automatically extracted the test statistics (i.e., the Chi-square, t, F, or z-score) and the degrees of freedom from each article. The exact p-values were calculated, which were then converted to z-scores. A Z-Curve was fit to 905 z-scores using an expectation-maximization algorithm.

Results: The Observed Discovery Rate was 49% (95% CI[45–52]), indicating the number of z-scores that were statistically significant. The Expected Discovery Rate was 57% (95% CI[26–83]), which represents the mean power of the set of studies. The Expected Replicability Rate was 77% (95% CI[68–86]), which is the probability of getting a repeated significant result in a single direct replication study. The Soric False Discovery Rate was 0.04, which estimates the percentage of significant findings that are false.

Conclusions: There are not many disciplines that have been Z-Curved, however, the Z-Curve from this set of studies is fairly reliable compared to disciplines such as social psychology. The observed discovery rate was lower than the expected discovery rate, indicating that there was no evidence of selection for statistically significant results. To confirm the robustness of these findings, hand coded z-scores should be extracted from a random sample of articles. The z-scores taken for the current study may not have corresponded to the central hypotheses of interest, since the text scraper coded all available test statistics. The current study shows that publication bias
does not appear to be an issue in this set of articles. Researchers can apply the z-curve to their own studies when direct replications are not feasible. The replicability of results is a key component for strong science. Thus, brain injury researchers should look to improve their research practices for this purpose. This can involve submitting registered reports, and forming multi-site collaborations for a larger sample size.

267 Influence Of Peer Pressure and Sport Commitment on Concussion Disclosure in The Canadian Population: An Exploration Study

Sophie-Andrée Vinet\textsuperscript{a,b}, Laurie-Ann Corbin-Berrigan\textsuperscript{b,c}, Samuel Guay\textsuperscript{a,}\textsuperscript{d}, Louis De Beaumont\textsuperscript{a,}\textsuperscript{b}

\textsuperscript{a}Université De Montréal, Montréal, Canada, \textsuperscript{b}Sports & Trauma Applied Research Lab, Hôpital du Sacré-Coeur de Montréal, Montréal, Canada, \textsuperscript{c}Université du Québec à Trois-Rivières, Trois-Rivière, Canada

ABSTRACT

In Canada, more than 46,000 children and teenagers visit the emergency room due to a concussion yearly. It is estimated however that a wider number of individuals may sustain a concussion without seeking medical care, due to fear of injury disclosure. These risky behaviors are especially present in contact sports such as football, soccer, lacrosse, and wrestling. Studies also show that males and females have different attitudes towards sports-related concussions, with females being more prone to reporting concussions. Athletes who fail to report a concussion and continue to play jeopardize their health. They are at an increased risk for sustaining a second head injury, which can result in second impact syndrome, a potentially fatal injury particularly reported in younger individuals. In addition, underreporting concussions have been linked to longer recovery periods. As the high prevalence of nondisclosure persists among athletes it is suggested that concussion knowledge may not be the only factor influencing disclosure. Understanding why young adults hesitate to report a concussion is crucial to identifying strategies for improving concussion disclosure attitudes. Therefore, the aim of the study was to examine the role of peer influence and sport commitment on concussion disclosure habits of young Canadians. Young athletes aged between 14 to 21 in the province of Quebec, Canada, were recruited to participate in the study and complete an online-based survey. The survey included questions on concussion reporting attitudes in various sport contexts (ex. practice versus game setting, own versus teammate’s concussion), the Sport-Commitment questionnaire (SCQ-2) and the Resistance to Peer influence questionnaire. A total of 372 Canadian (15,011.59 years, with 57.5% of the sample reporting biological sex as male) completed the survey. Our results suggest that factors such as biological sex, concussion history, sports commitment, and resistance to peer influence may affect concussion reporting behaviors. Youth with greater ability to resist peer influence are more likely to disclose their concussions, while youth with greater sports involvement are more likely to hide their concussions. Furthermore, young athletes are more likely to report their teammates’ concussion than their own.

A culture of concussion non-disclosure still surrounds the sports community. Our results suggest that beneficial intervention strategies should go towards education and focus on individual’s disclosure awareness in various sports scenarios. It is critically needed to further evaluate the factors that influence a young athlete’s intention to disclose a concussion in order to identify where targeted intervention strategies may be best and improve concussion reporting attitudes.

268 An Adapted Delivery of the Brick-by-Brick™ Programme to Develop Communicative Competence in Children with Acquired Brain Injury (ABI) who use Augmentative and Alternative Communication (AAC) Systems

Nicola Jones\textsuperscript{a,b}, Julie Marshall\textsuperscript{c}, Suzanne Gough\textsuperscript{d}, Stephen Walsh\textsuperscript{e}

\textsuperscript{a}Manchester Metropolitan University, Manchester, United Kingdom, \textsuperscript{b}ATtherapy, Oldham, United Kingdom, \textsuperscript{c}Bond University, Bond, Australia

ABSTRACT

Background: Communicative rehabilitation can be complex and challenging for children with an acquired brain injury (ABI) who use augmentative and alternative communication (AAC) systems. The development of communicative competence (CC) in children with use AAC systems is in itself complex and multifacetted (Light, 1989, Light and McNaughton, 2014) and it can be challenging for clinicians to target multiple competencies effectively through direct intervention.

The Brick-by-Brick™ programme (previously known as LEGO-based therapy\textsuperscript{a}) has an evidence base routed in research with verbal young people with Autism Spectrum Condition. The programme is a collaborative play therapy originally designed as a social intervention to target the development of social communication and interaction skills (LeGoff, 2004). Introduction: The presentation aims to explore a use of the Brick-by-Brick™ programme with children with ABI who use AAC to support or replace their verbal communication, as well as the areas of potential clinical need for adaptations to its delivery to increase access for this client group. It will also discuss the theory behind adaptations and the need for evidence to support decision making clinically around this topic. The aims and methods of the presenter’s current research will be discussed using Janice Light’s framework of communicative competence (Light, 1989; Light and McNaughton, 2012) to discuss areas of competence during the presentation.

Methods: The research agenda of an embedded quasi-experimental mixed methods design will be shared, along with considerations for the commencement of data collection in a country still significantly affected by the health, social, and educational repercussions of the Covid-19 pandemic.
Clinical adaptations to the programme made by the presenter in her role as highly specialist speech and language therapist will be discussed and linked to her current research.

Discussion, Conclusions and Recommendations: Adapting the delivery of the Brick-by-Brick™ programme for use with AAC users with ABI is not without difficulties, but these are not insurmountable. Practical and theoretical recommendations for the adaptation of the programme in both educational and healthcare rehabilitation settings will be shared. Future thoughts on the development of the current research base will also be discussed.

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269 Epidemiology of Work-Related Traumatic Brain Injury: A Systematic Review and Meta-Analysis

Danielle Toccalinoa, Angela Colantonioa,b,c,d, Vincy Chana,c,d

aInstitute of Health Policy, Management and Evaluation – University of Toronto, Toronto, Canada, bDepartment of Occupational Science and Occupational Therapy; Temerty Faculty of Medicine, University of Toronto, Toronto, Canada, cKITE -Toronto Rehabilitation Institute, University Health Network, Toronto, Canada, dRehabilitation Sciences Institute, University of Toronto, Toronto, Canada

ABSTRACT

Background: Traumatic brain injury (TBI) is a public health concern that can occur in a range of contexts. Work-related TBI (wrTBI) comprise and increasing proportion of work-related injury claims in Canada, despite work-related injuries as a whole decreasing. This suggests that prevention and support of wrTBI requires ongoing attention.

Objectives: This review aimed to update a 2015 review, providing an updated understanding of the burden and risk factors of wrTBI among the working adult population with a sex and gender lens.

Methods: Search strategies using a combination of TBI, work, and epidemiology (i.e., risk, burden, mortality) key words and subject headings were developed for MEDLINE, EMBASE, PsycINFO, and CINAHL based on the 2015 review. Prospective and retrospective cohort studies, case-control studies, cross-sectional studies, and case series reporting primary data on burden or risk factors for wrTBI in the global adult working population and published since January 2014 were eligible for inclusion. Two reviewers independently assessed titles, abstracts, and full text articles for inclusion. Study details, epidemiological findings, and TBI-related outcomes were extracted from included studies as reported. Meta-analyses were conducted to estimate prevalence and mortality of wrTBI and a narrative synthesis was conducted to provide additional context.

Results: The search returned 4,674 records, 56 of which were included after removing duplicates and reviewing 3,646 titles and abstracts and 152 full-text articles. An estimated 17.9% of TBIs occurred at work and 6.3% of injuries occurring in the workplace resulted in TBI, with 3.6% of wrTBI resulting in death, based on pooled proportions meta-analyses. In the included studies, wrTBI occurred predominantly in males (76.2%) and at an average age of 40.4 years old. Education and training, healthcare and social assistance, construction, manufacturing, and transportation were the industries where wrTBI was most commonly reported among included studies. The most commonly reported mechanisms of wrTBI were falls, being struck by an object or person, motor vehicle collisions, and assaults. Though 39% of included studies reported on the sex or gender of individuals with wrTBI, only 9% (five studies) reported on other variables stratified by sex or gender, all of which showed significant differences. Conclusions: A better understanding of the epidemiology of wrTBI can inform prevention and management strategies. This review highlights existing gaps, including a notable lack of sex or gender stratified data, to direct future investigation.

PROSPERO registration number CRD42020169642.

270 Unexpected Symptoms after Concussion: Links to Functional Neurological and Somatic Symptom Disorders

Edwina Picona, David Perezb,g, Grant L. Iversonb,g, Matthew Burkeb,c,d, Chantel Derberta, William Panenkaa, Noah Silverberga,d

aUniversity of British Columbia, Vancouver, Canada, bHarvard Medical School, Boston, United States, cSunnybrook Health Sciences Centre, Toronto, Canada, dUniversity of Toronto, Toronto, Canada, eUniversity of Calgary, Calgary, Canada, fVancouver Coastal Health Research Institute, Vancouver, Canada, gMassachusetts General hospital, Boston, United States

ABSTRACT

Objective: Typical post-concussion symptoms include headaches, fatigue, sensitivity to light and noise, and subjective cognitive difficulties. Reporting of unexpected symptoms after concussion, i.e., symptoms not considered to result from brain injury, has been attributed to Functional Neurological Disorder (FND) and Somatic Symptom Disorder (SSD), or alternatively to exaggeration (feigning). The present study aimed to determine whether reporting unexpected symptoms after concussion was associated with risk factors for FND/SSD, exaggeration, or both.
Method: Secondary analysis of baseline data from a randomized controlled trial involving adults (N = 77; 61% female) with persistent symptoms following concussion. Unexpected symptoms included neurological symptoms (from the Screening for Somatoform Symptoms scale, e.g., paralysis) and somatic symptoms (from the Personal Health Questionnaire-15, e.g., stomach pain) that did not overlap with post-concussion symptom scale items. The independent variables were risk factors for exaggeration (neuropsychological performance validity test failure and personal injury litigation) and a range of predisposing and perpetuating factors for developing FND and/or SSD (e.g., fear avoidance behavior).

Results: In unadjusted generalized linear modeling, current anxiety, catastrophizing, and fear avoidance behavior were associated with unexpected neurological and somatic symptoms. Performance validity test failure and litigation were associated with a greater burden of neurological symptoms but not somatic symptoms. Health history variables were not associated with either outcome. When adjusting for all covariates, fear avoidance behavior was most strongly related to unexpected neurological symptoms (B = 0.11, 95% confidence interval = 0.05–0.18, p < 0.001), while current anxiety scores were most strongly related to unexpected somatic symptoms (B = 0.34, 95% confidence interval = 0.15–0.52, p < 0.001). Performance validity test failure and litigation were not significant predictors in either multivariable model.

Conclusion: Unexpected neurological and other somatic symptoms after concussion should not be dismissed as exaggeration. Psychological factors thought to perpetuate FND and SSD (e.g., fear avoidance behavior) may contribute to unexpected symptoms following concussion. More research is needed at the intersection of FND, SSD, and persistent post-concussive symptoms.

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271 Traumatic Brain Injury Diagnosis with the Help of Magnetic Resonance Elastography and Machine Learning

Mohammadreza Ramzanpoura, Mariusz Ziejewski, Ghodrat Karamia

aNorth Dakota State University, Fargo, United States

ABSTRACT

Any pathological act can affect the stiffness of the involved biological tissue. An MRE-based study conducted by Boulet et al. on brain white matter injury and ex-vivo analysis of rats subjected to controlled cortical impact injury, revealed that the injured hemisphere has 23% to 32% lower stiffness compared to the healthy hemisphere. In other words, a comparative analysis of the brain tissue stiffness can be useful for traumatic brain injury (TBI) diagnosis. Thus, the aim has been to develop a machine learning and deep learning framework for classifying the tissue stiffness. Benefiting from a validated finite element (FE) simulation tool of MRE, a two-dimensional axi-symmetrical cylindrical model was employed for further analysis. A harmonic displacement with frequency of 200 Hz is imposed at the center of the model for a total duration of 10 ms which corresponds to the completion of two cycles. Assuming a linear elastic material, three controlling parameters of linear elastic modulus, Poisson’s ratio, and density were changed in a combinatorial fashion to generate more than three thousand FE simulation data, with the linear elastic modulus of the FE model varying in the range of 1.0 to 10.0 kPa. Subsequently, based on the material assigned linear elastic modulus, the simulation instances were split into three categories of “low,” “medium,” and “high” stiffness. By using the vertical displacement of some of the nodes of the FE model at two time-steps of the simulation, a logistic regression (LR) hypothesis was trained. Evaluation of the trained LR on the specific “low” instances of the testing dataset, revealed the accuracy of 96% with the sensitivity and specificity of 93% and 97%, respectively. Moreover, a well-known convolutional neural network (CNN) architecture named ResNet18 was trained with the vertical displacement field of the whole FE model used as input. The accuracy of 86.1% was achieved by this CNN in the testing phase.

To conclude, it was found that the machine learning techniques such as LR and CNN are effective tools for comparative analysis of tissue stiffness, which with their high accuracy, sensitivity, and specificity, can be helpful for TBI diagnosis. Moreover, it was shown that simpler machine learning technique such as LR can outperform the more complicated CNN model in terms of accuracy.

272 An Improved Machine Learning Based Biomarker for Characterizing Disorders of Consciousness

Elham Bagheri, James Reilly, Paniz Tavakoli, Adianes Herrera-Diaz, Richard Kolesar, John Connolly

aARiEAL Research Centre, McMaster University, Hamilton, Canada

ABSTRACT

Background: Event-related potentials (ERPs) can provide a non-invasive index of brain function for a range of clinical conditions. Coma is a deep state of prolonged unconsciousness with a complete absence of wakefulness. Such injury can also result in other disorders of consciousness (DOC), (i.e., unresponsive wakefulness syndrome (UWS), and minimally conscious state (MCS)). None of the current standard clinical approaches for assessing DOC have sufficient predictive accuracies to provide definitive prognoses. The mismatch negativity (MMN) component is the brain’s response to a rare, deviant stimulus interspersed with more common, standard stimuli. The MMN component reflects cortical functioning associated with attention, which requires a state of consciousness. The existence of the MMN in a coma patient has shown to correlate with coma emergence. However, the MMN is difficult to detect, and its detection has typically been based on error-prone visual inspection of averaged ERP waveforms. In the presence of latency variation, this averaging process may obscure the MMN even when it is present, thus diminishing its accuracy as a prognostic indicator.
Methods: To address this problem, we propose a machine learning framework for quantitative analysis of ERPs. We developed a convolutional neural network (CNN) to discriminate between standard and deviant responses. If the CNN can discriminate between standard and deviant responses, suggesting that the brain responds differently to the deviant, we can then postulate that the MMN exists (although perhaps not in its conventional form when considering a coma patient).

Results: The results show that the overall accuracy in standard vs. deviant classification for control subjects is 98.8%, while for coma subjects the accuracy is calculated to be 78.8%. These numerical results show a clear distinction between accuracy of standard vs deviant classification in healthy controls vs. coma patients.

Conclusions: On this basis, we propose that classification accuracy can be used as a biomarker for assessing level of consciousness in a DOC patient. This hypothesis is supported by the fact that if the CNN does not detect the MMN, then due to its high accuracy on controls it is likely the MMN does not exist, which is indicative of a DOC. Very preliminary results show that accuracies for MCS and UWS patients fall between those for controls and coma patients. Further investigation is needed using a greater number of patients, to fully determine the clinical implications of this methodology.

273 Epilepsy Risk Factors in One Million Post-9/11 U.S. Veterans: Impact of Traumatic Brain Injury, Deployment and Physical and Mental Comorbidities

Amy Heniona,1, Ali Roghani1, Samin Panahi1, Christine Baca,2, Maria Lopez2, Hamada Altilabi3, Alan Towne6, Sidney Hinds1, Jacob Kean8, Megan Amuan1, Anne Van Cott1, Mary Jo Pugh4

aDivision of Epidemiology, Department of Internal Medicine, University of Utah School of Medicine, Salt Lake City, United States; bUniversity of Colorado School of Medicine, Aurora, United States; cBruce W. Carter VAMC, Miami, United States; dVA Connecticut Healthcare System, West Haven, United States; eEpilepsy Center of Excellence, Central Virginia Veterans Administration Hospital; Department of Neurology, Virginia Commonwealth University, Richmond, United States; fUniformed Services University, Bethesda, United States; gDivision of Health System Innovation and Research, Department of Population Health Sciences, University of Utah School of Medicine, Salt Lake City, United States; hVA Pittsburgh Health Care System (ACVC); Department of Neurology (ACVC), University of Pittsburgh, Pittsburgh, United States; iVA Salt Lake City Health Care System, Salt Lake City, United States

ABSTRACT

Objectives: We examined predictors of epilepsy in over a million Post 9/11 Veterans. We hypothesized that individuals with epilepsy would be more likely to have a history of TBI or deployment, where blast-related injury/military exposures are common. We also evaluated other established risk factors for epilepsy including brain tumor, stroke, and other neurological conditions, as well as mental and physical health comorbidities.

Methods: We compiled and merged Veterans Health Administration (VHA) (2002–2018) and Department of Defense health data (2000–2019) for Veterans who entered VHA care between 2002 and 2014. We identified epilepsy using convulsions/epilepsy specific ICD9/10 codes, and concomitant use of anti-seizure medications (ASM). We identified TBI severity using self-reports (VHA comprehensive TBI screening evaluation) and ICD9/10 codes. Mental and physical health comorbidities were identified using ICD9/10 codes before the index date (Epilepsy: date of the first ASM after epilepsy diagnosis or the first seizure date if there was no ASM use; No Epilepsy: first care in VHA plus mean time to epilepsy [978 days]). We used logistic regression to calculate adjusted odds ratios and their 95% confidence intervals presented as (AOR; 95% CI).

Results: In this cohort (N = 1,055,873; mean age at index date = 34.6 years), 27,438 (2.6%) were veterans with epilepsy (VWE). Compared to those without epilepsy, fewer VWE were deployed (61% vs.71%) and more had TBI (39% vs. 18%). In analyses controlling for demographics, and mental/physical health comorbidities, the odds of epilepsy were significantly lower for deployed (vs. non-deployed; 0.66; [0.63–0.69]). Odds of epilepsy were significantly higher for people with all levels of TBI severity compared to no TBI: mild TBI (1.49; 1.43–1.54), moderate/severe TBI (2.43; 2.31–2.56), or penetrating TBI (5.59; 5.15–6.08). Other strong predictors included brain tumor (17.24; 15.51–19.16), encephalopathy (6.03; 5.22–6.97), Alzheimer’s disease or frontotemporal dementia (3.88; 3.81–5.35), stroke (3.74; 3.58–3.91), Parkinson’s disease (2.75; 2.2–3.75), multiple sclerosis (2.53; 2.17–2.95), headache (2.32; 2.25–2.39), anoxic brain damage (2.17; 1.69–2.78) and cardiovascular disease (1.96; 1.89–2.04). Smoking history, opioid abuse, sedative abuse, and overdose were also significantly associated with epilepsy.

Conclusions: As expected, TBI severity (including mild TBI) was significantly associated with epilepsy even after controlling for brain tumor and other neurologically related conditions. However, our hypothesis regarding deployment history as a risk factor for epilepsy was not supported, perhaps due to chronic physical and mental health conditions that preclude deployment. This is consistent with the finding that cardiovascular disease, smoking, overdose and opioid or sedative abuse were strong risk factors for epilepsy in this relatively young cohort. More sophisticated statistical models using longitudinal data (or extremely large observational cohort studies) are needed to better understand the interactions among TBI, deployment and chronic mental/physical comorbidities.

274 The Role of Speech and Language Therapy in Supporting the Development of Self-worth and Identity in Children and Young People with Acquired Brain Injury (ABI)

Nicola Jones, Emma Bowers, Fran Sephton, Andrea Pickering

aATtherapy, Oldham, United Kingdom, bRecolo, London, United Kingdom
Background: The Children’s Acquired Brain Injury (ABI) Interest Group (2003) report that 3,000 children per year in the UK sustain an ABI resulting in significant disability. Despite the prevalence of ABIs and significance of long-lasting disruption to typical physical, cognitive, emotional and behavioral functioning, brain injuries continue to be both a hidden and misunderstood disability. This is also true of clinicians, who without experience and specialist training within neurorehabilitation may fail to support a client appropriately.

Speech and language therapists can provide crucial intervention that supports the development of communication, social skills and emotional regulation following an ABI. An essential part of this work focuses on self-identify and self-esteem following the index injury. This has been noted as a similar rehabilitative theme for clinical and neuropsychologists and recognised as an area that requires joint, holistic working between these professions.

Recognition of reoccurring and overlapping areas of intervention within neurorehabilitation is limited, alongside understanding of the full remit of a speech and language therapist. In addition, there is a limited evidence base for joint working and resources within this area.

Objectives: The presentation will discuss the clinical experiences of reoccurring areas within the development of self-worth and identity with young people with ABI, and the definition and development of a speech and language therapist’s role within this process. Resources used to support the development of self-worth and identity will be discussed, including MyAbility; a pack of resources designed by the authors to support both speech and language therapists and psychologists in delivering effective and evidence-based intervention in self-worth and identity.

Methods: The design and results of a feasibility study on the use of MyAbility by speech and language therapists and psychologists will be outlined including the exploration of case studies from within the data set and anecdotal findings of clinicians supporting young people with self-worth and identity challenges. Themes drawn from the experience of creating the MyAbility resources will also be explored.

Discussion: The evidence base to support and define the role of speech and language therapy in the development of self-worth and identity in young people with ABI requires further research with larger participant groups. Themes that have been drawn from the undertaking of the feasibility study conducted by the MyAbility team indicate overlaps with the role of a psychologist within the multi-disciplinary team, as well as clearly separate areas of focused intervention. These will be discussed in the presentation along with the team’s perceived need for more autonomy as a member of a rehabilitation team.

**275 The Preservation of Rich Mental Life and Memory Formation in a Vegetative State Patient**

Lorina Naci\(^a\), Steve Beukema\(^b\), Laura Gonzalez-Lara\(^c\), Damian Cruse\(^c\), Adrian Owen\(^c\)

\(^a\)Trinity College Dublin, Dublin, Ireland, \(^b\)McGill University, Montreal, Canada, \(^c\)Western University, London, Canada, \(^d\)University of Birmingham, Birmingham, United Kingdom

**ABSTRACT**

A significant, small proportion of patients with disorders of consciousness (doc) exhibit cognitive-motor dissociation (CMD), or the ability to follow commands with their brain activity, despite the complete absence of behavioral signs of consciousness. The detection of awareness via clinical behavioral testing is unlikely in these patients, unless advanced neuroimaging research protocols are available to complement clinical testing. Even when neuroimaging is available, and awareness is detected via brain-based command-following tasks, very little is known about these patients’ mental life.

To address this question, here we asked whether CMD patients can attend to and continuously integrate information from their environment, leading to rich experiences that they may remember once they recover from the doc.

11 patients doc patients [6 vegetative state (VS), 4 minimally conscious state (MSC), 1 locked-in syndrome (LIS)] were tested, at Western University in Canada, with the Coma Recovery Scale-Revised and a previously-established command-following functional magnetic resonance imaging (fmri) task (Naci et al 2014). Furthermore, the patients’ ability to attend to and integrate information over time was tested with a naturalistic fmri task by Naci et al (2017), that involved listening to a suspenseful and plot-driven, brief (5 minutes) auditory narrative. One VS patient (P6), who regained consciousness within weeks of the research visit was brought back for a second visit, to assess whether he could recall any of the events from the first visit.

We found evidence of CMD in patient P6. He was able to selectively attend to specific stimuli according to the researcher’s command, suggesting that he was conscious and could follow-commands via willful modulation of his brain activity. We also found evidence that the patient was able to process the sensory and higher-order features of the auditory narrative on a moment-to-moment basis, suggesting that he understood the narrative and could feel suspense similarly to every healthy individual. Critically, in the second visit, the patient recalled freely several details of his first visit and successfully performed a personalised forced-choice recognition task, providing evidence of intact memories from the period when he was clinically deemed to be in a vegetative state.

These results suggested that the patient retained a much more sophisticated mental life than could be inferred by his clinical diagnosis of VS, and even the CMD classification. He demonstrated several high-level cognitive faculties, and an active mental life, including the ability to attend to, integrate and understand high-level auditory information continually for a period of time. These findings were corroborated by the patient’s report of a rich memory of his experience during the time when he was deemed unconscious. This case presents an important opportunity to examine our moral obligations to vulnerable patients and decision-making on their behalf.
276 Neurovascular Coupling is Subtly Altered in Survivors of Intimate Partner Violence-Related Brain Injury.

Colin Wallace,1 Jonathan Smirla,b,c,d,e,f,g, K. Elisabeth Jones,1 Matt Rieger,1 Krystal Rothlander1, Paul Van Donkelaar1

1School of Health and Exercise Sciences, University of British Columbia, Kelowna, Canada, 2Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, Canada, 3Cerebrovascular Concussion Laboratory, Faculty of Kinesiology, University of Calgary, Calgary, Canada, 4Hotchkiss Brain Institute, University of Calgary, Calgary, Canada, 5Integrated Concussion Research Program, University of Calgary, Calgary, Canada, 6Alberta Children’s Hospital Research Institute, University of Calgary, Calgary, Canada, 7Libin Cardiovascular Institute of Alberta, University of Calgary, Calgary, Canada

ABSTRACT

Background: Intimate partner violence (IPV) is a global health crisis with 30% of women over the age of 15 experiencing at least one event in their lifetime. Strangulation is reported in 76% of IPV survivors and 92% report sustaining an IPV-related brain injury (BI) with the face and neck being particularly common targets of violence. These forms of violence can trigger a neuropathological cascade along with psychopathological sequelae including, but not limited to, depression, anxiety and post-traumatic stress disorder (PTSD). Transcranial Doppler ultrasound (TCD) is a non-invasive method used to assess elevations in cerebral blood velocity (CBV) associated with increases in neuronal metabolism, commonly referred to as neurovascular coupling (NVC). The assessment of NVC has shown useful in quantifying the degree of vascular and metabolic decoupling in certain neurodegenerative conditions, such as Alzheimer’s disease and acutely following sport-related concussion and therefore may show utility in detecting long-term alterations in NVC in IPV survivors.

Objectives: To evaluate the NVC response in women who have experienced IPV-related BI to enhance understanding of the associated neurophysiological changes.

Methods: We characterized the NVC response in survivors of IPV-related BI through measurement of NVC metrics while participants performed a complex visual search task. A stepwise multiple regression was used to examine predictor variables of PTSD, anxiety, depression and executive dysfunction, along with scores on two unique measures that operationalize the experience of IPV survivors, the Women’s Experience with Battering Scale (WEB) and the Brain Injury Severity Assessment (BISA) on various NVC metrics in the middle cerebral artery (MCA) and posterior cerebral artery (PCA).

Results: We observed an alteration in MCA function, specifically in MCA slope (adjusted R² = .192, p = .005.) This was associated with increased levels of clinical depression as quantified by the Beck’s Depression Inventory – II neuropsychological assessment tool.

Conclusions: Many IPV survivors experience neuropsychological sequelae as a result of BI and strangulation. This study, along with others conducted by our lab, show that IPV-related BI events may also lead to dysregulation of CBF measures, particularly in the anterior cerebral beds, highlighting the need for targeted intervention strategies and increased support for this population as they navigate their recovery and aim to live in a future free from abuse.

277 Dynamic Cerebral Autoregulation as a Potential Cause for Prolonged Clinical Recovery in Survivors of Intimate Partner Violence-Related Brain Injury

Colin Wallace,1 Jonathan Smirla,b,c,d,e,f,g, K. Elisabeth Jones,1 Matt Rieger1, Krystal Rothlander1, Paul Van Donkelaar1

1School of Health and Exercise Sciences, University of British Columbia, Kelowna, Canada, 2Sport Injury Prevention Research Centre, Faculty of Kinesiology, University of Calgary, Calgary, Canada, 3Cerebrovascular Concussion Laboratory, Faculty of Kinesiology, University of Calgary, Calgary, Canada, 4Hotchkiss Brain Institute, University of Calgary, Calgary, Canada, 5Integrated Concussion Research Program, University of Calgary, Calgary, Canada, 6Alberta Children’s Hospital Research Institute, University of Calgary, Calgary, Canada, 7Libin Cardiovascular Institute of Alberta, University of Calgary, Calgary, Canada

ABSTRACT

Background: One in three women will experience intimate partner violence (IPV) in their lifetime, and up to 92% of women affected by IPV will suffer a brain injury (BI). These violent events can induce a neuropathological cascade along with psychopathological sequelae including, but not limited to, depression, anxiety and post-traumatic stress disorder (PTSD). It has been hypothesized impaired regulation of cerebral blood flow (CBF) is one of the underlying processes associated with a delayed recovery from a BI. Dynamic cerebral autoregulation (dCA) is key component of CBF regulation and involves a dynamic process that aims to maintain homeostatic blood flow despite changes in arterial blood pressure (BP).

Objectives: We examined the extent of BP-CBF decoupling in survivors of IPV-related BI through measurement of transfer function analysis metrics, while accounting for psychopathological comorbidity severity scores of PTSD, anxiety, depression and deficits in executive functioning.

Methods: Oscillations in BP were driven by 5-minute repetitive stand-squat maneuvers at both 0.05 and 0.10 Hz. BP was continuously measured using finger photoplethysmography, while transcranial Doppler ultrasound was used to measure cerebral blood velocity in the middle cerebral artery (MCA) and posterior cerebral artery (PCA). Transfer function analysis characterized the coherence (correlation metric), phase (timing offset) and normalized gain (amplitude modulation) between BP and cerebral blood velocity.

A stepwise multiple regression was used to examine predictor variables of PTSD, anxiety, depression and executive dysfunction, along with scores on two unique measures that
operationalize the experience of IPV survivors, the Women’s Experience with Battering Scale (WEB) and the Brain Injury Severity Assessment (BISA).

Results: In the 0.05 Hz range, alterations in both phase and gain dCA metrics were observed in both the MCA and PCA, specifically in diastolic MCA phase (adjusted $R^2 = .498$, $p = 0.003$), diastolic PCA normative gain (adjusted $R^2 = .323$, $p = 0.005$), mean PCA normative gain (adjusted $R^2 = .340$, $p = 0.004$), systolic MCA normative gain (adjusted $R^2 = .195$, $p = 0.029$) and systolic PCA normative gain (adjusted $R^2 = .279$, $p = 0.010$).

In the 0.10 Hz range, only an alteration in diastolic MCA normative gain was found (adjusted $R^2 = .260$, $p = 0.008$).

Conclusions: The observed alterations in dCA metrics were explained by the presence of psychopathologies including depression, anxiety, PTSD and executive dysfunction. Taken together, these results suggest that IPV-related BI can render the brain more susceptible to rapid changes in CBF dysregulation. These findings are associated with numerous clinical sequelae and help provide additional context to the delayed recovery often experienced in this vulnerable population.

### 278 Somatization in Adolescents with Persistent Post-Concussive Symptoms: A Retrospective Chart Review

**Katherine Green**, Jacqueline Purtzki, Tim Oberlander, Andrea Chapman, Noah Silverberg, Amrit Dhariwal

- Faculty of Medicine, UBC, Vancouver, Canada
- Division of Physical Medicine and Rehab, UBC, Vancouver, Canada
- Department of Pediatrics, University of British Columbia, Vancouver, BC, Canada
- BC Children’s Hospital Research Institute, Vancouver, BC, Canada
- Department of Psychology, University of British Columbia, Vancouver, Canada
- Department of Psychiatry, Vancouver, Canada

**ABSTRACT**

Objectives: After concussion, approximately 30% of adolescents experience symptoms that persist beyond one-month post-injury. These symptoms may affect daily functioning at school, return to recreational activities and social life, and quality of life. Somatization, where psychological distress is expressed as physical symptoms, may contribute to persistent post-concussive symptoms for some adolescents.

The purpose of this study was to describe the characteristics of adolescents with persistent post-concussive symptoms with clinician-identified somatization and compare them to adolescents with persistent post-concussive symptoms without identified somatization.

Methods: Retrospective chart review. Participants were 94 adolescents referred for persistent post-concussion symptoms to an interdisciplinary adolescent concussion clinic between January 2016 and May 2018. They were evaluated $M = 6.6$ (SD = 4.4) months post injury. Demographics, injury characteristics, post-concussive symptoms, school attendance, premorbid experiences, mental health, and medical service use were extracted from charts.

Results: Adolescents with clinician-identified somatization had more severe and unusual post-concussive symptoms, more post-injury impairment in school attendance, were more likely to have a history of premorbid chronic pain or medically unexplained symptoms, obtained more neuroimaging and health services after injury compared to adolescents without clinician-identified somatization. The two groups did not differ in depression or anxiety symptoms on the Kutcher Adolescent Depression Scale and the Patient Reported Outcomes Measurement Information System (PROMIS) Pediatric Anxiety Symptom Scale, respectively.

Conclusions: This study identified differences and similarities in adolescents with and without clinician-identified somatization in a concussion clinic setting. Findings have the potential to improve clinical identification and treatment of somatization in youth who are slow to recover from a concussion.

### 279 Hypo-arousal Secondary to Frontotemporal Involvement in Progressive Supranuclear Palsy (PSP): A Case Report

**Prathusha Maduri**, **Clayton Mucha**, Sharon Bushi

- Montefiore Medical Center, Bronx, United States
- Burke Rehabilitation Hospital, White Plains, United States

**ABSTRACT**

A 55-year-old female, with a history of progressive supranuclear palsy (PSP) sustained a fall and developed a left subdural hemorrhage (SDH) along the falx and bilateral tentorium with midline shift requiring an emergent decompressive craniotomy. Her hospital stay was complicated by a brief ventilator-dependent respiratory failure and urinary tract infection. She developed bilateral lower extremity weakness inconsistent with the sole diagnosis of her left SDH. Thus, spine imaging was pursued and revealed thoracic myelopathy (T10-T12). A lumbar puncture ruled out infectious and inflammatory etiologies and the neurology team concluded that her myelopathy was due to the traumatic fall.

Upon admission to the rehabilitation unit, her exam showed a deconditioned, frail woman who was alert, fully oriented, with hypophonic speech and flat affect. In her bilateral lower extremities, strength was 4/5 with minimal spasticity, reflexes 3 and intact sensation throughout. Over the following weeks, her strength and spasticity (Modified Ashworth Scale 2–3) worsened. Repeat spine imaging showed no changes. EMG confirmed an overlapping diagnosis of critical illness myopathy.

During her rehabilitation stay, the patient had several episodes of hypo arousal. These episodes were characterized by the patient blankly staring in a non-responsive manner. She would not follow commands. Brainstem reflexes, however, remained intact and she withdrew from painful stimuli.
There were no incidences of incontinence or tongue-biting associated with these episodes. After a few minutes, she slowly followed commands, then was able to verbalize short sentences. Due to a high suspicion of seizures, neurology was consulted after the first episode and a video electroencephalogram (VEEG) was done demonstrating that these episodes did not correspond with any abnormal seizure activity. Neurology concluded that these hypo arousal episodes were related to the frontotemporal impairments seen with PSP. A trial of Oxicarbazepine was initiated without improvement. Then, Amantadine 100 mg dosed at 7 am and 12 pm was started. The patient’s arousal improved and the episodes resolved.

In current literature, PSP is known to cause a spectrum of symptoms including executive dysfunction, cognitive slowing, memory impairments, limb apraxia, language impairment, and perceptuo-spatial impairment. These neurocognitive features are predominant in 58% of patients with PSP, but the evidence available for options of treatment is limited. Amantadine has been used generally in Parkinson’s disease with some success for the indications of transient improvement in freezing gait, dysphagia, and dyskinesia, but currently, there is minimal evidence trialing Amantadine for the clinical finding of hypo arousal with sustained improved cognitive function as seen on this patient’s outpatient follow up appointments. This case presentation suggests that Amantadine may be beneficial in treating hypo arousal secondary to frontotemporal involvement seen in patients with PSP.

280 Validating An Australian Coding System for Traumatic Brain Injury in Irish Hospital Discharge Records

Anthony Stainesa, Anne O’Farrellb, Kate O’Donnellb, Andrea Healyb, Teresa Burkea, Howard Johnsonc, Grainne McGettrickc, Catherine Corriganb

aDublin City University, Dublin, Ireland, bHealth Intelligence, HSE, Dublin, Ireland, cABI, Ireland, Dublin, Ireland

ABSTRACT

Background: Traumatic brain injury (TBI) is a leading cause of death and disability worldwide. Much work on the epidemiology and health services impact of TBI uses routinely collected health care data. There is no separate code for TBI in ICD-10, a commonly used coding system for acute care. Different approaches to defining traumatic brain injury in coded routine data contribute to variations between studies in TBI prevalence. This study assessed the performance of an Australian classification system, using ICD-10 to identify cases of likely TBI in routine hospital discharge data.

Method: The original study was done on hospital data from New South Wales. We replicated their approach using Irish hospital data, held by Health Intelligence, from 2013 to 2020. Irish hospital discharges are coded by trained coders using a common protocol. All cases with any ICD-10 code in S00 to S99 in any diagnosis were included. In the NSW system, in brief, cases with a relevant external code, (that s excluding non-traumatic codes) and a code indicating injury to the brain, or the skull, were taken as traumatic brain injury. Cases not classified as TBI by this system, but with codes, such as loss-of-consciousness, skull fracture or intra-cranial injury are manually reviewed.

Results: All 98,419 discharges with a code in S00 to S99 were reviewed. Of these 27,851 (28.3%) had a skull fracture or intra-cranial injury, and 12,106 (12.3%) had either loss-of-consciousness or post-traumatic amnesia, and most of these 11,976 (98.9%) of these (12.2% of the total) had either a skull fracture or an intra-cranial injury reported. 26,085 (26.5%) of the original 98,419 cases were classified as TBI using the NSW classification. Manual review of 1.3% (1356) cases added a maximum of 0.32% (321) further possible cases of TBI, suggesting a sensitivity of the classification of 98.8% (95% CI 98.6% to 98.9%).

Discussion: The main limitation of our work is that it is not possible to identify false positive cases – those coded as TBI, but where no TBI was present. This approach to identifying TBI works well, and is feasible for wider implementation. It provides comparability between different studies.

281 The Flynn Effect on Memory and Speed of Information Processing Performance: A Comparison of Norms Established 12 Years Apart

Sara Da Silva Ramosa, Michael Oddyb, Harriet Paula

aThe Disabilities Trust, Brain Injury Rehabilitation Trust, Horsham, United Kingdom

ABSTRACT

Objectives: The aim of this study was to examine possible increases in performance on memory and speed of information processing over a 12-year period. Several studies have described the Flynn effect, which refers to the steady increase in scores on tests of intellectual ability over time (Flynn, 1984, 1987). Similar effects have also been described for memory tests (Baxendale, 2010), where differences across time appear to be specific to learning and recall of visual materials.

Methods: Using the same method employed by Baxendale (2010), the norms of the BIRT Memory and Information Processing Battery (BMIPB, Oddy et al., 2007), and of its newest edition, the BMIPB-II (Oddy et al, 2019), were compared in each age range using independent samples t-tests, calculated from the published normative data, on the online MedCalc statistical calculators (MedCalc Software, Ostend, Belgium).

Results: The results revealed that learning of both verbal and visual information remained relatively stable over time, and across age groups, with no significant differences of performance between the 2007 and the 2019 normative samples. However, differences were found on recall tasks of both visual and verbal materials, particularly so in the older age groups. Performance on the processing component of the speed of information processing task was comparable across all age cohorts, although the 18–30 and 46–59 cohorts appeared to be faster in the 2019 sample.

Conclusions: The differences in performance over time found in this study were more subtle and less consistent than those reported by Baxendale (2010). This may be due to the shorter
time span elapsed in the present study (12 year vs. 22 years), although it is also possible that the impact of cultural evolution on human cognitive abilities (e.g. adaptation to the digital world), suggested as a possible mechanism underlying the better performance found for visual memory in the earlier study, had greater influence then, when technological developments were more substantial. It is also possible that fewer differences across generations may result from the recent decrease in the rate of cognitive decline seen with aging, which has been attributed to healthier lifestyles (Murman, 2015), leading to more comparable performance over time in the cohorts aged 18 to 60. We consider the implications of these findings for the use and interpretation of test scores and the risk of norms obsolescence.

282 Multivariate Decoding of Auditory Event-Related Potentials to Track Coma Progression

Adianes Herrera-Diaz, Richard Kolesar, Rober Boshra, James Reilly, Paniz Tavakoli, Netri Pajankar, Chia-Yu Lin, Elham Bagheri, Hope Morrison, John Connolly

McMaster University, Hamilton, Canada

ABSTRACT

Objectives: The present study uses multivariate pattern analysis (MVPA) to automatically quantify the neural differences of single-trial event related potentials (ERPs) in healthy controls and comatose patients, and track coma progression in patients. Methods: EEG data were collected from 17 healthy controls (one 12-hour recording each) and 3 comatose patients (up to 24-hour recording each), using an auditory oddball paradigm consisting of frequently occurring standard tones with 3 types of deviant tones. For patients, two recordings were conducted 3 days apart, denoted as day 0 and day 3, respectively. All trials of up to five blocks of the oddball paradigm per subject were concatenated to form a single “super-block,” representing all information collected from approximately a 12-hour period. Every healthy control had one superblock, while the comatose patients had two superblocks on day 0 and at least one superblock on day 3. MVPA was performed to discriminate between standard and deviant responses on 11 electrodes as features for every time point separately, using a support-vector machine (SVM) classifier and the area under the curve (AUC) as a performance metric. A 5-fold cross-validation with 10 repetitions was implemented to get a more realistic estimate of classification performance. Finally, a non-parametric permutation test was computed to assess whether the classifier performance was significantly above-chance level (50%). Results: All healthy controls exhibited significantly above-chance performance after stimulus onset, during the latency intervals associated with the MMN and P3a components. Maximum AUC scores were found mainly when discriminating the duration deviant versus standard tones, ranging from 80 to 94%. While none of the comatose patients exhibited significant results at the first superblock on day 0, MVPA showed some significant intervals in all patients at about the second half of day 0, and AUC scores slightly improved on day 3. These 3 patients eventually transitioned to different states of consciousness: one with unresponsive wakefulness syndrome, and two emerged from their coma fully conscious. Conclusions: These preliminary findings show that single-trial MVPA of ERPs can capture differences between healthy controls and comatose patients, and provide evidence of coma progression in patients. This method could be a promising tool for tracking neurophysiological changes in coma patients and assessing their potential for recovery. Further research is needed using a greater number of patients to determine the clinical implications of this method, and whether it may pave the way to develop real-time monitoring techniques of the state of consciousness.

283 Virtual Reality to Enhance Brain-injury Rehabilitation: Comparison of Everyday Activities in Virtual and Real-world Kitchen Environments

Belinda Lange, Sebastian Koenig

Caring Futures Institute, College of Nursing and Health Sciences, Flinders University, Bedford Park, Australia, Katana Simulations Pty Ltd, Hallett Cove, Australia

ABSTRACT

Objective: Evaluate the usability of two tasks, making tea and sandwiches, in a virtual kitchen environment compared to a real kitchen by people with and without brain injury. Methods: 20 adults with brain injury (n = 10) and without brain injury (n = 10) completed a questionnaire on their experience with digital technologies and completed two tasks, making a cup of tea and a sandwich, in a real-world setting and the same tasks in a virtual reality setting. The virtual reality system consisted of the Oculus Quest 2 and Sim:Kitchen software. Order of completion was counterbalanced. Upon completion of the virtual reality tasks, participants were asked to complete the System Usability Scale. At the end of the session, participants completed a semi-structured interview. Results: Mean age of participants was 38.5 (±14.1) years (21–66 years) and 70% were male (n = 14). The mean age of participants with brain injury was 39.5 (±14.0) years (21–59 years) and 80% were male (n = 8). The median self-rated confidence in using digital technologies for the whole sample was 4 (good) out of a maximum of 5. Forty-five percent of participants rated their confidence in using technologies as ‘very good’ (n = 9). The median score for people with brain injury was 3, compared to 5 for participants without brain injury. All participants had access to a smartphone device and reported using a mobile phone daily. Overall, participants followed the expected order of tasks and 85% of participants undertook the tasks in similar ways within both the real and virtual environments. There were only few task errors across both real and virtual tasks, for example, participants turned the kettle on to boil without adding water in both real and virtual environments (n = 2). Sixty percent of participants without brain injury (n = 6) and 50% of participants with brain injury took just as long to complete the virtual tasks as the real-world tasks.
Participants across both groups provided positive feedback on the use of the virtual reality system, stating that virtual reality could provide a ‘safe’ way to practice tasks before trying in the real environment. All participants stated they would use the system again, reporting the system to be easy to use and well-integrated. The median System Usability score for all participants was excellent (72.05 ± 10.29). Participants with brain injury rated the system higher (74.33 ± 8.65) than participants without brain injury (70.00 ± 11.64). Side effects were negligible to minimal for both groups.

Conclusions: People with and without brain injuries were able to complete two tasks in a virtual reality kitchen. Behaviors and time to complete were similar across both real and virtual environments. This demonstrates the potential to use virtual reality to rehabilitate and train real world behaviors and justifies further evaluation trials.

284 Dynamic Modularity of Brain Networks: A Neuromodulation and EEG-tracking Study in Patients with Optic Nerve Damage

Zheng Wu\textsuperscript{a,b}, Bernhard A. Sabel\textsuperscript{c}

\textsuperscript{a}Institute Of Medical Psychology, Medical Faculty, Otto-von-Guericke University of Magdeburg, Magdeburg, Germany, \textsuperscript{b}Data and Knowledge Engineering Group, Faculty of Computer Science, Otto-von-Guericke University of Magdeburg, Magdeburg, Germany

\textbf{ABSTRACT}

Partial vision loss after optic nerve damage can cause partially defected vision loss, and much is known about the effects on visual pathways and neuron activities. Much less is known about how these local lesion effects are manifest on the modular structure of whole brain network nor how they influence dynamic reconfigurations and interaction of modules, especially after receiving brain stimulation. Using visual evoked EEG on patients with optic nerve damage and normal subjects, we investigated the representative modular structure, explored global diagnoses and local interactions of intra and inter modules as well as the relevance of alterations of the modular interaction in multilayer network to their visual performance. We found that in the absence of considerable impairment in the overall diagnoses of multilayer network modules in patients with optic nerve damage, local interactions of inter modules correlated with their visual performance. Moreover, the improvement in the interaction strength of pathways linked to the attention module was associated with an increase in the number of detected trials after ACS treatment in patients with optic nerve damage, but the global modularity improved and flexibility decreased meanwhile.

Together, these findings suggest that there was overall temporal coordination of multiple cortical modules to support vision cognition in intact vision area, and such inter module interaction was relevant to visual performance. Further, ACS induced a more optimal balanced and stable multilayer modular structure for visual processing by enhancing the interaction pathways associated with the attention module.

285 Increased Brain Metabolism and EEG Connectivity After Apomorphine Therapy in Patients with Chronic Disorders of Consciousness

Leandro R. D. Sanz\textsuperscript{a,b}, Nicolas Lejeune\textsuperscript{a,c,d}, Estelle Bonin\textsuperscript{a,b}, Rajanikant Panda\textsuperscript{a,b}, Arianna Sala\textsuperscript{a,b}, David Dikenstein\textsuperscript{c}, Neal Farber\textsuperscript{c}, Aurore Thibaut\textsuperscript{a,b}, Steven Laureys\textsuperscript{a,b}, Olivia Gossieres\textsuperscript{a,b}

\textsuperscript{a}Coma Science Group, GIGA Consciousness, University of Liège, Liège, Belgium, \textsuperscript{b}Centre du Cerveau, University Hospital of Liège, Liège, Belgium, \textsuperscript{c}CHN William Lennox, Groupe Hospitalier Saint-Luc, Ottignies-Louvain-la-Neuve, Belgium, \textsuperscript{d}Institute of Neurosciences, UCLouvain, Brussels, Belgium, \textsuperscript{e}NeuroHealing Pharmaceuticals Inc., Waban, United States

\textbf{ABSTRACT}

Objectives: Few therapies to improve the prognosis of patients with disorders of consciousness (DoC) have reliable evidence to support their efficacy and outcome measures used in clinical trials rarely include neuroimaging biomarkers of recovery. Apomorphine is a dopaminergic agent which has demonstrated preliminary behavioral results in DoC. Its consciousness-promoting action is thought to rely on the restoration of dopaminergic striato-pallido-thalamo-cortical feedback loops in the mesocircuit. This open-label study uses clinical and neuroimaging outcome measures to investigate changes after apomorphine therapy, to confirm its efficacy and identify surrogate biomarkers of responsiveness.

Methods: 6 patients with chronic DoC following severe brain injury (4 male; 4 traumatic; 1 unresponsive, 3 minimally conscious “minus,” 2 minimally conscious “plus”; 38-year-old average; 99 days post-onset average) received daily subcutaneous apomorphine for 30 days. Multimodal outcome measures were recorded 30 days before, during therapy and 30 days after treatment withdrawal. Weekly behavioral assessments included the Coma Recovery Scale–Revised (CRS-R) and rehabilitation scales. Surveys on subjective feeling about the patient’s clinical status were filled out by families and healthcare staff before and after therapy. High-density electroencephalography (hdEEG) and fluorodeoxyglucose positron emission tomography (FDG-PET) were acquired before and after treatment.

Results: Compared to the 30-day baseline period, 3 patients improved their CRS-R behavioral diagnosis during therapy, 2 additional patients improved during the 12-month follow-up and the last patient spontaneously emerged before treatment but improved on all rehabilitation scales during therapy. All patients maintained their improvements at the latest available follow-up. Mean CRS-R scores were higher during therapy (+2.1 points) and 30-day washout (+4.3 points) periods, compared to the 30-day baseline.
All items evaluated in the clinical survey were rated higher after treatment than before treatment, both by the family (+30.9% mean difference) and the healthcare staff (+20.5%). The family and the staff observed the most important improvements in the patients’ communication abilities and spontaneous motricity, respectively.

4/6 patients demonstrated increased alpha-band hdEEG functional connectivity measured by network centrality after therapy, while the two patients who had already emerged during treatment did not improve (+23.1% average increase in connectivity when considering only the four “responders”). Wholebrain metabolism measured by FDG-PET increased in the same four patients and decreased in the two remaining (+20.1% on average after treatment, when considering only the four “responders”).

Conclusion: Long-lasting behavioral improvements were observed in these patients with chronic DoC who received 30-day apomorphine therapy. Multimodal neuroimaging measures such as hdEEG connectivity and FDG-PET metabolism may help tracking responsiveness to therapy and identifying potential responders. However, the clinical profile of patients (e.g., those who already emerged) may influence the dynamics of specific neuroimaging biomarkers. Future studies should confirm these preliminary results and guide the selection of adequate multimodal outcome measures following a precision medicine approach.

286 Addressing the Shadow Pandemic: COVID-19 Related Impacts, Barriers, Needs, and Priorities to Healthcare and Support for Women Survivors of Intimate Partner Violence and Brain Injury

Danielle Toccalinoa, Halina Haagb,c, Maria Jennifer Estrellad, Stephanie Cowle, Michael Ellisf, Judith Gargaroa,b, Angela Colantonioa,c,d,h,i

aInstitute for Health Policy, Management and Evaluation, University of Toronto, Toronto, Canada, bLyle S. Hallman Faculty of Social Work, Wilfrid Laurier University, Waterloo, Canada, cKITE-Toronto Rehabilitation Institute, University Health Network, Toronto, Canada, dRehabilitation Sciences Institute, University of Toronto, Toronto, Canada, eParachute, Toronto, Canada, fDepartment of Surgery, Section of Neurosurgery, University of Manitoba, Pan Am Concussion Program, Winnipeg, Canada, gOntario Neurotrauma Foundation, Toronto, Canada, hDepartment of Occupational Science & Occupational Therapy, University of Toronto, Toronto, Canada, iDalla Lana School of Public Health, University of Toronto, Toronto, Canada

ABSTRACT
Background: One in three women experience intimate partner violence (IPV) in their lifetime and both the rates and severity of IPV have increased during the COVID-19 pandemic. The majority of injuries to women experiencing IPV are to the head, face, and neck, leaving survivors at high risk for traumatic brain injury (TBI); however, the intersection of IPV and TBI (IPV/TBI) remains largely unrecognized. Here we report on the COVID-19 related impacts, barriers, needs, and priorities to healthcare and support services for women survivors of IPV/TBI.

Methods: A pan-Canadian group of 30 stakeholders was engaged in a two-day virtual summit using a participatory research model. Stakeholders were drawn from an IPV/TBI knowledge-to-practice (K2P) Network comprising women survivors, service providers, researchers, and decision makers. Semi-structured discussion guides were used by the research team to facilitate small group break-out sessions which were recorded and transcribed verbatim. Thematic analysis techniques were used to analyze transcripts and develop themes. Stakeholders were given the opportunity to contribute to the analysis and KT through member checking activities. Ethics approval was obtained through the University of Toronto.

Results: COVID-19 has increased rates and severity of IPV and resulted in barriers to help-seeking and accessing services. The impacts of the pandemic have been exacerbated by pre-existing infrastructure and resource limitations in rural and remote areas, including limited access to services. Stakeholders called for increased awareness across a number of groups. Survivors and the public need greater awareness of the resources available for survivors of IPV/TBI, particularly how access to or availability of resources and services have changed during the pandemic. Healthcare providers ranging from emergency departments to rehabilitation professionals need greater awareness of the intersection of IPV/TBI and how to appropriately manage these survivors’ unique needs, particularly considering the impact of COVID on the accessibility of that care. Requests from survivors for peer support have increased significantly during the pandemic, highlighting the need for more formalized and better supported peer roles for IPV/TBI survivors. Stakeholders also noted the implications of virtual care, for example, safety, privacy, and usability, require careful consideration.

Conclusions: The COVID-19 pandemic has intensified IPV/TBI, increased challenges for women survivors, and accentuated the continued lack of IPV/TBI awareness. Key recommendations for healthcare and rehabilitation and a national strategy to address this priority are discussed.

287 A Numerical Approach to Understand the Active Response of Cervical Muscles with Different Fiber Types on Head Kinematics in Concussive Impacts

Sakib Ul Islam, Grant James Dickey, Kewei Bian, Haojie Mao

aWestern University, London, Canada

ABSTRACT
Objective: The influence of cervical muscles in affecting the risk of mild Traumatic Brain Injury (mTBI) in contact sports have been studied in past literature. Due to the ability to contract at will, cervical muscles could provide adequate strength in stabilizing the head-neck segment by resisting impending force. However, methodological constraints and complexities involving human volunteers create a gap in understanding the
influence of muscle activation in head kinematics. We adopted a numerical approach using a detailed finite element head-neck model to investigate the role of the passive and active response of neck muscles with two different fiber types (type I and II) on head kinematics.

Methods: In this study, twenty-one mTBI impact scenarios were simulated using the validated GHBMC head-neck model with a pneumatic impactor by applying an initial velocity of 3 m/s. Force-velocity curves were adjusted to formulate the mechanism of different fiber types, and muscle activation pattern was adjusted for flexor and extensor muscles to represent active response within physical limit based on literature. Linear and rotational-based injury metrics (HIC-head injury criteria and BrIC-brain injury criteria) were compared for each of the cases.

Results: Our results suggest that activation of muscles does not have much influence on rotational-based head kinematics (BrIC). However, active muscle response reduced peak linear translational acceleration by 15% on average for the impacts to the cranium. Interestingly, peak linear translational acceleration increased (21%) in the impacts surrounding the chin. Muscle activation reduced HIC15 by 28% on average in all impact conditions except for the chin, where HIC15 increased by an average of 56%. We observed a slight difference in kinematics for the two different fiber types even though the fast fibers produced a much higher force in the neck before impact than slow fibers.

Conclusions: We concluded that activation of neck muscles could help reduce head injury but might have a negligible effect on reducing the risk of concussion in a low-velocity blunt impact to the head.

288 IBIA: A Spark for the Development of Community Based Rehabilitation for People with TBI in Ukraine

Deidre Sperry*, Natalie Kalymon, Mark Holloway, Howard Jackson, Anna Maviso

*aMcMaster University, Hamilton, Canada

ABSTRACT

In 2014, as a result of the Donbas conflict, the international health community took notice of the fact that the Ukrainian medical model of rehabilitation was out of date and could not meet the rehabilitation needs of their people.

Today, while having made some gains, the medical system in Ukraine continues to struggle to provide adequate rehabilitation for people with Traumatic Brain Injury. In general, they lack a compressive system of evidenced based, brain injury rehabilitation. Beyond the challenges facing inpatient programs, Community Based Rehabilitation (CBR) is virtually unknown. So, when a 54-year-old man was critically injured in London, England and required repatriation back to his home in Ukraine, a unique opportunity arose.

The International Brain Injury Association is widely known as a beacon in the brain injury community as a place where rehabilitation health care professionals, from all over the world, unite in efforts to bring evidence and best practice together in order to enrich the lives of those living with the effects of TBI. Professional relationships are made and enhanced within this context of learning and sharing. Most frontline allied healthcare practitioners would not expect to ever work together clinically, but that is just what happened in 2019 following the IBIA conference in Toronto Canada.

This presentation shares the unique journey of how an international, interdisciplinary team are developing and implementing a CBR program for a Ukrainian gentleman and his family. A UK based Social Worker Case Manager was charged with the task of developing a rehabilitation program to meet the rehabilitative needs of this gentleman. Certainly, the task was complicated by language barriers, but more critical was that, despite some gains being made, a long entrenched derisive attitude of imperfection and illness is still pervasive. As Ukraine does not have professionally trained, multi-disciplinary rehabilitation professionals in place to design, implement or evaluate a rehabilitation program that meets with international best practices, it was necessary to work creatively and lean into relationships forged at IBIA.

This presentation will outline how a Canadian-Ukrainian Occupational Therapist, Canadian Speech Language Pathologist, a Neuropsychologist and a Social Work Case Manager from the United Kingdom, and a Ukrainian Psychologist and Physiotherapist have developed this CBR program using local untrained and unregulated supports.

Preliminary successes and challenges experienced by this team will be explored. Using a hybrid of in-person and remote tele-health models the program has negotiated the cultures and the clinical practices of three countries. This is a clinical story that demonstrates the importance of cross-cultural knowledge sharing and the importance of international relationships in the rehabilitation community.

289 A Population-Based Sex-Stratified Study on Health Status Preceding Traumatic Brain Injury and Direct Medical Cost

Vincy Chan*, Mackenzie Hurst†, Tierza Petersen*, Jingqian Liu*, Tatyana Mollayeva*, Angela Colantonio*, Mitchell Sutton*, Michael Escobar†

*KITE-Toronto Rehabilitation Institute, University Health Network, Toronto, Canada, †Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Canada, ¤Rehabilitation Sciences Institute, Temerty Faculty of Medicine, University of Toronto, Toronto, Canada, dDalla Lana School of Public Health, University of Toronto, Toronto, Canada, eDepartment of Occupational Science & Occupational Therapy, Temerty Faculty of Medicine, University of Toronto, Toronto, Canada

ABSTRACT

Objectives: To understand how health status preceding traumatic brain injury (TBI) affects direct medical cost of publicly funded healthcare use two years post-injury.
Methods: A population-based retrospective cohort study was conducted using health administrative data from Ontario, Canada. All patients 19 years of age or older in the emergency department (ED) or acute care for a TBI between April 1, 2007 and March 31, 2014 were identified. Pre-injury health status was determined using International Classification of Diseases Version 10 codes identified in ED or acute care records for each patient five years prior to the TBI event. These codes were categorized into 43 factors internally validated for the TBI population assessed in this study. The outcome variable of interest was the direct medical cost for all publicly funded health services used within two years of ED or acute care discharge, adjusted to the 2016 Canadian dollar. Sex-specific Bonferroni adjusted multivariable linear regressions were conducted to assess the associations between pre-injury health status and direct medical cost.

Results: The total direct medical cost of publicly funded health service used within two years of discharge was $1.21 billion CAD. Patients who first received care for their TBI in the ED (81.9%; N = 45,585, of whom 49.9% were males) incurred a median cost of $2,492/male patient and $3,508/female patient; 37 pre-injury factors were significantly associated with increased medical costs. Patients who first received care for their TBI in acute care (18.1%; N = 10,084, of whom 63.2% were males) incurred a median cost of $25,081/male patient and $30,277/female patient; 21 factors were significantly associated with increased medical costs. Among more prevalent pre-injury health status, conditions that increased direct medical cost by at least 50% included mental health disorders, substance abuse, disorders or medical conditions frequently observed among the elderly, cardiovascular disorders, stroke and emergencies involving the brain, metabolic disorders and abdominal symptoms, conditions and symptoms of abdomen and pelvis, genitourinary disorders and disorders of prostate, and pulmonary abdominal and other emergencies.

Conclusion: Early identification of pre-existing health conditions may be opportunities to reduce direct medical cost post-injury and should be explored, to promote appropriate management and integrated care post-TBI.

290 A Population-Based Sex-Stratified study on Health Status Preceding Traumatic Brain Injury and Functional Outcome

Vincent Chan, Mitchell Sutton, Tatyana Mollayeva, Michael Escobar, Mackenzie Hurst, Angela Colantionio

aKITE-Toronto Rehabilitation Institute, University Health Network, Toronto, Canada, bInstitute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Canada, cRehabilitation Sciences Institute, Temerty Faculty of Medicine, University of Toronto, Toronto, Canada, dDalla Lana School of Public Health, University of Toronto, Toronto, Canada, eDepartment of Occupational Science & Occupational Therapy, Temerty Faculty of Medicine, University of Toronto, Toronto, Canada

ABSTRACT

Objectives: To understand how health status preceding traumatic brain injury (TBI) affects relative functional gain (RFG) after inpatient rehabilitation.

Methods: A population-based retrospective cohort study was conducted using health administrative data from Ontario, Canada. All patients 14 years of age or older admitted to inpatient rehabilitation within one year of acute care discharge between April 1, 2008 and March 31, 2015 were identified. RFG, in percentage, was calculated as [(discharge FIM score) – (admission FIM score)]/[126 – (admission FIM score)] x 100. International Classification of Diseases Version 10 codes were identified for each patient and categorized into 43 factors using data mining approaches. Sex-specific Bonferroni adjusted multivariable linear regressions were conducted to assess the associations between pre-injury health status and RFG.

Results: During the study period, 5,802 patients with TBI (63.4% males) received inpatient rehabilitation within one year of acute care discharge. The RFG among male patients was 52.8±27.6% and 10 factors of pre-injury health status related to neurology, emergency medicine, cardiology, psychiatry, geriatrics, and gastroenterology were significantly associated with reduced RFG. The RFG among female patients was 51.6±27.1% and one factor of pre-injury health status, geriatrics, was significantly associated with reduced RFG.

Conclusion: Pre-injury health conditions should be considered in planning and executing rehabilitation interventions to maximize functional gain. Future research is encouraged to continue to leverage data mining approaches to identify clusters of patients who are at risk of adverse functional outcomes to inform evidence-based planning of rehabilitation for patients with TBI.

291 Using Event-related Potentials to Track Fluctuations in Responsiveness in Disorders of Consciousness: A Case Study of Unresponsive Wakefulness Syndrome

Paniz Tavakoli, Adriana Herrera-Diaz, Richard Kolesar, James Reilly, Netri Pajankar, Rober Boshra, Alison Fox-Robichaud, Cindy Hamielec, John Connolly

aMcmaster University, Hamilton, Canada

ABSTRACT

Background: The assessment of cognitive functions in patients with disorders of consciousness (DOC) can be very difficult due to clinicians’ reliance on behavioral measures. Typically, unresponsiveness is attributed to unconsciousness, resulting in nearly 40% of patients being misdiagnosed. This alarmingly high rate may have grave consequences, including removing individuals from life support, or not providing treatment to support recovery. Recently, event-related potentials (ERPs), such as the mismatch negativity (MMN) and P3a, have been used to study DOC. The MMN reflects automatic sensory memory while the P3a reflects higher level attentional processing. The presence of the MMN and P3a in DOC is associated
with recovery to consciousness, although the association varies greatly across studies, making it difficult to assess their diagnostic/prognostic value. Given that DOC patients often experience fluctuations in arousal, it is possible that the MMN/P3a would show a waxing and waning pattern in accordance with these fluctuations. The present study assessed the MMN and P3a in a patient with unresponsive wakefulness syndrome (UWS) over the course of 24 hours to determine whether these ERP responses show fluctuations in detectability over time.

Methods: The MMN and P3a were recorded in a UWS patient and compared to four healthy controls. The patient’s ERPs were recorded over 24 hours while the controls were recorded for 12 hours to minimize movement artifacts and fatigue. The patient was included in the study 26 days post hospital admission for necrotizing pancreatitis. During the time of recording, the patient was opening his eyes spontaneously and withdrawing to pain. His GCS score was 9 (E4/V1/M4). The presence of the MMN and P3a were confirmed by conducting permutation testing.

Results: Results revealed that both the MMN and P3a fluctuated in detectability over the course of 24 hours for the UWS patient, a finding that was not observed in controls. Out of the nine 20-minute blocks of the oddball paradigm, the patient showed an MMN in five blocks and a P3a in three blocks over the course of 24 hours.

Conclusion: Despite behavioral evidence suggesting a complete lack of responsiveness/awareness of the external environment aside from pain withdrawal, the patient exhibited ERP signatures of cognitive information processing providing strong evidence for partially preserved cortical functioning and “islands” of cognition. Additionally, this study provides strong evidence that the MMN and P3a vary in detectability over the course of 24 hours in a patient UWS. This strongly suggests that the inconsistencies in detection of ERPs in previous studies could be attributable to the use of more traditional single block recording sessions. In these cases, the “absence” of ERP responses in UWS patients should be interpreted with caution and not taken as their definitive absence.

292 Spastic Muscle Stiffness Assessed using Ultrasoundography-Shear Wave Elastography in Patients with Chronic Disorder of Consciousness Following Traumatic Brain Injury

Jun Matsumoto-miyazakiab, Shogo Sawamuraab, Yumiko Nishibu, Maki Okada, Etsuko Owashi, Kazufumi Ohmura, Yuka Ikegame, Yoshitaka Asano, Hirohito Yanoac, Jun Shinodaabc

Chubu Medical Center for prolonged Traumatic Brain Dysfunction, Kizawa Memorial Hospital, Minokamo, Japan, Department of Cardiology, Gifu University Graduate School of Medicine, Gifu, Japan, Department of Clinical Brain Sciences, Gifu University Graduate School of Medicine, Minokamo, Japan, Department of Rehabilitation, Heisei College of Health Sciences, Gifu, Japan, Department of Radiation Technology, Kizawa Memorial Hospital, Minokamo, Japan, Department of Clinical Examination, Kizawa Memorial Hospital, Minokamo, Japan, Department of Emergency Medicine, Kizawa Memorial Hospital, Minokamo, Japan

Objective: The study was to investigate the relationship between spastic muscle stiffness quantified using ultrasonography (US)-shear wave elastography (SWE) and clinical findings in patients with disorder of consciousness (DOC) and spastic muscle overactivity after incurring a severe traumatic brain injury (TBI).

Methods: A cross-sectional observational study was conducted at a rehabilitation hospital specialized for severe TBI due to traffic accident.

Ten inpatients with DOC after TBI due to traffic accident (mean ± standard deviation [SD]; age, 33 ± 13 years, time after injury, 31 ± 11 months, 8 men and 2 women, including 4 patients in a vegetative state and 6 in a minimally conscious state) were included. Seven patients had developed spasticity (modified Ashworth Scale [MAS] score ≥ 1) in the upper extremity on at least one side. All the patients had been receiving physiotherapy, including passive range-of-motion exercise and muscle stretching therapy. Six patients received antispastic agents such as baclofen, dantrolene, and eperisone. The shear wave speed (SWS) of the biceps brachii muscle (BBM) on the more affected side of each patient was measured using SWE as an indicator of muscle stiffness. The SWS of the BBM was measured at 90° elbow flexion and at the maximally achievable elbow extension. The MAS and modified Tardieu Scale (MTS) scores were also evaluated as clinical parameters of spastic severity.

Results: The SWSs (mean ± SD) at elbow flexion and elbow extension were 2.49 ± 0.59 and 5.05 ± 2.13 m/sec, respectively, and the SWS at elbow extension was higher than that at elbow flexion (p < 0.01). Significant positive correlations between SWS and MAS were found at elbow flexion (rs = 0.81; p < 0.01) and maximally elbow extension (rs = 0.75; p < 0.05). Significant positive correlations were found between the SWS and the MTS score were also found at elbow flexion (r = 0.66; p < 0.05) and maximal elbow extension (r = 0.65; p < 0.05).

Conclusion: High stiffness quantified using US-SWE was associated with high clinical spastic severity evaluated using the MAS and MTS. US-SWE may be useful for the quantitative assessment of spastic BBM and treatment follow-up of spastic muscle overactivity in patients with chronic DOC after TBI.

293 Best-Evidence Synthesis on the Impact of Comorbidities in Traumatic Brain Injury on Functional Outcomes

Sara Hanafya,b,c, Chen Xiongab,c, Vincy Chan,a,b,c,d, Mitchell Sutton, Michael Escobar, Angela Colantonio,a,b,c,d,e, Tatyana Mollayeva,a,b,c,d

Rehabilitation Sciences Institute, Temerty Faculty of Medicine, University of Toronto, Toronto, Canada, Kite-Toronto Rehabilitation Institute, University Health Network,
Toronto, Canada, 2Acquired Brain Injury Research Lab, University of Toronto, Toronto, Canada, 3Institute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Canada, 4Dalla Lana School of Public Health, University of Toronto, Toronto, Canada, 5Department of Occupational Science and Occupational Therapy, University of Toronto, Toronto, Canada

**ABSTRACT**

Objective(s): The study of comorbidity in traumatic brain injury (TBI) is vital as “any distinct additional clinical entity during the clinical course of a patient who has the index disease under study” can affect persons’ functional outcome. To date, there has been no systematic review on the topic of comorbidity in TBI as it relates to functional outcomes. The objective of this study was to summarize scientific evidence on the relationship between comorbidity and functional outcome in adults with TBI.

Methods: Peer-reviewed English journal articles published between May 1997 and September 2020 from Medline, Central, Embase, and PsycINFO were identified. Articles with prospective or retrospective data collection and a longitudinal design focusing on the relationship between comorbidity and cognitive and/or physical functioning in adults with TBI were screened by three independent reviewers for eligibility. Quality assessment followed the Quality in Prognosis Studies tool and the Scottish Intercollegiate Guidelines Network methodology recommendations. All extracted data were synthesised through tabulation and qualitative description.

Results: Of the 12,073 titles and abstracts screened, twenty-two longitudinal studies met the inclusion and quality criteria and were included in the review. All of the studies were of fair quality. The strength of the association between comorbidity in persons with TBI and their adverse functional outcomes differed across studies, even within the same comorbidity types and classifications of comorbidity. Among the wide range of studied comorbidities, the presence of systemic medical diseases, psychiatric conditions, and neurological disorders were shown to adversely affect functional outcomes in persons with TBI across injury severities. There was inconclusive evidence on the effect of sex and gender and age on functional outcomes. Due to methodological and clinical heterogeneity between studies, meta-analyses were not performed.

Conclusions: Best-evidence synthesis suggests the potential for comorbidity to affect functional outcomes of persons with TBI. Healthcare and rehabilitation for patients with TBI should account for comorbidity to meet patients’ needs and prevent adverse functional outcomes.

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**294 Characterizing On-field Soccer Header Kinematics in Collegiate Women’s Soccer**

Rebecca Kenny, Marko Elez, Naznin Virji-Babul, Lyndia Wu

aUniversity Of British Columbia, Vancouver, Canada

**ABSTRACT**

Introduction: Soccer is a unique sport where players purposefully and voluntarily use their unprotected heads to manipulate the direction of the soccer ball (1). Thus, soccer players are exposed to a high number of subconcussive head impacts, which have been hypothesized to lead to cumulative brain trauma (2). Compared with contact sports, such as American football, soccer is a relatively under-investigated sport in studies of head impact biomechanics. The current study aims to evaluate the head kinematics across the different types of headers experienced during competitive women’s collegiate soccer using instrumented mouthpieces.

Methods: Ten collegiate women’s soccer players were recruited and followed during one season. Custom-fitted mouthpieces (4,5) were worn by each player during games and practices. Video recordings were collected for all on-field activity. We analyzed practice and game video footage to identify three factors: 1) delivery of the ball and 2) ball impact location and 3) position at time of header. Mouthpiece and video data were time-synchronized and cross-referenced to verify recorded impacts. Peak linear acceleration, peak angular acceleration, and peak change in angular velocity were extracted from each impact.

Results: A total of 150 video-verified impacts were analyzed across 39 practices and 3 games. Long kicks (>10 yards) resulted in the greatest peak linear acceleration (22.33 ± 7.61 g), change in angular velocity (11.06 ± 3.52 rad/s), and angular acceleration (2477.48 ± 1172.62 rad/s2). The lowest peak kinematics were seen in balls that bounced off the ground before contacting the head (9.21 g, 7.65 rad/s, 861.92 rad/s2). Balls that hit the top of the head (as opposed to the forehead) resulted in a 4% increase in average peak linear acceleration, an 8% increase in angular velocity and an 8% increase in angular acceleration. Additionally, players in the air experienced an 18% increase in linear acceleration, a 2% increase in angular velocity and a 13% increase in angular acceleration compared to players planted while receiving the ball.

Conclusions: The current study focused on evaluating the kinematics of soccer heading in collegiate women’s soccer. Our results show that long kicks, impacts to the top of the head, and headers while jumping produced the greatest peak head kinematics, which is consistent with previous heading research (6,7). Cumulative head impact exposure incorporating linear and angular peak kinematics has been found to correlate with brain white matter integrity changes (8). Reducing linear and angular head kinematics in soccer headers could potentially reduce the risk of subconcussive effects. Based on our findings, strategies such as minimizing long
Taking a Break from On-field Soccer Activity May Be Beneficial to Collegiate Women Soccer Players

Rebecca Kenny*, Marko Elez*, Sandra Wong*, Britney Ha*, Naznin Virji-Babul*

*University Of British Columbia, Vancouver, Canada

ABSTRACT

Introduction: A typical season for Canadian collegiate women soccer players consists of a pre-season training camp, in-season competitive games, and in-season practices. Over the course of a single season, players are exposed to a high number of subconcussive head impacts (1), which have been hypothesized to lead to cumulative brain trauma (2). Due to the COVID-19 pandemic, collegiate athletes in Canada did not have an in-person pre-season and off-season training was conducted virtually. Players experienced extended time off from the field and thus their training was less focused on soccer-specific training and more focused on fitness retention. The purpose of this study was to investigate the COVID-19 effect of playing time restrictions on brain function (using electroencephalography (EEG) and N-back-2), sleep, anxiety, and depression.

Methods: Ten female collegiate soccer players were recruited. EEG, N-Back-2, Pittsburgh Sleep Quality Index (PSQI) and Sleep Condition Indicator (SCI), and the Hospital Anxiety and Depression Scale (HADS) were collected during both the 2019 and 2020 seasons (1–3). Average spectral power density was calculated across five frequency bands. Accuracy and reaction time were evaluated for the N-Back-2. PSQI, SCI and HADS scores were evaluated.

Results: When comparing the end of the 2019 season and the beginning of the 2020 season, power analysis of the resting state EEG demonstrated a decrease in power spectral density across the delta, theta, and alpha frequency bands. There was a 9% increase in accuracy and a 3% decrease in reaction time using the N-Back-2. There was no change in sleep quality using the PSQI but a 6% change in sleep condition using the SCI. There was a 25% decrease in depression and a 19% decrease in anxiety.

Discussion: This study is unique in our ability to access a significant time off in between two collegiate soccer seasons. Our pilot data suggests that there is an association between brain function, sleep and anxiety and depression after a stoppage in playing time. Varsity athletes are used to playing consistently over the course of their collegiate season, even playing through the summer. Additionally, on-filed practices and games expose players to a high number of subconcussive impacts. This pilot study sheds light on the potential benefit of providing collegiate athletes time off from on-field activities in between their collegiate seasons to fully recover from the strains of the season (4). Additionally, a switch in focus from on-field work to fitness-based activities may help alleviate athlete burnout and may boost overall stressors experienced by high-performance athletes (5,6). This is a preliminary pilot study and data analysis is ongoing. Further analyses will be conducted to better understand these relationships.

A Cross-Sectional Study of Caregivers and Service Providers Adapting to COVID-19 in a Canadian Brain Injury Service Organization

Lucas DiRienzo*, Ramtin Hakimjavadi*, Liana Martel*, Dar’ya Semenova*

*University of Ottawa, Faculty of Medicine, Ottawa, Canada

ABSTRACT

Objectives: The COVID-19 pandemic has caused a disproportionate disruption to the delivery of in-person services in a multitude of essential and non-essential health service organizations. Management teams have had to seek alternative methods for effective service delivery while meeting appropriate safety precautions. COVID-19 mediated work changes have sparked an increasing concern about allied health worker’s well-being and health in the work environment. Vista Centre Brain Injury Services (VCBIS), a Canadian organization committed to providing services to individuals with acquired brain injury, has modified in-person services and transitioned to remote work in response to the pandemic. This study aims to investigate and compare the impact of the pandemic among VCBIS workers. We surveyed individual staff members to assess their physical, psychological and social well-being in their work environment. Additionally, we investigated the staff’s perspective on current management strategies and pandemic prospects.

Methods: Between March 16th, 2021 and April 2nd, 2021, staff members were surveyed on changes in service due to COVID-19 and its effect on workflow and well-being. In total, there were ninety-two questions containing a mixture of binary and linear numeric response formats. Fifty-seven questions asked staff members to reflect on their experience since the onset of the pandemic (“Retrospective component”) and thirty-five questions asked about thoughts and feelings about the future of the pandemic as it relates to their employment (“Prospective component”). For descriptive statistics, numeric variables are presented as means with standard deviations and categorical variables are presented with frequencies and percentages. We tested for differences in responses between genders, age groups, employment status, and program involvement using a student’s t-test, or single factor Anova and Tukey-kramer test post hoc.

Results: Twenty-five staff members responded to the survey during the response period (32% female, 68% male). Most reported their age in the 30–39 range (28%), followed by the 60 or older, (24%), 18–29 (16%), 40–49 (16%) and 50–59 (16%) age ranges. Statistical analysis is in progress to elucidate significant differences across gender, age groups, employment status and program involvement.

kick heading scenarios and training heading techniques to avoid top-of-head impacts may help to reduce heading kinematics. Future research should further explore the relationship between soccer heading kinematics and brain function. Data collection is ongoing.
Conclusions: The results of this study have important implications for VCBIS service delivery, team management and funding distribution. Due to the long-lasting impact of the pandemic, it is important to consider these findings as VCBIS operates through the pandemic and transitions back to normal services. Preliminary results demonstrate that the COVID-19 pandemic service changes have impacted staff, suggesting the need for additional support and resources to improve staff well-being. Given that many health organizations have had to reorganize as a result of the pandemic, it is expected that staff outside VCBIS may share similar experiences.

297 Brain Structure-Function Coupling in Female Roller Derby Athletes

Derek Monroe a, Samantha DuBois a, Christopher Rhea a, Donna Duffy a

aUniversity Of North Carolina At Greensboro, Greensboro, United States

ABSTRACT

Introduction: Athletes competing in contact and collision sports are at risk for sustaining mechanical loading of the head that may accelerate the onset of cognitive decline decades later. The mechanisms underlying these effects are poorly understood, particularly for female athletes, because most neuroimaging studies i) focus on concussion in collegiate athletes, without considering the long-term effects and ii) exclusively recruit male athletes, even though sex differences in injury outcomes and brain aging are known to exist. Brain structure and function exhibit distinct patterns of (de)coupling over the lifespan. We tested the hypothesis that these patterns differed between Women’s Flat Track Roller Derby (RD) athletes (i.e., collision athletes) and controls not competing in collision sports.

Participants: RD athletes (n = 19) were 24–41 years old (mean = 32.1 years) and controls (n = 14) were 20–49 years old (mean = 24.6 years). Structural, functional, and diffusion-weighted brain imaging was performed in a Siemens TIM Trio (3 T) using standard sequences.

Methods: One million tracts were reconstructed from preprocessed diffusion data using a deterministic fiber tracking algorithm based on quantitative anisotropy. Individual structural connectivity matrices were defined as the total number of reconstructed tracts connecting areal pairs (360 x 360) in the Glasser parcellation normalized by the median fiber length. Graph signal processing was performed on individual structural graphs using pre-processed functional data as the graph signal at each area. This yielded structural-decoupling (Sd) and structural-coupling (Sc) metrics for each cortical area representing the degree to which the brain function was aligned (coupled) or liberal (decoupled) from the underlying structure. A partial least squares correlation was performed to determine whether age was predicted by patterns of Sc and Sd and whether that predictive relationship was different between the two groups. Permutations (N = 10,000) were performed to test for statistical significance of each latent variable. Stability of the saliences was estimated by bootstrapping (1000 iterations). Brain areas with a bootstrap ratio >2.58 (a 99.5% confidence interval) were examined to characterize the brain networks that contributed strongly to these effects.

Results: Age was predicted by increasing Sc in sensorimotor networks in both groups (p < .0001), whereas age-related patterns in association networks differed between the groups (p < .0006). Specifically, controls exhibited increasing Sd with age whereas RD athletes exhibited increasing Sc with age in frontoparietal and default networks.

Conclusion: Structure decoupling in association networks, like the frontoparietal and default networks, is proposed to represent an increased repertoire of brain dynamical states that may be important for cognition. We report that post-collegiate female RD athletes exhibited increased structure coupling in these networks relative to controls. These networks are known to exhibit early signs of neurodegeneration even in the absence of clinical symptoms. Therefore, these findings warrant a more extensive evaluation of post-collegiate female athletes.

298 Qualitative Analyses of Cognitive and Social Difficulties Reported by Emerging Adults with Mild Traumatic Brain Injury

Kojo Mintah a, Mary Desrocher a

aYork University, Toronto, Canada

ABSTRACT

Emerging adults experience higher incidence rates of traumatic brain injuries (TBIs) than do other age groups. Mild TBIs can place young people at risk for executive functioning (EF) deficits. According to the multilevel social competence model (MSCM), EF deficits can negatively impact social cognition and social functioning. The MSCM also outlines risk and resilience factors, such as family support, that influence the effects of EF deficits on social functioning. Studying executive and social functioning among emerging adults is important, given their ongoing executive and social development, and higher risk of brain injury and neuropsychological sequelae. Emerging adulthood also coincides with the onset of occupational and romantic relationship stressors. The goals of the current qualitative study were to explore the impact of concussion-induced EF and social-cognitive deficits on emerging adult social functioning, as well as risk and resilience factors in this population. Semi-structured interviews were conducted with fifteen emerging adults (aged 17–29 years, 40% female) with histories of single or multiple concussions, ranging from mild to severe. Data were analyzed using deductive thematic analyses couched in realist and reality-testing frameworks. Several sub-themes included making assumptions a priori were confirmed, including problems with EF and social-cognition, and problems with friendships, school, work, and romantic relationships, in addition to social support risk and resilience factors. Emergent sub-themes included non-executive cognitive problems, physical symptoms, temperamental characteristics, sports and driving problems, and positive and negative coping strategies.
Negation sub-themes also emerged, including a lack of EF, social-cognitive, or social adjustment problems. Many participants also reported that neuropsychological sequelae were temporary. Concussions put emerging adults at risk for a range of EF, social-cognitive, and other neuropsychological deficits. Even temporary symptoms can disrupt the course of social development, which is also influenced by a range of psychosocial risk and resilience factors. Coping strategies sub-themes, emergent in this study, have implications for the MSCM which does not list coping strategies as risk or resilience factors. These are recommended to be incorporated into the model. Clinicians equipped with the knowledge of sources of support and coping strategies generated in this study can provide therapeutic benefits to emerging adults suffering from social difficulties from head injuries.

299 The Portable Neurostimulator Brain Injury Treatment Program: A Six Patient Clinical Feasibility Study

Sukhvinder Kalsi-ryan\textsuperscript{a,b}, Ryan D'Arcy\textsuperscript{c,d,e}, Heather Condello\textsuperscript{f}, Carole Chebaro\textsuperscript{g,h}, Julie Vaughan-Graham\textsuperscript{b,h}

\textsuperscript{a}Kite Research Institute, Toronto, Canada, \textsuperscript{b}Department of Physical Therapy, University of Toronto, Toronto, Canada, \textsuperscript{c}BraiNET, Applied Sciences, Simon Fraser University, Vancouver, Canada, \textsuperscript{d}DM Centre for Brain Health, UBC, Vancouver, Canada, \textsuperscript{e}Centre for Neurology Studies, Health Connex, Vancouver, Canada, \textsuperscript{f}Complex Injury Rehabilitation, Pickering, Canada, \textsuperscript{g}NeuroCore Physiotherapy, Richmond Hill, Canada, \textsuperscript{h}Physio-Logic Rehabilitation Services, Toronto, Canada

\textbf{ABSTRACT}

Background: Although the majority of persons who suffer a mild TBI recover within a period of 10–14 days, recovery timelines are highly variable. An estimated 15–20% of persons affected by a mild TBI experience persisting symptoms affecting their ability to return to school, work and perform independent activities of daily living. Cranial nerve non-invasive neuromodulation (CN-NINM) has been shown to significantly improve balance and gait for those who suffer chronic balance deficits following mild-to-moderate TBI (mmTBI) and whom plateaued on prior conventional therapies.

Rationale: Unresolved gait and balance problems are common amongst persons with mmTBI. Understanding the benefits of CN-NINM in the treatment and resolution of balance and gait deficits in persons with mmTBI is essential in developing a clinically relevant evidence base. A clinical feasibility program was undertaken to gain a greater understanding through experience, the application, feasibility and outcome of a PoNS mmTBI program.

Methods: A pre-post design was used. All therapists and researchers involved in the delivery of the PoNS mmTBI program participated in an in-person 2 day training program to become PoNS certified. Potential participants were referred from the community as well as TBI/concussion programs to the Principal investigator. All potential participants were screened, and, if eligible, were assessed by a neurosurgeon for review and clearance. On medical clearance the participant underwent baseline assessments. The PoNS mmTBI program was delivered via private community neuro-rehabilitation clinics in the greater Toronto area. All baseline and follow-up assessments were conducted by an independent assessor who was not blinded, but was not involved in the delivery of the treatment program. Six participants with mmTBI were recruited and enrolled to the study from January 2020 to February 2021. The PoNS mmTBI program was a 14-week physical therapy program coupled with PoNS stimulation. Outcome assessments were conducted prior to program initiation, at 2 weeks, 8 weeks and 14 weeks after program initiation. The primary outcome measure was the Community Balance and Mobility Scale (CB&M). Secondary outcome measures included the Functional Gait Assessment (FGA) and the Neurocatch (N100, P300, & N400).

Results: Fourteen individuals were screened, 8 were eligible and 8 completed baseline assessment. Two participants did not initiate the program; 6 commenced the PoNS mmTBI program, 1 dropped out of the program at weeks 2 due to the intensity of the program. Mean (SD) change scores towards improvement for CB&M and FGA were 18 (11.2) and 6.2 (2.7) respectively. Examination of NeuroCatch results showed improvements in the speed of cognitive processing, as measured by the N400, within the group.

Conclusions: Individuals with persistent gait and balance deficits related to mmTBI demonstrated significant and clinically meaningful improvements in balance, gait and speed of cognitive processing following a PoNS mmTBI program.

300 Reduced Inter-hemispheric Functional Connectivity in Traumatic Brain Injury

Reut Raizman\textsuperscript{a,b}, Nofar Itzhaki\textsuperscript{c}, Inbar Meninger\textsuperscript{a}, Galia Tsarfaty\textsuperscript{c,b}, Ofer Keren\textsuperscript{a,b}, Abigail Livny\textsuperscript{a,b,d}

\textsuperscript{a}Division of Diagnostic Imaging, Sheba Medical Center, Ramat Gan, Israel, \textsuperscript{b}Sackler Faculty of Medicine, Tel-Aviv University, Tel-Aviv, Israel, \textsuperscript{c}Department of Brain Injury Rehabilitation, Sheba Medical Center, Ramat Gan, Israel, \textsuperscript{d}The Joseph Sagol Neuroscience Center, Sheba Medical Center, Ramat Gan, Israel

\textbf{ABSTRACT}

Background: Traumatic brain injury (TBI) is an important socioeconomic and global public health concern, as is continues to be a leading cause of death and disability worldwide. TBI often results in impaired resting state functional connectivity (RSFC) among different brain regions. Inter-hemispheric functional connectivity (IH-FC), or functional homotopy, describes a fundamental characteristic of the intrinsic RSFC. Studies have shown changes in functional homotopy in certain brain regions associated with a variety of diseases. Thus, it is reasonable to expect that an important aspect of TBI may be impairment of inter-hemispheric functional interactions. The present study aimed to examine whether chronic moderate to severe TBI patient exhibit disruptions in brain homotopy across several brain regions which in turn may lead to RSFC disruptions with other brain regions.
Methods: sixteen TBI patients in the sub-acute stage and thirty-six Healthy Control subjects (HC) matched by age and gender were recruited from the general population. First, we assessed differences in inter-hemispheric functional connectivity (IH-FC) between TBI and HC. RSFC data was obtained, and inter-hemispheric synchronization was examined using Inter-hemispheric atlas-based functional homotopic connectivity, which calculated the correlation between each region and its counterpart on the opposite hemisphere. Second, seed-based correlation (SBC) was computed by placing the seed-reference resulted from the homotopic connectivity analysis. One-way analysis of covariance was conducted between the seed-reference and all other regions within the brain.

Results: TBI patients exhibited decreased IH-FC compared to HC in the middle and posterior part of the cingulate gyrus, thalamus, superior temporal pole and part of the cerebellum. No region exhibited significantly higher IH-FC in TBI patients. Subsequent SBC revealed disrupted functional connectivity in TBI patient between the left cerebellum and the right parahippocampal gyrus and vermis, and between the superior temporal pole and the left caudate, superior left and right frontal orbital gyrus.

Conclusion: We suggest that our results may reflect that TBI is associated with regionally decreased inter-hemispheric functional connectivity leading to further patterns of disrupted FC between the cerebellum and the superior temporal pole with other temporal and frontal brain regions. The results of our study enabled to deepen the understanding of TBI effects on brain RSFC and neuronal reorganization post-TBI.

Method: The Brief Cognitive Exam in Traumatology (EXACT; Potvin & al., 2020), a test specifically designed to assess cognitive functioning during the acute phase of the TBI, was administered post-accident (< 4 months) to 405 hospitalized patients who suffered a TBI. Patients with severe TBI were excluded to avoid masking the effect of an AUD on cognitive recovery. After screening, the study sample was divided into groups matched according to TBI severity (8 mild and 34 moderate TBI in each group), age, sex, and education: 1) patients who sustained a TBI (TBI; n = 42) and 2) victims of a TBI who also had a prior AUD, according to the DSM-5 criteria (TBI+AUD; n = 42).

Results: Compared to patients of the TBI group, patients with TBI+AUD obtained lower results on the EXACT total score and the following sub-scores: Language, Attention and Working Memory, Episodic Memory, and Instrumental Functions. However, there was no group difference for the Executive Functions/Behavioral Regulation sub-score, Glasgow Coma Scale and length of hospital stay. Finally, age was a significant predictor of the total score and the effect was moderated by the AUD diagnosis.

Conclusion: Cognitive recovery after a TBI seems to be negatively affected by prior chronic and abusive alcohol consumption. Moreover, that effect appear to be stronger in older patients, who have an AUD diagnosis. These results indicate that it is important to identify patients at risk of having a less favorable recovery after a TBI to adapt rehabilitation services offered to them.

301 The Influence of Chronic and Abusive Alcohol Consumption on Cognitive Recovery After a Traumatic Brain Injury

Sarah-Jade Roya, Camille Livernoche Leducb, Véronique Paradisa, Marie-Julie Potvina,b

aDepartment of psychology, Université du Québec à Montréal, Montréal, Canada, bNeurotraumatology program, Hôpital du Sacré-Cœur de Montréal, CIUSSS du Nord-de-l’Île-de-Montréal, Montréal, Canada

ABSTRACT

Objective: Alcohol consumption increases the risk of suffering of a Traumatic Brain Injury (TBI) (Taylor & al., 2003). While many studies have examined TBI effects on alcohol consumption post-accident, very few have verified the influence of chronic and abusive alcohol consumption on acute cognitive recovery after a TBI. Considering the negative effect of Alcohol Use Disorder (AUD) on cognitive functioning (Grant & Adams, 2009), the following hypothesis can be formulated: cognitive recovery after a TBI will be negatively affected by a prior AUD diagnosis. This study aims to 1) compare cognitive recovery of patients with comorbid TBI and AUD relative to TBI alone and 2) define more precisely the effect of an AUD on cognitive functions after a TBI, according to severity and age.

302 Traumatic Brain Injury Associated with Falls Among Older-Adults in the United States

Anthony Asemota

aJohns Hopkins University, Baltimore, United States

ABSTRACT

Introduction: Falls represent a major injury burden including in traumatic brain injury. Older-adults are especially vulnerable to traumatic brain injury (TBI) associated even with low-impact falls due to volumetric and vascular changes of the aging brain. With increasing population of older-adults in the United States, there is concern that rates of fall-related TBI events would expectedly increase. We sought to characterize the burden of fall-related TBI incidence and outcomes in the elderly and explore opportunities for intervention.

Methods: Data from the Nationwide Inpatient Sample 2010–2014 was queried for records of elderly patients ≥65 years with a “TBI” diagnosis identified using ICD-9-CM diagnosis codes that was associated with an external-cause-of-injury code of “falls” and analyzed.

Results: In total, 504,738 cases of traumatic brain injury associated with falls were identified representing 74.86% of all causes of TBI among older-adults aged >65 years. Most patients were female (55.16%). Mean age of older-adults presenting with falls was 80.58± SD7.80 years, median 82 years (IQR = 75–87). Fall patterns reported were: trips/slips on
sidewalk (25.40%), fall from stairs (9.67%), fall from bed (3.90%), fall from wheelchair (2.09%), fall from chair (1.52%), fall from ladder (1.77%), fall from different levels (1.57%), and unspecified (53.58%). TBI was categorized as mild, moderate and severe in 19.05%, 28.69%, and 52.26% of cases respectively. Intracranial hemorrhage was present in 62.88%, while associated injuries included fractures to the cranium (11.49%), facial bones (8.93%), and cervical spine (3.50%). A history of intake of blood thinners including aspirin, anticoagulants, and antiplatelets was present in 12.00%, 11.45%, and 3.85% of cases respectively. The presence of intracranial hemorrhage was associated with only moderate and severe injuries (P < 0.001), and among patients on blood thinning medications (P < 0.001). A history of repeated falls was reported in 6.70% of cases. Frailty was reported in 20.12% of patients and was significantly higher among those with history of repeated falls (P < 0.001). Common comorbid conditions present with increased frequency among patients with a history of repeated falls included cerebrovascular disease/prior stroke (12.55%), hemiplegia/paraplegia (3.61%), rheumatoid disease (2.59%), diabetes with complications (2.94%), and dementia (2.01%), (all P < 0.001). TBI mortality associated with falls among the elderly was 8.48%, and was higher in individuals with intracranial hemorrhages (P < 0.001). Overall mean length of hospital stay was 5.43 days (SD = 6.34), mean total charges were $53,869.37 (SD = 76,366.00), representing an average annual burden of approximately 5 billion dollars.

Conclusion: Falls are associated with a significant TBI burden among the elderly. Certain comorbidities might be associated with an increased fall-risk. The potential for catastrophic outcomes might be accentuated by use of blood-thinners and frailty in the elderly. Hospitalization costs exceed, on average, over 5 billion dollars annually, necessitating a comprehensive approach to management and prevention of these injuries.

303 Acute Post Traumatic Hydrocephalus in Pediatric Patients with Moderate to Severe Traumatic Brain Injury

Anthony Asemota*

*Johns Hopkins University, Baltimore, United States

ABSTRACT

Introduction: Traumatic brain injury (TBI) is associated with long-term sequelae among victims. Post-traumatic hydrocephalus (PTH) is one of many such potential sequelae causing significant morbidity among TBI patients. This especially more so in children given the often-lifelong dependency and overall greater quality-of-life issues over their life course. Post-traumatic hydrocephalus is a potentially treatable condition often requiring placement of ventriculoperitoneal (VP) shunts among affected individuals. We sought to assess the burden of PTH requiring VP-shunt placement and associated outcomes among pediatric TBI patients.

Methods: The Nationwide Inpatient Sample 2000–2014 was employed and patients ≤19 years with a diagnosis of moderate to severe TBI identified using ICD-9-CM codes. Descriptive statistics were performed using weighted-data and outcomes examined.

Results: A total 328,971 pediatric TBI cases were identified. Most patients were male (67.26%). The mean patient age was 9.74 years (SD = 6.63), median 12 years (IQR = 3–16). Age-group categories were: <1-year (14.58%), 1–9 years (30.14%), 10–19 years (55.28%). Majority of cases were treated at teaching hospitals (81.98%). The most common injury-causes were falls (20.35%), followed by motor-vehicle accidents (18.47%), and undefined causes (26.97%). A total 1.47% cases of new VP-shunt placements occurred during hospitalization. Approximately 0.30% had prior history of VP-shunt placement. By age-group distribution, VP-shunt placement occurred in <1-year (3.69%), 1–9 years (1.14%), 10–19 years (1.07%) categories (p < 0.001). The mean age of patients undergoing VP-shunt placement was 6.95 years (SD = 7.08), median age 4 years (IQR = 0–14). Ventriculitis occurred in 552 cases, i.e. 0.17% of TBI cases, among <1-year-olds (0.19%), 1–9-year-olds (0.18%) and 10–19-year-olds (0.16%). Overall, VP-shunt placement was more common among patients with findings of ventriculitis (11.69% vs 1.46%, p < 0.001). In total, tracheostomy and percutaneous endoscopic gastrostomy (PEG) tube placements occurred in 3.60% and 2.57% respectively. Significantly greater proportions of patients undergoing VP-shunt placement also underwent tracheostomy (14.62% vs 3.43%, p < 0.001) and PEG tube placement (12.97% vs 2.41%, p < 0.001) prior to discharge. Overall inpatient mortality was 6.64%, and was significantly higher among patients developing PTH requiring VP-shunt placement (11.06% vs 6.58%, p < 0.001). Overall length of stay (LOS) for patients was 6.61 days (SD = 11.49), median 3 days (IQR = 1–7), mean LOS for patients undergoing VP-shunt placement was 25.64 days (SD = 27.32), median 19 days (IQR = 8–34). Overall mean total charge associated with individual hospitalization was $58,256.58 (SD = 107,971.60), mean total charges associated with cases involving VP-shunt placement was $218,094.80 (SD = 247,032.90).

Conclusion: Post-traumatic hydrocephalus in children with moderate-severe traumatic brain injury is associated with significantly higher morbidity and mortality, as well as greater costs and length of hospitalization. Notably, infants and patients with findings of ventriculitis are more commonly affected. Patients developing PTH demonstrate higher rates of tracheostomy and PEG tube placements prior to discharge. Research to better understand factors associated with post-traumatic hydrocephalus in pediatric patients are warranted.
304 Traumatic Brain Injury Hospitalizations Associated with Skating and/or Skateboarding Activity in the United States

Anthony Asemota, Eric Schneider

*Johns Hopkins University, Baltimore, United States

ABSTRACT

Introduction: Skating and skateboarding activities generally performed as leisure and sporting activities, are also employed as a form of transportation. These activities often fraught with high-risk maneuvers, occasionally lead to high impact events that result in significant head trauma. Although gaining in popularity, the incidence of traumatic brain injury (TBI) associated with these activities has not been well studied at the population level. We sought to examine the hospitalization incidence and inpatient outcomes of TBI associated with skating/skateboarding activity across different age-groups in the United States.

Methods: Data was obtained from the Nationwide Inpatient Sample 2004–2014. All patients with traumatic brain resulting from skating and/or skateboarding activity were identified using the appropriate ICD-9-CM diagnosis codes in conjunction with external causes of injury codes. Injury severity was categorized using the abbreviated injury scale (AIS) algorithm.

Results: A total 12,496 cases were identified, 87.10% of whom included male patients, mean patient age was 20.41 years (SD = 11.60), median age was 17 years (IQR = 14–21). TBI was categorized as mild, moderate, and severe in 26.02%, 55.64% and in 18.35% respectively. Fractures involving the cranium were reported in 55.17% with a significantly greater incidence of skull fractures more common among younger patients compared to older-aged patients (≤18-year-olds (52.23%), 19–44 years (61.51%), 45–64 years (34.08%), and ≥65 years (26.21%), p < 0.001). Associated facial-bone fractures occurred in 5.68% of cases, as follows: ≤18-year-olds (4.09%), 19–44 years (6.90%), 45–64 years (10.55%), and ≥65 years (13.72%), p < 0.001. Intracranial hemorrhages were common among patients, occurring in 15.85% [≤18-year-olds (14.61%), 19–44 years (14.18%), 45–64 years (38.25%), ≥65 years (51.21%), p < 0.001]. Specifically, subdural hemorrhages occurred in 8.03% of cases, [≤18-year-olds (6.24%), 19–44 years (8.04%), 45–64 years (17.20%), ≥65 years (44.11%), p < 0.001]. Traumatic subarachnoid hemorrhages occurred in 4.65% of cases, [≤18-year-olds (3.76%), 19–44 years (4.13%), 45–64 years (21.12%), ≥65 years (11.58%), p < 0.001]. Cervical spine fractures occurred less commonly and were present in 0.63% with older patients more likely to present with cervical spine fractures [≤18-year-olds (0.39%), 19–44 years (0.80%), 45–64 years (1.17%), ≥65 years (2.36%), p < 0.001]. In all, 5.75% of patients underwent cranial surgery (craniotomy/craniectomy), mostly among younger-aged patients (p = 0.03). The overall inpatient mortality associated with skating/skateboarding activity was 1.49%, with significant differences noted across age-groups [≤18 years (0.68%), 19–44 years (2.20%), 45–64 years (3.55%), and ≥65 years (4.00%), (p < 0.001)]. Individual hospitalization costs associated with skating/skateboarding related TBI averaged approximately $49,546.82 (SD = 104,689.6), amounting to an average annual burden of $56,285,187.52 in total hospitalization costs.

Conclusion: Skating and skateboarding activities are associated with significant brain trauma, including intracranial hemorrhages and skull fractures. Measures that help moderate the impact associated with falls during skating activity including wearing of protective head gear/helmets and equipment should be considered and implemented for individuals involved in these activities whether for leisure or sports.

305 A Psychological Perspective on Heading in Women’s Varsity Soccer

Rebecca Kenny, Allegra Passacantilli, Marko Elez, Lyndia Wu

*University Of British Columbia, Vancouver, Canada

ABSTRACT

Introduction: The mental side of sports performance is often overlooked when athletes and coaches are focused on training and competition (1). It is well known that the mind and the body act as a unit, where attitudes and emotions can directly affect our bodies at a physiological level (2). A growing area of research is focused on studying the subconcussive repetitive head impacts that occur in the game of soccer. Heading is an important skill in soccer and players purposefully and voluntarily use their unprotected heads to manipulate the direction of the soccer ball to affect both offensive and defensive playing schemes (3). Current research is heavily focused on understanding the biomechanics of heading as well as understanding the potential neurocognitive consequences of heading (4–6). Instead of focusing on the performance aspect of heading, the purpose of the current study was to investigate the players’ perspective of heading in soccer.

Methods: A women’s university varsity soccer team was recruited to participate in this exploratory study, with 20 players responding to the online survey. A 35-question survey was designed to address five main psychological categories that may affect how a player approaches heading a soccer ball. These categories included confidence, fear, motivation, injury history, and technique.

Results: Preliminary analysis of select questions revealed that while players were confident in their abilities to head the ball (60% of players), some players reported feeling afraid of accidentally suffering an injury while heading (45% of players) and felt they needed more training in practice (35% of respondents). Most players reported heading to be an important skill to acquire (95% of players) and most players are motivated to improve their technique (70% of players). Less than half of the players reported a previous injury due to heading (45%), and of those players, the majority reported concerns about re-injury (80% of the 45%).

Conclusion: Investigating players’ perspective regarding a sports-specific skill is a new avenue of research. The results from this exploratory study are still being analyzed.
Preliminary results suggest fear to be a significant issue with female collegiate soccer players and fear of heading may undermine performance and increase injury risk (7). Conversely, players reported high confidence levels and reported a motivation to improve their skills. Future research will need to explore the relationship between a player’s perception of heading and a player’s on-field performance. This avenue of research has the potential to influence training practices and contribute to maximizing the health of athletes.

306 The Efficacy of Digital Health Interventions for People with Traumatic Brain Injuries and their Carers: A Systematic Review

Petra Avramovic, Rachael Rietdijk, Emma Power, Belinda Kenny, Michelle Attard, Leanne Togher

*University Of Sydney, Sydney, Australia, †University of Technology Sydney, Sydney, Australia, ‡Western Sydney University, Sydney, Australia

**ABSTRACT**

Objectives: Evaluate the current literature in relation to efficacy and effectiveness of digital health interventions for people with traumatic brain injury and/or their carers (close others and paid carers).

Study design: Systematic review

Background: Traumatic brain injury leads to a range of high-level cognitive linguistic deficits. Cognitive-communication disorders can significantly impact an individual’s quality of life and psychosocial wellbeing. People with TBI have been reported to have worse general health, elevated probabilities of depression, social isolation and worse labour force participation rates than people without TBI. Those who sustain moderate and severe injuries, face the challenge of lifelong deficits requiring intensive rehabilitation efforts and ongoing support to facilitate community reintegration. People with severe TBI are likely to require expensive long-term care due to loss of independence, reduced work capacity and relationship breakdown. The growth of eHealth has allowed for the development of intervention programs that allow people with TBI timely access to specialised services and to increasingly take control of and play a more active role in their health.

Methods: Information sources: Systematic searches of nine databases (PsycINFO, MEDLINE, CINAHL, Embase, Cochrane Library, Scopus, Web of Science Core Collection, speechBITE, and PsychBITE) from database inception to August 2020. Inclusion criteria: Intervention studies on interventions for people with brain injury and/or their communication partners where the primary focus of the program (>50%) was on improving communication, social, psychological or cognitive skills of people with TBI and/or communication partners. Data: participants, characteristics of the interventions, outcome measures and findings. Risk of bias: standard checklists were used for methodological quality (PEDro-P, ROBIn-T) and intervention description (TIDieR). Synthesis: qualitative data was analysed using thematic synthesis.

Outcomes: 38 articles met eligibility criteria: 18 randomized controlled trials, three single-case experimental designs and 17 case series studies. Studies included a total of 3640 people with TBI, 317 carers or close others and 69 health professionals. Methodological quality was varied and intervention description was poor. Most studies focused on intervention programs delivered via a single digital modality e.g. telephone, mobile phone applications or online rather than a combination of intervention modalities. Only three interventions were co-designed with key stakeholders. All studies reported positive outcomes for digital health interventions, however, few studies included blind assessors.

Conclusions: Digital health interventions for people with TBI and their carers targeting communication, social, psychological or cognitive skills are feasible, with positive outcomes reported. Improved methodological rigor, more clearly described intervention characteristics and more consistent application of outcome measurement is recommended. Further research needed to strengthen the evidence of the use of multimodal digital health intervention in TBI rehabilitation.

307 Influencing Acute and Rehabilitative Factors on Functional Outcome and Quality of Life up to 10 Years After Traumatic Brain Injury

Katrin Rauen, Lara Reichelt, Philipp Probst, Alexander Younsi, Malte Claussen, Barbara Schäpers, Friedemann Müller, Klaus Jahn, Nikolaus Plesnila

*aPsychiatric University Hospital Zurich/ Department of Geriatric Psychiatry, Zurich, Schweiz, †Institute for Stroke and Dementia Research/ University of Munich Medical Center, Munich, Germany, ‡Schoen Clinic Bad Aibling, Bad Aibling, Germany

**ABSTRACT**

Introduction: Traumatic brain injury (TBI) results in neuropsychiatric long-term sequelae and knowledge gaps regarding the patients’ long-term outcome make early prognosis difficult. Hence, the aim of this study was to investigate how neuropsychiatric care parameters and time factors of neurorehabilitation (time to onset/duration) influence functional outcome at discharge from neurorehabilitation and health-related quality of life (HRQoL) up to ten years after TBI.

Methods: In this cross-sectional study, 128 (77% males; age: 18–84 years) out of 135 chronic TBI patients were eligible. Neuropsychiatric care parameters (TBI severity/intracranial pressure monitoring/decompressive craniectomy/ventriculoperitoneal shunt/tracheostomy/degree of disability at admission to neurorehabilitation) and patients’ demographics (age/sex) were analyzed as predictors for time factors (time to onset/duration) of neurorehabilitation using multivariate linear regression. Functional recovery throughout neurorehabilitation was quantified comparing the degree of disability (modified Rankin Scale (mRS)) at admission to and discharge from neurorehabilitation. A cutoff score for the duration of neurorehabilitation with a higher probability for good HRQoL
(QOLIBRI questionnaire) was calculated. The probability of good functional outcome (mRS 0–2) and good HRQoL (QOLIBRI total score ≥60) were calculated using Cox regression (HR, 95% CI). The predicting relation between functional outcome and HRQoL is given (simple linear regression).

Results: Neurorehabilitation started 23 days after TBI and lasted 28 days (median). At admission to neurorehabilitation, 96% of TBI patients were severely disabled (mRS 4–5), while after neurorehabilitation most patients (82%) were able to walk unassisted (mRS 0–3) (p < 0.0001). Tracheostomy predicts prolonged neurorehabilitation (p < 0.0001, adj. R² = 0.3), while neurocritical parameters, demographics and time to onset of neurorehabilitation do not. The duration of neurorehabilitation correlates with a better functional outcome (p < 0.0001) at discharge and better HRQoL (p < 0.0001) up to ten years after TBI with a cutoff at 62 days of neurorehabilitation. After short (long) neurorehabilitation, 71.6% (42.3%) of TBI patients reported good (QOLIBRI total score ≥60), 16.7% (30.8%) moderate (QOLIBRI total score 40–59), and 11.8% (26.9%) an unfavorable HRQoL (QOLIBRI total score <40) (Kruskal-Wallis test: p < 0.0001). The probability of a good functional outcome (mRS 0–2) at discharge from neurorehabilitation and of good HRQoL up to ten years after TBI was four-fold higher after short (<62 days) compared to after long (≥62 days) neurorehabilitation (p < 0.0001; mRS: HR 4.4; HRQoL: HR 4.2). Better functional outcome at discharge from neurorehabilitation is a predictor for better HRQoL up to ten years after TBI (p < 0.0001, slope: −7, R²: 0.14).

Conclusion: Neurorehabilitation is highly effective for TBI patients. Prolonged neurorehabilitation (>62 days) predicts a four-fold increased risk of functional dependency and unsatisfied HRQoL up to ten years after TBI. Thus, prolonged neurorehabilitation might be a new clinical biomarker for detecting TBI patients at risk of unfavorable long-term outcome early that can support for decision-making for neuropsychiatric follow-ups after discharge from neurorehabilitation.

309 Hospitalization Trends in Firearm-related Traumatic Brain Injury in the United States

Anthony Asemota*, Eric Schneider*

*Johns Hopkins University, Baltimore, United States

ABSTRACT

Introduction: Firearm injuries resulting in traumatic brain injury (TBI) often result in significant levels of morbidity and mortality among victims due to the high velocity and impact associated with these injuries. As a result of the high lethality of firearms, many victims of firearm injuries particularly those with gunshot wounds to the head usually die in the field with only a smaller percentage making it to the hospital. Using a national database, we examine hospitalization trends associated with firearm-related TBI in the United States.

Methods: We analyzed weighted data from the Nationwide Inpatient Sample 2003–2014, and identified all cases of TBI involving the use of firearms as an external injury cause. Descriptive analyses were undertaken and incidence/trends of cases were analyzed across different age-categories. Outcomes were examined across age-categories and among patients undergoing neurosurgical intervention.

Results: In total 43,787 inpatient cases of firearm-related TBI were studied, among whom 85.64% included male patients. Distribution by race was as follows: whites (37.31%), blacks (27.49%), and Hispanics (12.6%). Age group distribution was as follows: ≤18 years (9.29%), 18–44 years (65.71%), 45–64 years (17.81%), ≥65 years (7.20%). Mean patient age was 34.49 years (SD = 17.46), median (29 years; IQR = 22–44). Majority of cases involved individuals who belonged to lower median income brackets 1st-quartile i.e. <$40,000/year (42.60%), followed by 2nd-quartile i.e. $40,000–$49,999/year (25.27%). Fire-arm related TBI cases were categorized as mild (4.74%), moderate (32.11%), and severe (63.16%). Most cases were categorized as unintentional (50.74%), while intentional included cases relating to assault (23.77%), and self-harm (19.67%). In all, 6.59% underwent cranial surgery (craniotomy/craniectomy), and these rates varied significantly across age-groups: ≤18 years (8.6%), 18–44 years (7.04%), 45–64 years (5.55%), ≥65 years (2.38%), p < 0.001. Overall inpatient mortality was 43.48%, and differed significantly across age-groups as follows: ≤18 years (42.62%), 18–44 years (39.58%), 45–64 years (48.89%), ≥65 years (66.78%), p < 0.001. Mortality among patients undergoing cranial surgery was 17.96% and increased significantly with increasing patient age (p < 0.001). Mean LOS was 7.94 days (SD = 14.42); Mean total charges were $95,178.62 (SD = 145,423.30). Conclusion: Firearm related TBI occur across all age groups with the highest burden occurring among individuals within the 18–44 years old bracket. Neurosurgical intervention in the form of cranial surgery occur more commonly in greater proportions of individuals under 18 years old. High rates of inpatient mortality are associated with firearm-related traumatic brain injury across all age groups. Hospitalization costs remain high for individuals being treated for TBI arising from firearm-related causes.

313 How are the Surfaces and Shape Important to Prevent Pressure Sores?

Martino Avellib, Franco Molteni, Mauro Rossini, Domenico Carnevale, Roberto Prosdociob, Eugenio Cometob

bOrmesa Srl, Asso, Italy, bOrmesa srl, Foligno, Italy, c"Villa Beretta" Center for TBI, Costamasnaga, Italy

ABSTRACT

Introduction: The contact surfaces shape and the material type which they are made of, are very crucial to figure out better the consequences on the skin integrity of the users sitting on a wheelchair. More, we have to consider how a contact surfaces can grant breathability and moisture absence, in order to avoid the increasing skin temperature and local humidity.

Objectives: In this study, we demonstrated that a particular backrest shape (a V-shape) and an innovative material used for the backrest as well as for the seat, can work significantly decreasing the interface pressure on the user’s skin, even
without using a specific antidecubitus cushion (for those patients with no so high level of risk, according to Braden, Norton, Waterlow Scale, etc.)

Methods: We evaluated two patients: one with severe outcome of Sub Aracnoid Haemorrhage by Brain Aneurism followed by a non-response period, with high pressure sore risk (weight 45 kg), and another with an outcome of a Stroke Ischemic and Haemorrhagic followed by a non-response period (weight 78 kg). They were seated in a tilt-in-space wheelchair with a specific V-shape backrest and with a particular surfaces material, totally breathable and with a visco-elastic effect

Results and Discussions: We tried to put them in different position according with the items of the study (no tilt, −20° of tilting, max tilting, max tilting and backrest reclination, max tilting and backrest reclination plus rised legrest), with and without the upholstery. The acquisition with Pressure Mapping Sensor were done immediately after positioning, after 10 minutes and after 1 hour and half of sitting.

Conclusion: The data obtained showed in both patients a good distribution of the pressures, bearing in mind that there was not any interface cushion between the seat and the user’s bottom. The records without upholstery showed that the back in the middle was completely unloaded and the pressure has been spread effectively.

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314 Walk and Grow Up! The Influence of Gait on Cognitive Development

Martino Avellis

Ormesa Srl, Asso, Italy, bOrmesa srl, Foligno, Italy

ABSTRACT
When we think of an activity like walking, we consider something dynamic and our attention focuses on biomechanical issues. Therefore, when faced with any problem regarding walking in early intervention, we usually consider pattern, stability and balance. In CP, the physiological mechanisms of the gait pattern are often altered. When patients are affected by spasticity, dystonic patterns, sensory disturbances, tendons retractions, or structured deformities, we can observe, in their behavior, the occurrence of internal compensations (kinematic and/or postural changes). Usually, if the patients need it, we can provide them with external compensations (orthosis and/or technical aids).

Several authors pointed out the correlation between the motion/locomotion and the cognitive development, which can depend from:

• Spatial perception
• Depth visual perception

Considering the importance of motion/locomotion for the cognitive development, we should suggest walking in early intervention and, for those patients which need external compensations, walking with a gait trainer can make the difference in order to improve the spatial and depth perception, the initiative and the social skills as well as the school performances.

That’s why the kids’ posture should be well stabilized during walking.

The modularity and versatility of the gait trainer are crucial. As the kids grow, their clinical needs, their skills and, of course, their size and body shape change and we have to adjust and adapt the equipment to these changes so we can offer to the kids the best possible quality of life.

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503 Effective Connectivity Within and Between Default Mode Network and Anterior Forebrain Mesocircuit is Disrupted in Prolonged Disorders of Consciousness

Sean Coulborna, Chris Taylora, Lorina Nactd, Adrian Owen, Davinia Fernandez-Espejoa

aUniversity Of Birmingham, Birmingham, United Kingdom, bTrinity College Dublin, Dublin, Ireland, cWestern University, Ontario, Canada

ABSTRACT
Introduction: Prolonged disorders of consciousness (PDOC) result from structural and functional impairments to key cortical and subcortical networks, such as the default mode network (DMN) and the anterior forebrain mesocircuit (AFM). However, the specific causal mechanisms which underpin such impairments remain unknown. Previous research suggests that disruptions in the striatal-pallidal pathway can result in the over inhibition of the thalamus and lack of excitation to the cortex that characterises PDOC. Here, we used spectral dynamic causal modelling on rs-fMRI data to assess whether DMN changes in PDOC are caused by disruptions in the AFM.

Methods: 17 PDOC patients (8 female), 11 in a vegetative state and 6 in a minimally conscious state, and 20 healthy volunteers (8 female) took part in the study. We acquired data with a 3 T Siemens scanner using a 32-channel head-coil. We used SPM12 to pre-process data in native space including
ABSTRACT

510 tDCS Combined with Passive Mobilization Increases Brain Activity During Command-Following; a Proposed Intervention to Increase Behavioral Responsiveness in Prolonged Disorders of Consciousness

Davide Aloib, Melanie Lafanechereb, Roya Jalaliac, R Chris Mialia,b, Davinia Fernández-Espejoa,b

aUniversity Of Birmingham, Birmingham, United Kingdom, bCentre for Human Brain Health, Birmingham, United Kingdom

Methods: 22 healthy participants (14 women, 25 ± 4 years old) received 5 daily sessions of anodal, cathodal, and sham tDCS (counterbalanced, 1 week break between each polarity). In each session, participants received 20 mins of 1 mA tDCS (active electrode over the left M1 and reference electrode over the right orbitofrontal area) paired with passive mobilization of the right thumb. Each week’s first and fifth stimulation sessions were delivered in a 3 T-MRI scanner, where participants performed an active motor command-following task before and after tDCS.

We ran GLM analyses using SPM12 to estimate neural responses during command-following (i.e., active thumb movements) and assess the effect of one vs multiple tDCS sessions on a network involving the left M1, left Th, left Supplementary Motor Area (SMA) and right cerebellum (Cb).

Panels: One session of anodal-tDCS increased activity in M1 and SMA compared to both cathodal and sham, as well as in Th when compared to cathodal-tDCS. In turn, cathodal-tDCS increased activity in Cb and decreased activity in M1, SMA, and Th. These effects were similar after 5 stimulation sessions, with only small additional increases in SMA after anodal-tDCS and decreases in M1 after cathodal-tDCS at 5 sessions as compared to only 1.

Conclusion: We demonstrate that tDCS combined with passive mobilization of the thumb can lead to long range, polarity-specific modulations in the motor network during simple command-following. The specific effects identified on M1 and thalamic activity suggest that anodal tDCS coupled with passive mobilizations may be able to facilitate behavioral command following in PDQC. While adding multiple sessions did not appear to increase the effects in these key regions, further research should assess whether multiple sessions can contribute to increase the durability of the effects instead.

ABSTRACT

525 The Associated Benefits of a Cranioplasty on Rehabilitation: A Review of the Literature

Niamh Fleming

aBeaumont Hospital, Dublin 8, Ireland

ABSTRACT

The presentation will discuss the findings of a literature review which examined the associated benefits of a cranioplasty on rehabilitation. There is an ever-increasing demand for appropriate neurorehabilitation to optimise recovery post-traumatic brain injury. Some patients undergo decompressive surgery, which involves partial removal of the skull bone to help relieve the associated swelling and oedema. These patients are left with a skull defect and are placed on a waiting list for surgical repair of same by means of a procedure referred to as a cranioplasty. Cranioplasty, until recently, was not regarded as being a clinical priority in the neurorehabilitation phase, given the limited evidence supporting enhanced recovery.
The writer carried out a literature review to highlight the phenomenon syndrome of the trephined and to establish the potential impact it has on enhanced neurorehabilitation and recovery. The associated symptoms of syndrome of the trephined are predominately motor and cognitive in nature and are believed to result in a stalling or regression of the recovery process until the skull defect is repaired. The writer has critically analysed studies that have compared motor and cognitive functioning pre- and post-cranioplasty. Patients with enhanced functioning in the cognitive domain displayed marked improvements in the areas of memory, language and executive functioning. With regards to motor function, improvements were most evident in areas of activities of daily living, eating, grooming, walking and toileting. The theory underlying these improvements appears to be physiological in nature. Contrary to former opinion, the findings of this literature review highlight the importance of repairing skull breech prior to rehabilitation to optimise patient recovery for those experiencing syndrome of the trephined. The recommendations support the need for further research and education, as well as the development of a screening assessment tool that can be used by all members of the multidisciplinary team.
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