ABSTRACT

Background: Previous findings from our group show that in the acute (ie, 6–10 weeks) post-injury period, women with concussions have a 70% greater risk of sexual dysfunction than those with extremity injuries. There are currently limited treatment options for the clinical management of concussions. Resilience is a protective, modifiable psychological construct that has been shown to improve concussion-related sequelae. To date, however, no research has evaluated how resilience impacts sexuality outcomes after concussion in women.

Aim: Evaluate if resilience offers protection against negative sexuality outcomes in a cohort of reproductive, aged women with a concussion, seeking care in the Emergency Department of a Level-1 Trauma Center. We hypothesized that women with low resilience will be more likely to experience negative impacts on sexuality and that increasing levels of resilience will be associated with more positive sexuality outcomes.

Methods: Secondary data analyses.

Measures: Resilience was evaluated with the Resilience Scale (RS), and the Brain Injury Questionnaire for Sexuality (BIQS) was used for sexuality.

Results: Of the 299 participants recruited for the parent study, 80 with concussion had complete follow-up data and were included in these secondary analyses. Less than half (42.5%; n = 34) had low resilience (score ≤ 130 on the RS), and the remaining 46 (57.5%) had high resilience (score > 130 on the RS). In crude linear regression models, 1-unit increase in resilience was associated with a 4% increase in sexuality outcomes (β = 0.04, 95% CI: 0.01, 0.05; P = .008). The effect estimate remained similar in post-concussion-symptom-adjusted models (β = 0.03, 95% CI: 0.002, 0.06; P = .03). Mood-adjusted models showed a statistically significant interaction term (P < .0001). After stratifying by mood, findings showed that unit increases in resilience were associated with a 6% increase in sexuality outcomes for women in the high risk mood group (HADS score ≥ 11; PCS-adjusted β = 0.06, 95% CI: 0.02, 0.11; P = .009).

Conclusion: Longitudinal studies are needed to evaluate how these improvements in resilience translate to patient recovery measures following concussion. Anto-Ocrah M, Oktapodas Feiler M, Pukall C, et al. Resilience and Sexuality After Concussion in Women. Sex Med 2021;9:100297.
emergency department (ED) visits, hospitalizations, and deaths occur in the United States (US) annually. Approximately 50,000 persons die from the injury, and more than 80,000 of the survivors experience an onset of long-term disability. At least 75% (over 2.1 million) of all TBIs are mild traumatic brain injuries (mTBIs) or concussions; a trauma-induced physiological disruption in brain function (such as loss of consciousness, amnesia, or confusion), resulting from a blunt impact force and or acceleration-deceleration event. Although deemed “mild,” the physiological damage induced by concussions has been associated with physical/somatic symptoms such as headache, nausea, fatigue, vestibular issues, cognitive defects, depression, anxiety, and other emotional difficulties, and sleep disturbances. Between 30% and 80% of all patients with mTBI will experience at least one of these symptoms at some point.

Typical concussion symptoms resolve within weeks. However, studies have reported that a “miserable minority” of those who sustain mTBIs experience symptoms that linger into months, if not years. Women, unfortunately, make up a large proportion of this “miserable minority,” and their long-term outcomes tend to be worse than men’s. Women experience more post-concussion symptoms, worse cognitive deficiencies, higher levels of emotional/psychological disturbances, greater physiological burden, greater declines in the ability and functioning, and overall longer recovery time after injury.

Negative sexual changes and dysfunctions are also known adverse outcomes after mTBI. Previous findings from our group show that in the acute (ie, 6–10 weeks) post-injury period, women with concussions have a 70% greater risk of sexual dysfunction (SD) than injured women with extremity injuries. Concussed women with SD also report more post-concussion symptoms (PCS), higher levels of anxiety, and greater depression.

There are no evidence-based therapies for concussion management. Past consensus-based recommendations emphasized physical and cognitive rest until complete symptom resolution. This “rest is best” policy was supported by animal and human evidence of a vulnerable period early after a concussion during which the brain is susceptible to repeat injury and/or worsening symptoms with cognitive or physical stress. Although emerging research challenges this notion, there are still limited treatment options for the clinical management of concussions. In order to improve the recovery trajectory of the miserable minority of patients with mTBI—primarily women—it is important that researchers explore additional opportunities for intervention and treatment.

The concept of resilience as a major focus of treatment for TBI-related complications and rehabilitation has been gaining attention over the years. Resilience refers to the process of overcoming any negative or adverse effects of particular risks and the ability to maintain mental and physical function following aversive stress or trauma. It is a protective and modifiable psychological construct that reflects one’s positive adaptations to adversity. Resilience was thought to be a personality trait that one was either born with or without. It is now understood that resilience can be taught and learned, depending on life circumstances, and targeted interventions can improve one’s overall resiliency. The idea of incorporating resilience into treatment options is based on a positive psychology paradigm, which differs from the traditional deficit-based framework as it focuses on a strength-based model that seeks to identify qualities that help individuals thrive.

Several studies have linked resilience with risk for concussion morbidity among civilian, military, and veteran populations. No research, however, has evaluated the role of resilience in concussion-induced SDs. Resilience is modifiable. Understanding its role in the neurosexuality of concussions offers opportunities for clinicians (rehabilitation scientists, psychologists, neurologists, to name a few), researchers, and implementation scientists to develop resilience-targeted interventions for mTBI patients who may experience changes in their sexuality (eg, sexual function, relationship quality) after their head injuries. Such interventions would be particularly beneficial for women with concussions, whose post-concussion sequelae tend to be worse than men’s.

The objective of this study was to fill this gap in the neurosexuality literature. Building off our earlier findings, we sought to determine if resilience offers protection against negative sexuality outcomes in a cohort of women with mTBI seeking care in the Emergency Department (ED) of a Level-1 Trauma Center. We expanded our focus from SD specifically to sexuality in general by using a measure that assesses relationship quality and self-esteem, and mood related to sexuality, in addition to sexual functioning. Focusing exclusively on the subgroup of women with concussions, we hypothesized that those with low resilience will be more likely to experience negative sexuality outcomes than those with high resilience, and increasing levels of resilience will be associated with more positive sexuality outcomes. Identifying who within the concussed group is at great risk will allow researchers and clinicians to target them for appropriate treatment.

**METHODS**

This was a secondary data analysis of our previous research, which assessed the relationship between concussion and risk of SD in women of reproductive age (Figure 1).

**Participants**

To be eligible to participate in the parent prospective cohort study, women had to be between the ages of 18–45 years and seeking care in the level-1 trauma center ED or its affiliated urgent care centers within 7 days of their injuries. Patients were required to meet the Centers for Disease Control and Prevention and/or American Congress of Rehabilitation Medicine (ACRM) clinical definitions of concussion or have an ED diagnosis of concussion. Because we were unable to collect hormonal biomarkers to determine participants’ menopause status, we took a
conservative approach and excluded women over the age of 45 due to the increased likelihood of menopause-associated hormonal irregularities after this age; a potential confounder for women’s sexual health. Additional exclusion criteria included current pregnancy, ≤ 3 months post-partum, having had a full hysterectomy that may impact hormonal regulation of sexual function, and admitted in-hospital or staying over 24 hours in the ED. All inclusion/exclusion criteria were self-reported and/or confirmed by chart review as appropriate.

Procedures
Enrollment and consent and was completed by trained and experienced Emergency Medicine Research Associates (EDRAs) in the ED. All participants provided written consent. The study was approved by the University of Rochester’s Institutional Review Board.

Baseline Assessment (January–July 2017)
The baseline survey administered by the EDRAs in the ED collected data on the injury attributes and mechanism (fall, motor vehicle crash, assault, etc.), patient demographics, relationship status, parity, menstrual and other reproductive histories, sexual orientation, religious affiliation, and mental health/medication history.

Follow-Up Outcome Assessment (March–September 2017)
At week 6 (up to week 10) after enrollment, participants were re-contacted by the PI (MAO) through a combination of telephone, email, or text messaging based on patient preference, and administered the follow-up survey. The survey evaluated participants’ sexuality outcomes, post-concussion symptom burden, mood, and resilience. We chose to evaluate outcomes between 6–10 weeks after injury because, within this acute timeframe, concussion symptoms are expected to have resolved. This timeframe also reflects the 1-month follow-up period used by Losoi, McCauley, and other research groups to evaluate the impact of resilience on concussion outcomes.

Measures
Predictor Variable

Resilience. We used the Resilience Scale (RS) to evaluate participants’ post-mTBI resilience at 6–10 weeks. The 25 item survey is the original resilience measure and considered the “gold standard” for resilience assessments in various populations. The RS measures the degree of individual resilience through 5 components: equanimity, perseverance, self-reliance, meaningfulness, and existential aloneness. All items are scored on a 7-point scale from 1 = disagree to 7 = agree, with total scores of increasing resilience ranging from 25 to 175. The scale can be used continuously or dichotomized to cutoffs of ≤ 130 and > 130 to determine low and high resilience. Cronbach’s alpha coefficients range from 0.72–0.94, supporting the internal consistency reliability of the measure. The resilience scale has been previously used to determine the resilience of mTBI populations in the literature.

Primary Outcome

Sexuality outcome. The Brain Injury Questionnaire on Sexuality (BIQS) is a validated 15-item instrument that evaluates sexuality after TBI through 3 subscales: sexual functioning, relationship quality, and self-esteem, and mood (ie, feelings of sexually-related depression and worry). The instrument requires respondents to compare aspects of their sexuality (eg, sex drive, sex appeal, communication with a sexual partner) with their pre-injury status on a 5-point Likert scale (1 = greatly decreased to 5 = greatly increased). Total sexuality scores range from 15–75, with lower scores indicative of decreases in sexuality outcomes. Scores below 45 are considered critical and indicative of injury-related changes in sexuality.

Covariates

A priori we considered the following demographic and concussion-related variables as important covariates to adjust for, based on their associations with resilience and/or sexuality: age at the time of injury, race, ethnicity, education, religious affiliation, relationship status, sexual orientation, parity, history of previous concussions, injury mechanism, post-concussion symptom (PCS) burden, and mood. All these variables were self-reported by the study participants and confirmed with chart review as appropriate. For PCS and mood, we used the following validated questionnaires:

Post-concussion Symptoms (PCS). We used the Rivermead Post-concussion Symptoms Questionnaire (RPQ), a 16-item self-report measure of the presence and severity of the most commonly reported post-concussive symptoms. The scale compares any current symptoms to pre-injury symptom levels to account for potential symptom exacerbation subsequent to the head injury. Values for each of the 16 items are ranked on a 5-point scale (0 = not experienced at all, 4 = severe problem). Scores on the RPQ range from 0–64, with higher scores indicating greater PCS burden. This scale has been endorsed for mTBI populations by the National Institutes of Neurological Disorders and Stroke, and was used previously to assess outcomes in mTBI populations.

Mood. We used the Hospital Anxiety and Depression Scale (HADS) to evaluate post-injury mood. The HADS is a 14-item self-report measure designed to assess levels of emotional stress.
and somatization. It has been used in a range of clinical and research settings, including studies with mTBI populations.\(^8,57,58,68\) The tool includes 14 items, 7 related to anxiety (HADS-A) and 7 to depression (HADS-D). The 14 items are combined to provide a Total-HADS score, which can be further categorized into HADS-A and HADS-D for clinical and therapeutic purposes. Each item on the scale is scored between 0 (No, not at all) and 3 (Yes, definitely), for a total scale ranging from 0 to 21. Higher scores are indicative of more depressive and/or anxiety symptoms. The HADS has advantages over other instruments because of its clearly defined cutoffs for clinical caseness (normal = 0–7, borderline = 8–10, clinical caseness \(\geq 11\)).\(^69\) Studies have shown that the instrument has great versatility and is translational in nature,\(^69,70\) allowing researchers to identify and refer study participants who fit the clinical cutoffs for treatment.

**Statistical Analyses**

Univariate analyses and descriptive statistics were performed to examine the frequencies and distributions of the data stratified by resilience, sexuality, and other important covariates, including PCS and mood. Bivariate differences were evaluated with chi-square (\(\chi^2\)) tests and Fisher’s exact tests as appropriate. Crude
Table 1. Demographic and resilience attributes of study population (n = 80)

| Attribute                        | Low resilience (Scores ≤ 130) | High resilience (Scores > 130) | P  |
|----------------------------------|--------------------------------|--------------------------------|----|
| **Age, continuous**              |                                |                                |    |
| Mean (±SD)                       | 28.4 (±8.0)                    | 27.5 (±7.3)                    | .61|
| Range                            | 18–45                          | 18–45                          |    |
| **Age Groups, categorized**      |                                |                                |    |
| 18–34                            | 26 (76.5%)                     | 34 (73.9%)                     |    |
| 35–44                            | 7 (20.6%)                      | 11 (23.9%)                     | .90|
| 45                               | 1 (2.9%)                       | 1 (2.2%)                       |    |
| **Race**                         |                                |                                |    |
| White                            | 23 (67.7%)                     | 24 (52.2%)                     | .35|
| Black                            | 7 (20.6%)                      | 16 (34.8%)                     |    |
| Other                            | 4 (11.8%)                      | 6 (13.0%)                      |    |
| **Ethnicity**                    |                                |                                |    |
| Hispanic                         | 3 (8.8%)                       | 9 (19.6%)                      | .18|
| Non-Hispanic                     | 31 (91.2%)                     | 37 (80.4%)                     |    |
| **Education, continuous**        |                                |                                |    |
| Mean (±SD)                       | 14.6 (±2.3)                    | 14.5 (±2.4)                    | .85|
| Range                            | 10–20                          | 11–22                          |    |
| **Education, categorical**       |                                |                                |    |
| High School/GED                  | 19 (55.6%)                     | 24 (52.2%)                     |    |
| Associates, Bachelors or Higher  | 13 (38.2%)                     | 18 (59.1%)                     | .94|
| Other                            | 2 (5.9%)                       | 4 (8.7%)                       |    |
| **Religious Affiliation**        |                                |                                |    |
| Christian/Muslim/Jewish          | 13 (38.2%)                     | 24 (52.2%)                     | .0017|
| Non-Religious                    | 20 (58.8%)                     | 11 (23.9%)                     |    |
| Other                            | 1 (2.9%)                       | 11 (23.9%)                     |    |
| **Relational Attributes**        |                                |                                |    |
| Relationship Status              |                                |                                |    |
| Single, not in a relationship    | 11 (32.4%)                     | 16 (34.8%)                     |    |
| Relationship, not married        | 13 (38.2%)                     | 21 (45.7%)                     |    |
| Married                          | 8 (23.5%)                      | 8 (17.4%)                      | .74|
| Divorced/Other                   | 2 (5.9%)                       | 1 (2.2%)                       |    |
| **Relational Attributes, continued** |                              |                                |    |
| Parity, continuous               |                                |                                |    |
| Mean (±SD)                       | 1.1 (±1.5)                     | 1.0 (±1.6)                     | .96|
| Range                            | 0–6                            | 0–6                            |    |
| Parity, categorized              |                                |                                |    |
| 0                                | 19 (55.9%)                     | 27 (58.7%)                     |    |
| 1 to 2                           | 9 (26.5%)                      | 13 (28.3%)                     | .84|
| 3 or more                        | 6 (17.7%)                      | 6 (13.0%)                      |    |
| **Concussion comorbidities and mechanism** |                        |                                |    |
| Concussion History               |                                |                                |    |
| Yes                              | 8 (23.5%)                      | 9 (19.6%)                      | .67|
| No                               | 26 (76.5%)                     | 37 (80.4%)                     |    |
| Post-Concussion Symptom Scores (Rivermead Post-Concussion Symptom Scale) |                |                                |    |
| Mean (±SD)                       | 26.3 (±16.5)                   | 18.0 (±14.0)                   | .017|
| Range                            | 0.0–61.0                       | 0.0–48.0                       |    |
| Post-Injury Mood Scores (Hospital Anxiety and Depression Scale) |                 |                                |    |
| Mean (±SD)                       | 19.2 (±10.0)                   | 10.4 (±8.9)                    | < .0001|
| Range                            | 1.0–38.0                       | 0.0–37.0                       |    |
Table 2. Select predictors of sexuality outcomes among study participants (n = 80)

| Predictor                          | Decreased sexuality outcomes (BIQS < 45) (n = 46) | No decrease in sexuality outcomes (BIQS ≥ 45) (n = 34) | P       |
|-----------------------------------|-------------------------------------------------|---------------------------------------------------|---------|
| Age, continuous                   | Mean (±SD) 28.4 (±7.4) 27.3 (±7.9)               | P = .51                                           |
| Range                             | 18–45                                           | 18–45                                             |         |
| Age Groups, categorized           |                                                 |                                                   |         |
| 18-34                             | 35 (76.1%) 25 (73.5%)                            | P = 1.00                                          |
| 35–44                             | 10 (21.7%) 8 (23.5%)                             |                                                   |         |
| 45                                | 1 (2.2%) 1 (2.9%)                                |                                                   |         |
| Race                              |                                                 |                                                   |         |
| White                             | 20 (58.8%) 27 (58.7%)                            | P = .98                                           |
| Black                             | 13 (28.3%) 10 (29.4%)                            |                                                   |         |
| Other                             | 6 (13.0%) 4 (11.8%)                              |                                                   |         |
| Ethnicity                         |                                                 |                                                   |         |
| Hispanic                          | 10 (21.7%) 2 (5.9%)                              | P = .05                                           |
| Non-Hispanic                      | 36 (78.3%) 32 (94.1%)                            |                                                   |         |
| Education, continuous             | Mean (±SD) 15.0 (± 2.4) 14.1 (±2.3)               | P = .10                                           |
| Range                             | 10–22                                           | 11–18                                             |         |
| Education, categorical            |                                                 |                                                   |         |
| High School/GED                   | 24 (43.5%) 19 (55.9%)                            |                                                   |         |
| Associates, Bachelors or Higher   | 20 (43.5%) 11 (32.4%)                            | P = .35                                           |
| Other                             | 2 (4.4%) 4 (11.8%)                               |                                                   |         |
| Religious Affiliation             |                                                 |                                                   |         |
| Christian/Muslim/Jewish           | 19 (41.3%) 18 (52.9%)                            | P = .55                                           |
| Non-Religious                     | 20 (43.5%) 11 (32.4%)                            |                                                   |         |
| Other                             | 7 (15.2%) 5 (14.7%)                              |                                                   |         |
| Relational Attributes             |                                                 |                                                   |         |
| Relationship Status               |                                                 |                                                   |         |
| Single, not in a relationship     | 15 (32.6%) 12 (35.3%)                            |                                                   |         |
| Relationship, not married         | 16 (34.8%) 18 (52.9%)                            |                                                   |         |
| Married                           | 12 (26.1%) 4 (11.8%)                             | P = .14                                           |
| Divorced/Other                    | 3 (6.5%) 0 (0%)                                  |                                                   |         |
| Relational Attributes, continued  |                                                 |                                                   |         |
| Parity, continuous                | Mean (±SD) 1.0 (±1.3) 1.1 (±1.9)                  | P = .75                                           |
| Range                             | 0–5                                             | 0–8                                               |         |
| Parity, categorized               |                                                 |                                                   |         |
| 0                                 | 24 (52.2%) 22 (64.7%)                            |                                                   |         |
| 1 to 2                            | 17 (37.0%) 5 (14.7%)                             | P = .07                                           |
| 3 or more                         | 5 (10.9%) 7 (20.6%)                              |                                                   |         |
| Sexual Orientation                |                                                 |                                                   |         |
| Heterosexual                      | 37 (80.4%) 31 (91.2%)                            | P = .18                                           |
| Non Heterosexual                  | 9 (19.6%) 3 (8.8%)                               |                                                   |         |
| Concussion comorbidities and mechanism |                                                 |                                                   |         |
| Concussion History                |                                                 |                                                   |         |
| Yes                               | 5 (16.1%) 9 (16.4%)                              | P = .08                                           |
| No                                | 26 (83.9%) 46 (83.6%)                            |                                                   |         |
| Post-Concussion Symptom Scores (Rivermead Post-Concussion Symptom Scale\(^{90,91}\)) | | |         |
| Mean (±SD)                        | 25.3 (±16.2) 16.4 (±13.4)                         | *P = .01                                          |
| Range                             | 0.0–61.0 0.0–52.0                                |                                                   |         |

(continued)
and adjusted linear regression models were fit to determine the effect estimates for the average change in resilience scores with each unit increase in women’s sexuality. We hypothesized that as resilience scores increased, there would be improvements in sexuality outcomes; thus, concussed women with low resilience will be more likely to experience negative sexuality outcomes than those with high resilience. We used \( P < .05 \) to determine statistical significance for all bivariate, crude, and adjusted analyses. All analyses were conducted using SAS version 9.4.

**RESULTS**

Of the 299 participants recruited for the parent study, there were 103 eligible concussion cases, of which 80 (78%) had complete follow-up data and were included in these analyses (Figure 1). As shown in Table 1, 42.5% (n = 34) had low resilience (met cutoff of \( \leq 130 \) on the Resilience Scale), and the remaining 46 (57.5%) were classified as having high resilience (scored \( > 130 \) on Resilience Scale). Women with low resilience tended to be slightly older, married, have only a high school/GED level education, and have a history of previous concussions, though these differences were not statistically significant (Table 1). However, there were statistically significant differences between the groups with regards to their post-concussion symptom scores and mood. Women with low resilience had higher PCS burden (\( P = .017 \)) and worse mood scores (\( P < .0001 \)) compared with those with high resilience. Additionally, there were high levels of religiosity amongst concussed women with high resilience, whereas those with low resilience tended to describe themselves as being non-religious (\( P = .0017 \)). PCS and mood remained significant predictors of sexuality as well. As shown in Table 2, women with decreased sexuality outcomes also reported worse PCS morbidity (\( P = .01 \)) and mood scores (\( P = .0003 \)) than those without decreased sexuality outcomes. We included PCS and mood in linear regression models, given their associations with both resilience and sexuality.

Table 3 shows crude and adjusted effect estimates of the association between resilience and SD in the 80 women with a concussion. Crude linear regression models showed that every 1-unit increase in resilience was associated with a 4% increase in sexuality scores (\( \beta = 0.04, 95\% CI: 0.01, 0.05; P = .008 \)). The estimate was reduced slightly in PCS-adjusted models but remained statistically significant (\( \beta = 0.03, 95\% CI: 0.002, 0.06; P = .03 \)). Mood, however, changed the effect estimate by more than 10% from the crude estimate in all mood-adjusted models (Table 3), and the interaction term of mood and resilience showed statistical significance (mood*resilience interaction term = \( P < .0001 \)), suggesting that mood was an effect modifier and that we needed to risk stratify the study sample by mood to identify potentially vulnerable subgroups of patients.

To achieve this, we grouped study participants into clinical and non-clinical mood groups based on their responses and scores on the HADS (Table 4). Participants who met the cutoff of \( \geq 11 \) on the HADS were classified in the high-risk group of mood “clinical cases,” and those who scored below 11 were grouped as “non-clinical cases.” As shown in Table 4, every 1-unit increase in resilience was associated with a 6% unit increase in sexuality scores for those in the high-risk group (PCS-adjusted \( \beta = 0.06, 95\% CI: 0.02, 0.11; P = .009 \)), a 2% increase from the crude model. This model explains 19% of the variability in sexuality after concussion in this high-risk group of clinical mood cases (scatter plot in Figure 2).

**DISCUSSION**

Although the field of neurosexuality is beginning to gain momentum, sexual changes after mTBI have been reported across the literature for decades. As stated by the National Head Injury Foundation, “sexual dysfunction is more the
Table 3. Effect estimates of association between resilience and Sexual functioning (n = 80)

Mean change in sexuality outcomes

| Mean change in sexuality outcomes* | Crude | PCS-adjusted model‡ | Mood-adjusted Model§ | PCS and mood-adjusted model |
|-----------------------------------|-------|---------------------|----------------------|----------------------------|
| Resilience Score†                | $\beta = 0.04$ (95% CI: 0.01, 0.05) $P = .008$ | $\beta = 0.03$ (95% CI: 0.002, 0.06) $P = .03$ | $\beta = 0.006$ (95% CI: 0.03, 0.04) $P = .72$ | $\beta = 0.009$ (95% CI: −0.03, 0.04) $P = .60$ |
| Post-Concussion Symptom (PCS)‡    | -     | −0.10 (95% CI: −0.35, −0.05) $P = .0001$ | -                    | −0.03 (95% CI: −0.10, 0.05) $P = .51$ |
| Mood Scores§                      | -     | -                   | −0.21 (95% CI: −0.29, −0.13) $P < .0001$ | −0.17 (95% CI: −0.3, −0.05) $P = .005$ |
| Mood*Resilience                   |       |                     |                      |                            |

*Sexuality outcomes evaluated with Brain Injury Questionnaire for Sexuality (BIQS)56.
†Resilience evaluated with the Resilience Scale (RS)11.
‡Post-Concussive Symptoms (PCS) evaluated with Rivermead Post-Concussion Symptom Questionnaire (RPQ)91.
§Mood Scores assessed with Hospital Anxiety and Depression Scale (HADS)70.

Table 4. Association between Resilience and Sexual Functioning, stratified by Mood Clinical Cut-offs (n = 80)

Mean change in sexuality outcomes

| Mean change in sexuality outcome scores* | Crude model | Met mood§ clinical cut-off (HADS ≥11) n = 46 | Did not meet mood§ clinical cut-off (HADS <11) n = 34 |
|-----------------------------------------|-------------|---------------------------------------------|---------------------------------------------|
| Resilience Score†                       | $\beta = 0.04$ (95% CI: 0.01, 0.05) $P = .008$ | $\beta = 0.06$ (95% CI: 0.02, 0.11) $P = .009$ | $\beta = −0.05$ (95% CI: −0.08, −0.02) $P = .002$ |
| Post-Concussion Symptom (PCS)§          | -           | −0.14 (95% CI: −0.23, −0.06) $P = .0007$ | 0.02 (95% CI: −0.05, 0.08) $P = .6$ |

*Sexuality outcomes evaluated with Brain Injury Questionnaire for Sexuality (BIQS)56.
†Resilience evaluated with the Resilience Scale (RS)11.
‡Post-Concussive Symptoms (PCS) evaluated with Rivermead Post-Concussion Symptom Questionnaire (RPQ)91.
§Mood Scores assessed with Hospital Anxiety and Depression Scale (HADS)70.
Concussion-induced sexual dysfunctions (SDs) have been associated with cognitive decline, employment status, relationships discord, fertility, and overall quality of life. However, there is little to no research on treatment options for individuals who experience these sexual sequelae after their concussion injuries. Resilience is a modifiable psychological construct that has been shown to protect against adverse concussion sequelae, but the association between resilience and SD, particularly in women with mTBI, has not been explored until now. We evaluated the association between resilience and sexuality in a cohort of women with mTBI seeking care in the ED of a level-1 trauma center. This group of head-injured patients represents the increasing majority of women who sustain their concussions via non-sports mechanisms, and who also comprise a large proportion of the "miserable minority" of patients who experience prolonged concussion recovery.

In this cross-sectional assessment, we observed small yet positive increases in sexuality outcomes among women with higher levels of resilience. These results suggest that women with low resilience are more likely to experience more negative concussion-induced sexuality outcomes than women with high resilience. Even more vulnerable are women who experience high levels of post-concussion anxiety and depression. The effect estimate was larger in this subgroup of mood-affected patients who could be targeted for resilience-focused interventions. This potentially positive impact of resilience on sexuality outcomes observed in our study in the acute (6 to 10 week) post-injury period aligns with the results of other concussion researchers; these researchers have shown that this period in the concussion recovery trajectory is critical for identifying and targeting the "miserable minority" who experience atypical concussion recovery. In a longitudinal study designed to evaluate short-term and long-term outcomes of injured individuals, Losoi and colleagues compared return-to-work (RTW) outcomes in adults with mTBI (n = 74) and ankle injuries (n = 40) at 1, 6, and 12 months post-injury. The authors reported that concussed patients reported significantly more PCS than the extremity injured comparison group at 1 and 6 months post-injury (P = .001 and P = .029, respectively). Although 96% of mTBI patients reached RTW status at the 12-month assessment, the subgroup that did not have "modifiable psychological risk factors" (ie, depression, traumatic stress, and/or low resilience) at 1-month of follow-up. At the 6-month follow up, they had greater post-concussion symptoms, fatigue, insomnia, traumatic stress, and depression. McCauley and collaborators also observed that preinjury resilience, evaluated within 24 hours after mTBI, significantly predicted postinjury anxiety and post-concussion symptoms at 1-week and 1-month post-injury (all P < .007) for patients with mTBI (n = 46) and an orthopedic comparison group (n = 29) recruited from the ED of level-1 trauma centers. Similarly, Merritt et al. observed a negative relationship between resilience and self-reported neurobehavioral symptoms within 12 months following mTBI in 142 US military service members. These studies emphasize that certain acute, short-term outcomes are predictive of long-term recovery and illustrate the importance of providing evidence-based treatment.
and rehabilitation services early in the recovery period after a concussion.

Although anxiety and depression are factors that are substantially easier to change with psychological therapy than resilience, we advocate for a more comprehensive, novel, and dynamic psychological therapy of anxiety, depression, and resilience so patients can cope better with the stress of the brain injury, in addition to their mood. During the mTBI recovery and rehabilitation processes, resilience skills can be developed in individuals who, early on, demonstrate low or non-resilient profiles.84 Although many TBI survivors find it difficult to remain positive in the face of the traumatic changes imposed by their injuries, interventions such as the Resilience and Adjustment Intervention (RAI), a seven-hour curriculum-based outpatient program,84 have been shown to improve patient resilience, emotional well-being, and overall post-injury adjustment. By focusing on emotion regulation, relationship building, goal setting, and optimism, the skills-based intervention program has been shown to improve patient’s resilience outcomes by an average of 7.29 points (P < .001) and decrease depression and anxiety scores by 7.06 (P < .001) and −5.28 (P = .006) scores, respectively. Our findings that higher resilience scores are associated with better sexual functioning outcomes in women with concussion align with that of other concussion researchers and advocates for incorporating the RAI and other resilience-building tools early in the rehabilitation process of head-injured patients. Through randomized control trials, future studies should evaluate the impact of these resilience interventions on women’s post-mTBI sexual sequelae since there are currently little to no treatment options available for those who experience these morbidities.

Human sexuality is a complex and multidimensional construct that includes the interaction of various biological, intrapersonal and interpersonal, and socio-cultural factors.59 Increasing awareness of the bio-psycho-social nature of sexuality has led to a better acknowledgment within the scientific community of the importance of assessing sexuality as a health outcome to promote the quality of life of individuals with neurodisabilities.71 To our knowledge, this is the first study to evaluate the impact of resilience on women’s sexuality after a concussion. By focusing on women ED patients, we targeted one of the fastest-growing mTBI populations in the United States who are under-represented in the concussion and neurosexuality literature, yet who experience worse sexual sequelae.6,15,22,85 Despite the study’s importance, there are some limitations. First is the small sample size. Although we found statistically significant findings that supported our hypothesis, larger studies are needed to substantiate our findings. Studies with larger sample sizes would accommodate more resilience groups (instead of high vs low, there could be 3 groups of low, medium, high, for example) and also accommodate more complex analyses that can pinpoint the most salient questions on the resilience scale/measure for the mTBI patient. A second limitation of the study is the lack of temporality in assessing the relationship between resilience and women’s sexuality. Both resilience and sexuality were measured at the same point (6–10 weeks after injury). This cross-sectional assessment makes it difficult to determine the directionality between resilience and sexuality. Like other research groups, our analyses held the assumption that resilience predicts mTBI-induced sexuality outcomes. However, poor sexuality outcomes could have also predicted low resilience. The study’s cross-sectional design creates challenges for determining the directionality of the association between resilience and sexuality. Resilience requires social support, optimism, religiousness and spirituality,86 attributes that may also be sequestered after trauma. After mTBI, individuals’ social support may increase as friends and family members garner their support for the injured person. Highly resilient participants in our study also reported high levels of religiosity (Table 1), but without pre-injury and/or relative assessments, it is difficult to determine the magnitude of patients’ changes in resilience and what the benchmark is for determining “recovery.”

Despite these limitations, our study fills an important gap in the concussion literature and offers potential treatment targets for women with concussion who also experience negative mTBI-induced sexuality outcomes. Knowing that treatment options that incorporate resilience may be available for these concussed patients could encourage more provider-initiated discussions about the sexual sequelae of concussions in the neuro-rehabilitation and outpatient settings.37,88 These discussions are especially crucial for women, given societal expectations placed on them as wives, mothers, and daughters, which often result in a much more differentiated constellation of family dynamics when TBI is introduced.89

**CONCLUSION**

mTBI is a stressful event that can induce individual-level changes in sexuality outcomes, an important aspect of quality of life. Resilience training may improve sexuality outcomes after a concussion, and is worthy of further investigation. Resilience-based interventions may be most critical during the early, acute, post-mTBI recovery process, as studies have shown that intervening and modifying behaviors early in the recovery trajectory may have the greatest impact on patients’ overall recovery outcomes.

Women with post-injury anxiety and depression may benefit the most from such resilience-gear interventions.

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