Abstract

Objective: Parents may use various information sources to obtain information about sport-related concussions (SRC). This study examined SRC-related information sources used by parents of United States middle school children (age: 10–15 years).

Methods: A panel of 1083 randomly selected U.S. residents, aged ≥18 years and identifying as parents of middle school children, completed an online questionnaire capturing parental and child characteristics, and utilization and perceived trustworthiness of various sources of SRC-related information. Multivariable logistic regression models identified factors associated with utilizing each source. Adjusted odds ratios (OR) with 95% confidence intervals (95% CIs) excluding 1.00 were deemed significant.

Results: Doctors/healthcare providers (49.9%) and other healthcare-related resources (e.g., Centers for Disease Control and Prevention, WebMD) (37.8%) were common SRC-related information sources; 64.0% of parents utilized ≥1 of these sources. Both sources were considered “very” or “extremely” trustworthy for SRC-related information among parents using these sources (doctors/healthcare providers: 89.8%; other healthcare-related resources: 70.9%). A 10-year increase in parental age was associated with higher odds of utilizing doctors/healthcare providers (adjusted odd ratio (OR adjusted) = 1.09, 95% CI: 1.02–1.16) and other healthcare-related resources (OR adjusted = 1.11, 95% CI: 1.03–1.19). The odds of utilizing doctors/healthcare providers (OR adjusted = 0.58, 95% CI: 0.40–0.84) and other healthcare-related resources (OR adjusted = 0.64, 95% CI: 0.44–0.93) were lower among parents whose middle school children had concussion histories versus the parents of children who did not have concussion histories.

Conclusion: One-third of parents did not report using doctors/healthcare providers or other healthcare-related resources for SRC-related information. Factors associated with underutilization of these sources may be targets for future intervention. Continuing education for healthcare providers and educational opportunities for parents should highlight accurate and up-to-date SRC-related information.

Keywords: Information seeking; Media use; Traumatic brain injury

1. Introduction

Concussions are challenging to prevent, identify, and manage in youth populations.1 Concussion management is complicated by the delayed identification that may occur following such injuries. Delayed identification in this age group is primarily driven by a failure to disclose concussion symptoms to healthcare providers, parents, or coaches (as well as parents not disclosing their children’s symptoms to healthcare providers).2–5 There is general consensus that rapid concussion identification and careful clinical injury management are
critical to preventing reinjury and maintaining lifespan neurological health.  

Parents play a critical role in guiding healthcare decisions and use of healthcare services for their children. As such, they are often the primary decision makers for seeking a healthcare assessment. This is also true in the case of preventing and managing their children’s concussions (or suspected concussions). Their own substantive knowledge related to concussions may influence their care-seeking knowledge and beliefs,  which may potentially influence their behaviors. A recent study demonstrated associations between parental concussion-related attitudes and their children’s knowledge and perceptions of concussions. Further, other factors such as marital status, race/ethnicity, parent perception of health, parent enrollment in private health insurance, and perception of health insurance adequacy contribute to the decision to seek care following a concussion.  

Generally, substantive knowledge of a particular medical condition plays a critical role in the understanding of the perceived risk and the care-seeking attitudes related to that condition. Ideally, credible and substantive knowledge regarding sport-related concussions (SRCs) would be acquired via other healthcare-related resources such as a healthcare provider (e.g., physician, athletic trainer) or health-focused organizations such as the Centers for Disease Control and Prevention (CDC). However, these are not the exclusive sources of SRC-related knowledge, and individuals rely on other sources, such as their social networks, for this information. However, some of these sources may provide inaccurate information, which can consequently lead to less than optimal decision making. Parents need access to accurate and reliable information to make informed healthcare decisions for their children.  

From both clinical and public health perspectives, surveying the landscape of concussion information source utilization is an important precursor to effective dissemination of accurate and reliable concussion information. Further, from a socioeconomic perspective, it is important to understand the factors that may be associated with specific information source utilization in order to help ensure such dissemination. At the same time, because most non-adult-based research focuses on adolescents in high school settings, it is important to better understand the knowledge and information-seeking behaviors of parents of younger children. In the United States, school-based sports primarily begin in the middle school (MS) setting, which consists of children approximately aged 10–15 years. However, concussions can occur outside of sport settings as well, through such mechanisms as falls and motor vehicle crashes.  

Given the existing gaps in the literature, the purpose of this study was to examine the sources from which parents of MS children (age: 10–15 years) obtain SRC-related information. Using data from a nationwide survey, we aimed to: first, identify the sources used to obtain SRC-related information; and second, specifically explore what parent and child characteristics, as well as community-level factors, were associated with use of each SRC-related information source.  

2. Methods  

The current study used a cross-sectional survey design. Our population of interest was parents of MS-aged children. The study was approved by the Institutional Review Board of the University of North Carolina at Chapel Hill.  

2.1. Participants and sampling  

The study sample was recruited by Survey Sampling International (SSI; now rebranded as Dynata), which used a pool of U.S. residents who agreed to participate in online survey research. SSI used certification processes such as digital fingerprinting, IP verification, and built-in quality control questions to ensure data quality. The pool of participants provides demographic information from which SSI can recruit specifically for studies.  

For this study, SSI only recruited individuals that had self-reported as parents of children aged 10–15 years. Outside of the sampling pool, no additional exclusion criteria were used. Among this group of eligible participants, SSI randomly generated a sample that received an invitation to participate in this study. Communications for this invitation included desktop and in-app alerts. To avoid self-selection bias, specific study details were not included in the invitation; rather, participants were simply invited to “take a survey”, with study details provided upon accepting the invitation. Upon completion of a survey study, SSI reimburses participants with reward points that can be redeemed for cash, gift cards, and so on.  

2.2. Data collection  

The online questionnaire was hosted on Qualtrics (Qualtrics Labs, Provo, UT, USA), based off a modified version of a previously validated questionnaire and developed with input from injury epidemiologists, athletic trainers, sports medicine practitioners, and parents of youth sport athletes. The questionnaire was piloted in a sample of parents of young children and revised accordingly. Questionnaire items are available upon request.  

We provided the finalized survey via the URL of the online questionnaire to SSI, which integrated it into its survey platform. During September and October 2018, a panel of 1362 randomly selected U.S. residents (aged ≥18 years) identifying as parents of children aged 10–15 years were invited and agreed to complete the online questionnaire. No follow-up reminders were sent. Of the 1362 potential participants, 1083 (79.5%) respondents confirmed having children currently enrolled in MS, completed all survey items, and were subsequently included in the analyses.  

2.3. Measures  

Our outcomes of interest were the utilization and perceived trustworthiness of various sources of SRC-related information. Respondents were asked to note any of the following sources they currently used to obtain SRC-related information: local news sources (e.g., television, newspaper, website), national news sources (e.g., The New York Times, Fox News, USA
Today), sport-specific media (e.g., Entertainment and Sports Programming Network (ESPN), Fox Sports, Columbia Broadcasting System (CBS) Sports), blogs/social media; friends and family, doctors/healthcare providers, and other healthcare-related resources (e.g., CDC, WebMD). Respondents indicating yes for use of a specific source were provided a follow-up question on how trustworthy they believed the source to be, using the following scale: “Not at all”, “Slightly”, “Somewhat”, “Very”, and “Extremely”.

Our explanatory variables of interest consisted of parent, child, and community-level characteristics. Parent characteristics included age (years), gender, race/ethnicity, education, and concussion history. Child characteristics included participation in organized sports within the past year and concussion history. Respondents were instructed to provide characteristics only for their children currently enrolled in MS. Also, because the questionnaire focused on parent experience, questions focused on characteristics attributable to any of their children in MS. Organized sports included sports played at the MS or in youth club/recreation leagues. Respondents with MS children who played sports were asked to list all the sports that their children played from a preselected set (with a fill-in option). We then classified sports according to contact level, based on the existing literature. Noncontact sports included archery, cross country, dance, golf, swimming, tennis, and track and field. Limited contact sports included baseball, fencing, flag football, racquetball, softball, and volleyball. Contact sports included basketball, boxing, cheerleading, field hockey, gymnastics, ice hockey, lacrosse, martial arts, soccer, water polo, and wrestling. Although football is included as a contact sport, we opted to keep this as a separate category given that it has been found it to have higher concussion rates than other contact sports. If children played multiple sports, they were categorized according to the highest contact level to which they were exposed (e.g., a child participating in ice hockey and tennis was classified in the “contact sports” category). Because the count for noncontact sports was low, we merged noncontact and limited contact sports into one category.

The questionnaire also gathered zip code of residency to obtain community-level characteristics from the American Community Survey (2013–2017). The American Community Survey data provided estimates of community-level characteristics associated with each respondent’s zip code. These included the percentage of residents over the age of 25 years with at least a bachelor’s degree; the percentage of residents who were non-white; the percentage of families with incomes below the poverty line; and the percentage of families with an Internet subscription (which included dial-up and broadband, including cellular data plan, cable, fiber optic, digital subscriber line, or satellite Internet service).

2.4. Statistical analysis

Data were analyzed using SAS (Version 9.4; SAS Institute Inc., Cary, NC, USA). Descriptive analyses, including frequencies and measures of central tendency and variability, were conducted for all measures of interest. For our outcomes of interest, the utilization and perceived trustworthiness of various sources of SRC-related information, we first calculated the percentage of respondents noting use of each source of information; second, we calculated, among those noting use, the distributions of perceived trustworthiness.

Next, multivariable logistic regression models identified parent, child, and community characteristics associated with the utilization of each source of SRC-related information (i.e., a total of 7 separate models, one for each source). In the multivariable logistic regression models, parent characteristic-related adjusted Odds ratios (ORs) were computed for age (maintained as discrete variable, with the adjusted ORs examining the effect of 10-year increases), sex (female vs. male), race/ethnicity (non-white vs. white/non-Hispanic), education level (with vs. without at least a bachelor’s degree), and concussion history (yes vs. no). Similarly, child characteristic-related adjusted ORs were computed for concussion history (yes vs. no) and sport participation (each contact level of sport participation compared to no sports participation). Finally, community characteristic-related adjusted ORs were computed for each community characteristic variable (which were kept as continuous, with adjusted ORs examining effects of 10% increases in each variable). Each model of the odds of utilizing a specific source also controlled for the use of the other sources of SRC-related information that were specifically examined. All adjusted ORs with 95% confidence intervals (95%CIs) excluding 1.00 were deemed significant.

3. Results

3.1. Respondent characteristics

Sample respondents resided across all 50 U.S. states plus the District of Columbia. Most of the 1083 respondents were under the age of 40 years (51.8%), female (61.8%), white/non-Hispanic (54.8%), and had less than a bachelor’s degree (53.1%) (Table 1). Most respondents had 1 or 2 MS children (74.2% or 20.1%, respectively) and had MS children who had played organized sports within the past year (74.1%). Of these respondents with sport-playing MS children, 20.5% (15.2% of total sample) reported that their MS-aged children played football. In addition, 29.7% of respondents reported a personal concussion history, and 18.6% reported that their MS-aged children had a concussion history.

3.2. Use of sources for SRC information

Overall, 98.2% of respondents noted currently using at least one of the 7 listed sources for SRC-related information. The most common SRC-related information sources were doctors/healthcare providers (49.9%) and other healthcare-related resources (37.8%) (Table 2). Notably, 64.0% of the sample utilized at least one of these sources. Additionally, local news sources (30.6%) and friends and family (29.5%) were listed as other common sources for SRC-related information. Among those who reported using the listed sources, doctors/healthcare providers were most commonly considered to be “very” or “extremely” trustworthy for SRC-related
Table 1
Descriptive profile of responding parents of middle school students (n = 1083).

| Variable                                      | Percentages |
|-----------------------------------------------|-------------|
| **Parent characteristics**                   |             |
| Age (years)                                   |             |
| < 30                                          | 40 ± 10     |
| 30–39                                        | 125 (11.5)  |
| 40–49                                        | 436 (40.3)  |
| > 49                                         | 325 (30.0)  |
| **Gender**                                    |             |
| Male                                          | 414 (38.2)  |
| Female                                        | 669 (61.8)  |
| **Race/Ethnicity**                            |             |
| White/non-Hispanic                            | 594 (54.8)  |
| Nonwhite                                      | 489 (45.2)  |
| Black/African-American                       | 151 (13.9)  |
| Asian/Pacific Islander                       | 85 (7.8)    |
| Latino                                        | 162 (15.0)  |
| Mixed race/other                              | 91 (8.4)    |
| **Education**                                 |             |
| Less than a bachelor’s degree                 | 575 (53.1)  |
| Less than high school                         | 14 (1.3)    |
| High school graduate or GED                   | 209 (19.3)  |
| Some college; no degree                       | 215 (19.9)  |
| Associate’s degree                            | 137 (12.7)  |
| Bachelor’s degree and above                   | 508 (46.9)  |
| Bachelor’s degree                             | 318 (29.4)  |
| Master’s degree                               | 117 (10.8)  |
| Doctorate                                     | 32 (3.0)    |
| Professional degree                           | 41 (3.8)    |
| **Parent concussion history**                 |             |
| No                                            | 761 (70.3)  |
| Yes                                           | 322 (29.7)  |
| **Child characteristics**                    |             |
| Played organized sports within past year^a    |             |
| No                                            | 280 (25.9)  |
| Yes, noncontact/limited contact sports^b       | 136 (12.6)  |
| Yes, contact sports^c                         | 502 (46.4)  |
| Yes, football                                 | 165 (15.2)  |
| **Child concussion history**                  |             |
| No                                            | 882 (81.4)  |
| Yes                                           | 201 (18.6)  |
| **Community characteristics^d**               |             |
| Aged 25 and older with at least a bachelor’s degree (%) | 29.6% ± 16.3% |
| < 25.0%                                       | 519 (47.9)  |
| 25.0%–50.0%                                   | 432 (39.9)  |
| > 50.0%–75.0%                                 | 119 (11.0)  |
| > 75.0%                                       | 15 (1.2)    |
| **Residents who are nonwhite (%)**            |             |
| < 25.0%                                       | 414 (38.2)  |
| 25.0%–50.0%                                   | 289 (26.7)  |
| > 50.0%–75.0%                                 | 202 (18.7)  |
| > 75.0%                                       | 178 (16.4)  |
| **Households below poverty level (%)**        |             |
| < 25.0%                                       | 1005 (92.8) |
| 25.0%–50.0%                                   | 77 (7.1)    |
| > 50.0%–75.0%                                 | 1 (0.1)     |
| > 75.0%                                       | 0           |
| **Households with Internet subscription (%)^e**|             |
| < 25.0%                                       | 78.1% ± 11.1% |
| 25.0%–50.0%                                   | 27 (2.5)    |
| > 50.0%–75.0%                                 | 342 (31.6)  |
| > 75.0%                                       | 714 (65.9)  |

Notes: Values are presented as mean ± SD or n (%). Percentages may not sum to 100.0% due to rounding error.

^a Includes organized sports played at middle school or youth club/recreation leagues. Contact-level classifications originate from Rice et al. 18 If children played multiple sports, they were categorized into the highest contact-level group (e.g., a child participating in ice hockey and tennis was classified in the “contact sports” category).

^b Includes archery, baseball, cross country, dance, fencing, flag football, golf, racquetball, softball, swimming, tennis, track and field, and volleyball.

^c Includes basketball, boxing, cheerleading, field hockey, gymnastics, ice hockey, lacrosse, martial arts, soccer, water polo, and wrestling.

^d Community-level characteristics correspond to the number of participants found to be residing within communities with those specific characteristics; data originated from the 2013–2017 American Community Survey (ACS) 5-year estimates and were matched by respondents’ self-reported zip code.

^e Internet subscription includes dial-up and broadband, including cellular data plan, cable, fiber optic, DSL, or satellite Internet service. Abbreviation: GED = general educational development.
4. Discussion

Our results suggest that parents of MS children relied on various sources for SRC-related information and that the trustworthiness associated with each utilized source varied greatly. The most common SRC-related information sources were doctors/healthcare providers and other healthcare-related resources, with parents reporting high levels of trustworthiness for both. Consistent with the socioecological model, a combination of parental, child, and to a lesser extent, community factors were associated with the utilization of these sources of SRC-related information. Ultimately, a robust understanding of this relationship will present avenues through which clinicians can intervene to improve concussion knowledge among parents and influence downstream implications regarding care-seeking behavior. Such continued examinations will benefit from extending beyond our U.S. population-based sample to better understand variations based on regional and cultural differences.

4.1. Utilization of sources of SRC-related information

More than 60% of the sample reported currently utilizing doctors/healthcare providers or other healthcare-related resources for SRC-related information. Moreover, a large proportion of those who utilized these sources also considered them to be “very” or “extremely” trustworthy. These results suggest that these sources can be effective mediums for providing reliable and credible medical information. It is important to consider that our study did not obtain data on parents’ insurance status; parents without insurance may have defaulted to not using doctors/healthcare providers as information sources. Nonetheless, it is important for these sources to continue providing information to parents that is current and accurate. Reviews of concussion information via websites and news articles found a number of sources included incorrect statements (e.g., same-day return-to-play is possible with medical clearance). As such, clinicians should receive continuing education on SRC pathology and the associated risk and and

Table 2
Sources for SRC information used by parents of middle school students (n = 1083).

| Information source                                      | Respondents reporting use of SRC-related information | Respondents reporting source as “very” or “extremely” trustworthy, among those reporting use of source |
|--------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Local news sources (e.g., TV, newspaper, website)     | 331 (30.6)                                          | 181 (54.7)                                                                                                       |
| National news sources (e.g., The New York Times, Fox News, USA Today) | 257 (23.7)                                          | 149 (58.0)                                                                                                       |
| Sport-specific media (e.g., ESPN, Fox Sports, CBS Sports) | 256 (23.6)                                          | 152 (59.4)                                                                                                       |
| Blogs/social media                                    | 170 (15.7)                                          | 69 (40.6)                                                                                                        |
| Friends and family                                    | 319 (29.5)                                          | 183 (57.4)                                                                                                       |
| Doctors/healthcare providers                          | 540 (49.9)                                          | 485 (89.8)                                                                                                       |
| Other healthcare-related resources (e.g., CDC, WebMD)  | 409 (37.8)                                          | 290 (70.9)                                                                                                       |

Notes: Data are presented as n (%). Respondents were asked to identify those sources they currently use. Respondents were asked to check all that apply.

* Each row reads as follows: 30.6% (n = 331) reporting currently using local news sources for SRC-related information; of these 331, 54.7% (n = 181), noted the source as “Very” or “Extremely” newsworthy.

Abbreviations: CBS = Columbia Broadcasting System; CDC = Centers for Disease Control and Prevention; ESPN = Entertainment and Sports Programming Network; SRC = sport-related concussion.

Fig. 1. Reported trustworthiness of sources for sport-related concussion information that were currently being used by parents of middle school students. Only includes responses from parents who had reported 3 current use of that specific information source.
preventative factors to ensure they receive accurate and up-to-date information. Further, this provider education should emphasize strategies that help them effectively initiate conversations with parents about primary, secondary, and tertiary prevention, as they relate to SRCs to improve the proportion of parents receiving concussion information from reliable healthcare sources. Current efforts have been created to help other stakeholders address potential inaccuracies of SRC-related information; for example, efforts such as the “Media Concussion Checklist” aim to help journalists more accurately discuss SRCs in their news articles.20,21

More than one-third of the sample did not utilize doctors/healthcare providers or other healthcare-related resources, indicating there are other sources of concussion-related information that should be considered for providing SRC-related information. School-based healthcare providers, such as school nurses and athletic trainers (where available), are in ideal positions to implement such conversations. Previous research found that, in high school sports, the best compliance with return-to-play guidelines occurred when there was an athletic trainer or healthcare provider on the field collaborating with a physician.22 However, many MS settings have limited or no access to athletic trainers, which highlights the need for increased access to such medical professionals, as well as continued educational opportunities to inform school nurses about concussion prevention and management. There is a need to ensure that accurate SRC-related information penetrates other sources as well. Future research should consider how to encourage parents to consider and use clinicians and healthcare-related resources as viable sources of SRC-related information compared to other sources. Also, educational interventions for parents should advocate that parents seek SRC-related information from doctors/healthcare providers and other healthcare-related resources. State legislation regarding youth concussion exists across all 50 U.S. states and the District of Columbia,23 with many inclusive of parent education directives. These directives offer an opportunity to provide current and reliable educational sources. Such efforts would make these important resources readily available to parents, particularly those without access to a healthcare provider.

We also observed considerable variability in the trustworthiness associated with sources of SRC-related information. For example, despite being a potential medium for sharing and disseminating information,24 those who utilized blogs/social media for SRC-related information did not unequivocally perceive this source as “very” or “extremely” trustworthy. Moving forward, researchers in this space may consider how the utilization of various sources in conjunction with their perceived trustworthiness affects parental perceptions of their children’s concussion risk and their care-seeking attitudes and behaviors. Importantly, we note that data on perceived trustworthiness originated from only those parents utilizing the source; in the case of blogs/social media, this excludes the 84.3% of parents who did not utilize this source. These parents may have refrained from using blogs and social media due to a perceived lack of trustworthiness in them. Although our study cannot confirm this, previous research has explored information-seeking in the context of the trustworthiness of the source.25 Future research should further explore the information-seeking process for parents in the scope of SRC.

4.2. Factors associated with the utilization of sources of SRC-related information

A number of factors associated with utilizing each examined source of SRC-related information emerged from this study. The observed roles of parental age, sex, race/ethnicity, and education highlight the need for clinicians and public health practitioners to consider delivery methods and accessibility concerns related to delivering credible SRC-related education and prevention materials to parents of MS children. Our findings differed from a previous study that found that adults with a high school diploma were more likely to obtain health information from text-based sources, whereas adults without a high school diploma were more likely to obtain health information from oral-based sources.26 In contrast, we found education—although focused on differences between those with and without at least a bachelor’s degree—was not associated with use of other healthcare-related resources. Future research should establish how information-seeking related to SRC compares and contrasts with information-seeking for general health information.

Our results suggest that parents of sport-playing MS children, particularly those whose children played contact sports such as football, were more reliant on certain information sources such as sport-specific media, doctors/healthcare providers, and other healthcare-related resources, as compared with parents of non-sport-playing MS children. Although the findings may highlight the need to ensure that such sources provide information for sport-specific contexts, it is important to consider those children not involved in organized sports and the access their parents have to concussion-related information. Concussions can occur outside of sport, through such mechanisms as falls and motor vehicle crashes;15 thus, all parents need access to credible information that enables them to identify and properly manage suspected concussions.

Interestingly, we observed lower odds of utilizing doctors/healthcare providers and other healthcare-related resources for SRC-related information among parents whose MS children had concussion histories, as compared with parents whose MS children did not have concussion histories. We suspect that those parents whose children had concussion histories may have obtained SRC-information from these sources in the past and thereby did not feel the need to continue using them at the time of responding to this survey. It is also possible that parents, particularly those who were anxious about the effects of concussions, were dissatisfied with the information received from these sources, and thus searched for less credible sources that aligned with their concerns about SRC. However, considering the cross-sectional nature of this study, it is difficult to make such implications involving temporal precedents. With that said, it is important to note that the scientific knowledge of the pathology, symptomatology, and management of
Table 3
Multivariable models predicting use of each sources for SRC information. a

| Variable | Local news sources (n = 331) | National news media (n = 257) | Sport-specific media (n = 256) | Blogs/social media (n = 170) | Friends and family (n = 319) | Doctors/healthcare providers (n = 540) | Other healthcare-related resources (n = 409) |
|----------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|--------------------------------------|------------------------------------------|
| **Parent characteristics** | | | | | | | | |
| Age (10-year increase) | 1.08 (1.00–1.16) | 0.94 (0.87–1.03) | 1.05 (0.97–1.14) | 0.87 (0.79–0.96) | 1.03 (0.96–1.11) | 1.09 (1.02–1.16) | 1.11 (1.03–1.19) |
| Gender (female vs. male) | 0.80 (0.60–1.07) | 0.84 (0.61–1.16) | 0.65 (0.48–0.89) | 0.95 (0.66–1.36) | 1.35 (0.997–1.82) | 1.19 (0.90–1.56) | 1.25 (0.94–1.65) |
| Race/ethnicity (Nonwhite vs. White/non-Hispanic) | 1.02 (0.75–1.41) | 1.04 (0.73–1.49) | 1.26 (0.89–1.78) | 0.98 (0.66–1.45) | 0.79 (0.57–1.09) | 0.94 (0.69–1.27) | 1.57 (1.16–2.12) |
| Education (bachelor’s degree and above vs. less than a bachelor’s degree) | 0.76 (0.56–1.02) | 1.65 (1.18–2.30) | 1.48 (1.07–2.04) | 1.26 (0.87–1.83) | 0.96 (0.71–1.30) | 0.81 (0.61–1.07) | 1.13 (0.85–1.50) |
| Concussion history (Yes vs. No) | 1.09 (0.80–1.49) | 0.63 (0.44–0.91) | 1.24 (0.89–1.74) | 0.79 (0.53–1.19) | 0.84 (0.61–1.15) | 1.07 (0.80–1.44) | 1.06 (0.79–1.42) |
| **Child characteristics** | | | | | | | | |
| Played organized sports within past year b | | | | | | | | |
| Yes, played noncontact/limited contact sports vs. No sports | 0.68 (0.42–1.10) | 0.78 (0.44–1.39) | 1.64 (0.94–2.83) | 1.45 (0.81–2.59) | 1.55 (0.96–2.50) | 0.95 (0.61–1.48) | 1.18 (0.75–1.87) |
| Yes, played contact sports vs. No sports | 0.84 (0.59–1.20) | 1.14 (0.76–1.71) | 1.66 (1.09–2.51) | 0.88 (0.56–1.40) | 1.89 (1.32–2.71) | 1.26 (0.91–1.74) | 1.76 (1.26–2.46) |
| Yes, played football vs. No sports | 0.95 (0.60–1.51) | 1.24 (0.74–2.07) | 2.56 (1.54–4.23) | 1.20 (0.68–2.13) | 1.29 (0.80–2.07) | 1.91 (1.24–2.96) | 1.89 (1.22–2.93) |
| Concussion history (Yes vs. No) c | 1.05 (0.71–1.54) | 1.56 (1.03–2.34) | 1.20 (0.80–1.79) | 1.03 (0.64–1.65) | 1.05 (0.71–1.55) | 0.58 (0.40–0.84) | 0.64 (0.44–0.93) |
| Aged 25 and older with at least a bachelor’s degree (%), 10% increase | 1.03 (0.91–1.15) | 1.15 (1.01–1.30) | 1.03 (0.91–1.17) | 1.09 (0.95–1.26) | 0.95 (0.85–1.07) | 1.04 (0.93–1.16) | 1.02 (0.91–1.14) |
| Residents who are nonwhite (%), 10% increase | 1.03 (0.96–1.10) | 0.98 (0.91–1.06) | 0.95 (0.89–1.02) | 1.06 (0.98–1.15) | 0.97 (0.91–1.04) | 0.99 (0.93–1.05) | 0.95 (0.89–1.01) |
| Households below poverty level (%), 10% increase | 1.18 (0.87–1.59) | 1.10 (0.79–1.52) | 1.20 (0.88–1.66) | 1.07 (0.75–1.55) | 1.07 (0.79–1.45) | 1.00 (0.76–1.33) | 1.04 (0.78–1.38) |
| Households with Internet subscription (%), 10% increase d | 1.16 (0.93–1.45) | 0.84 (0.66–1.07) | 0.94 (0.74–1.19) | 1.02 (0.77–1.35) | 1.05 (0.85–1.31) | 1.11 (0.90–1.36) | 0.92 (0.75–1.13) |

Note: Data are presented as adjusted odds ratios (95% confidence intervals).

a Multivariable logistic regression models predicted odds of use of each specific SRC information source; variables considered in model include those listed in table as well as use of the 6 other SRC information sources.

b Includes organized sports played at middle school or youth club/recreation leagues. Contact-level classifications originate from Rice et al.16 If children played multiple sports, they were categorized into the highest contact-level group (e.g., a child participating in ice hockey and tennis was classified in the “contact sports” category).

c Community-level characteristics correspond to the number of participants found to be residing within communities with those specific characteristics; data originated from the 2013–2017 American Community Survey (ACS) 5-year estimates and were matched by respondents’ self-reported zip code.

d Internet subscription includes: dial-up and broadband, including cellular data plan, cable, fiber optic, DSL, or satellite Internet service.

* Statistical significance (95% confidence interval does not include 1.00).

Abbreviations: DSL = digital subscriber line; SRC = sport-related concussion.
Concussions is constantly evolving. Consequently, public health practitioners must continually work to provide the public with up-to-date information on best practices as they evolve. As discussed previously, ensuring that healthcare-related resources provide current and accurate SRC-related information is critical in the provision of education regarding the prevention and management of SRC. For healthcare providers in particular, it may be helpful that such information occurs through Continuing Education opportunities that provide education as well as strategies that may help them effectively communicate with parents in order to debunk concussion-related misconceptions.

Last, we observed limited evidence of an association between community-level characteristics and the utilization of SRC-related information sources. Although we observed an association between indicators of community socioeconomic profile (percentage of residents with a bachelor’s degree) and utilization of national news sources, our results generally suggest that community characteristics may not factor into SRC information-seeking behaviors. However, we urge tempered inferences in this regard. The interplay between personal and community-level factors is difficult to reconcile in a single cross-sectional study. Previous research has noted the association of community-level factors and concussion education and prevention. Therefore, we suggest further examination of the effects of community characteristics on the concussion-reporting paradigm.

4.3. Limitations

As with all survey-based research, we acknowledge the limitations imposed by our chosen sampling scheme on the internal and external validity of our findings. However, we note that concerns related to the generalizability of our findings are at least partially mitigated by the nationwide sampling pool that SSI used to recruit participants for this study. Also, although we used data collected from nearly 80% of all respondents, we acknowledge the potential for differential profiles of parents who completed the survey, as compared with those who did not. Still, because our sample is U.S.-based, it is essential for continued research to examine populations from other countries to better understand the potential role of region-specific cultural norms that may be associated with information seeking.

Furthermore, it is important to note that our study was unable to determine whether the utilization of these specific sources was unique to seeking SRC-related information or whether it applies to general information seeking. Our examples provided for certain sources (e.g., The New York Times or Fox News as examples of national news sources) may have also influenced participant feedback. Also, although our study focused on the use and trustworthiness of these sources, future research should more directly examine the perceived quality and usefulness of the information provided. Further, future examination of information-seeking behaviors may benefit from gauging how the utilization of certain information sources may vary depending on the content being researched or the examples of each source provided.

Moreover, because this study focused on external sources of information, we were unable to account for how personal history influenced concussion knowledge. Finally, we also acknowledge that additional parent-, child-, and community-level factors exist that we were unable to collect through our questionnaire. This includes: parent occupation, which may be associated with parental SRC knowledge levels; parent insurance status, which may have affected information seeking from doctors/healthcare providers; and concussion histories of any older siblings of the MS children, which may have influenced concussion information-seeking behaviors. We therefore urge future studies to consider additional factors across each of the aforementioned levels, as well as the element of temporality (i.e., when the information was obtained relative to personal experiences with concussions), in further examining information-seeking behaviors related to concussions and concussion-reporting behaviors.

5. Conclusion

Previous literature suggests parents play a critical role in guiding healthcare decisions for their children following concussions (or suspected concussions). Our results highlight the variety of sources that parents of MS children may use to obtain SRC-related information. Although a majority of the sampled parents reported currently utilizing doctors/healthcare providers or other healthcare-related resources for SRC-related information, future research can aim to understand the reasons for nonutilization. Meanwhile, it is essential that all sources of SRC-related information include up-to-date, accurate, reliable, and trustworthy information to ensure that parents understand their children’s SRC-related risk and how to prevent and manage such injuries.

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Authors’ contributions

ZYK conceived the study, led its design and coordination, and led the drafting of the manuscript; JKR M assisted in the conception of the study, led its design and coordination, and assisted in the drafting of the manuscript; AC, AKN, MCK,
Competing interests

The authors declare that they have no competing interests.

References

1. Kerr ZY, Register-Mihalik JK, Haarbaucer-Krupa J. et al. Using opinion leaders to address intervention gaps in concussion prevention in youth sports: Key concepts and foundational theory. *Inj Epidemiol* 2018;5:28. doi:10.1186/s40621-018-0158-7.

2. McCrea M, Hammeke T, Olsen G, Leo P, Guskwicz K. Unreported concussion in high school football players: Implications for prevention. *Clin J Sport Med* 2004;14:13–7.

3. McDonald T, Burghart MA, Nazir N. Underreporting of concussions and concussion-like symptoms in female high school athletes. *J Trauma Nurs* 2016;23:241–6.

4. Register-Mihalik JK, Guskwicz KM, McLeod TC, Linnan LA, Mueller FO, Marshall SW. Knowledge, attitude, and concussion-reporting behaviors among high school athletes: A preliminary study. *J Athl Train* 2013;48:645–53.

5. Kerr ZY, Register-Mihalik JK, Marshall SW, Evenson KR, Mihalik JP, Guskwicz KM. Disclosure and non-disclosure of concussion and concussion symptoms in athletes: Review and application of the socio-ecological framework. *Brain Inj* 2014;28:1009–21.

6. McCrory P, Meeuwisse W, Dvorak J, et al. Consensus statement on concussion in sport-the 5th international conference on concussion in sport held in Berlin, October 2016. *Br J Sports Med* 2017;51:338–47.

7. Register-Mihalik IK, Linnan LA, Marshall SW, McLeod TC, Mueller FO, Guskwicz KM. Using theory to understand high school aged athletes’ intentions to report sport-related concussion: Implications for concussion education initiatives. *Brain Inj* 2013;27:877–86.

8. Zandieh SO, Gershel JC, Briggs WM, Mancuso CA, Kuder JM. Revisiting predictors of parental health care-seeking behaviors for nonurgent conditions at one inner-city hospital. *Pediatr Emerg Care* 2009;25:238–43.

9. Haarbaucer-Krupa J, Lee AH, Bitsko RH, Zhang X, Kresnow-Sedacca MJ. Prevalence of parent-reported traumatic brain injury in children and associated health conditions. *JAMA Pediatr* 2018;172:1078–86.

10. Lin AC, Salzman GA, Bachman SL, et al. Assessment of parental knowledge and attitudes toward pediatric sports-related concussions. *Sports Health* 2015;7:124–9.

11. Zrelak PA. Sex-based differences in symptom perception and care-seeking behavior in acute stroke. *Perm J* 2018;22:18–42.

12. Corrigan PW, Druss BG, Perlack DA. The impact of mental illness stigma on seeking and participating in mental health care. *Psychol Sci Public Interest* 2014;15:37–70.

13. Cook CE, O’Connell NE, Hall T, et al. Benefits and threats to using social media for presenting and implementing evidence. *J Orthop Sports Phys Ther* 2018;48:3–7.

14. Register-Mihalik JK, Baugh C, Krosnos E, Kerr ZY, McLeod TC. A multifactorial approach to sport-related concussion prevention and education: Application of the socioecological framework. *J Athl Train* 2017;52:195–205.

15. Haarbaucer-Krupa J, Arboagast KB, Metzger KB, et al. Variations in mechanisms of injury for children with concussion. *J Pediatr* 2018;197:241–8.

16. Rice RG. American Academy of Pediatrics Council on Sports Medicine and Fitness. Medical conditions affecting sports participation. *Pediatrics* 2008;121:841–8.

17. Kerr ZY, Chandran A, Nedimyer AK, Arakkal A, Pierpoint LA, Zucker- man SL. Concussion incidence and trends in 20 high school sports. *Pediatrics*. 2019;e20192180. doi:10.1542/peds.2019-2180.

18. Kerr ZY, Cortes N, Caswell AM, Ambegaonkar JP, Hallsmith KR, Milbert AF. Concussion rates in U.S. middle school athletes, 2015–2016 school year. *Am J Prev Med* 2017;53:914–8.

19. Ahmed OH, Sullivan SJ, Schneider AG, McCrory PR. Concusion information online: Evaluation of information quality, content and readability of concussion-related websites. *Br J Sports Med* 2012;46:675–83.

20. Ahmed OH, Hall EE. “It was only a mild concussion”: Exploring the description of sports concussion in online news articles. *Phys Ther Sport* 2017;23:7–13.

21. Ahmed OH, Blake T, Hall EE. Educating the masses: Suggestions for improving online concussion information via the mainstream media. *Concussion* 2016;2:C27. doi:10.2217/cnc-2016-0026.

22. Haarbaucer-Krupa JK, Comstock RD, Lionbarger M, Hirsch S, Kavee A, Lowe B. Healthcare professional involvement and RTP compliance in high school athletes with concussion. *Brain Inj* 2018;32:1337–44.

23. Yang J, Comstock RD, Yi H, Harvey HH, Xun P. New and recurrent concussions in high-school athletes before and after traumatic brain injury laws, 2005–2016. *Am J Public Health* 2017;107:1916–22.

24. Sullivan SJ, Schneider AG, Cheang CW, et al. “What’s happening?” A content analysis of concussion-related traffic on Twitter. *Br J Sports Med* 2012;46:258–63.

25. Turcotte J, York C, Irving J, Scholl RM, Pingree RJ. News recommendations from social media opinion leaders: Effects on media trust and information seeking. *J Comput Mediat Commun* 2015;20:520–35.

26. Feinberg I, Frijters J, Johnson-Lawrence V, Greenberg D, Nightingale E, Moodie C. Examining associations between health information seeking behavior and adult education status in the US: An analysis of the 2012 PIAAC data. *PloS One* 2016;11:e0148751. doi:10.1371/journal.pone.0148751.

27. Krosnos E, Kerr ZY, Lee JG. Community-level inequalities in concussion education of youth football coaches. *Am J Prev Med* 2017;52:476–82.

28. Wallace J, Covassin T, Noggle S, Gould D, Kovar J. Concussion knowledge and reporting behavior differences between high school athletes at urban and suburban high schools. *J Sch Health* 2017;87:665–74.

29. Post E, Winterstein AP, Hetzel SJ, Lutes B, McGuine T. A school and community socioeconomic status and access to athletic trainer services in Wisconsin secondary schools. *J Athl Train* 2019;54:177–81.