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The School-Based Speech-Language Pathologist and Students With Concussion: An Examination of Evolving Knowledge and Confidence

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ABSTRACT

Purpose: This study examines school-based speech-language pathologists' (SLPs') experience, knowledge, and confidence in supporting students as they return to the classroom following concussion, with a particular focus on knowledge of new management guidelines over the last decade.
Method: Participants were 74 school-based SLPs who completed an electronic survey about their knowledge and experiences serving students with concussion. We examined participants' accuracy and confidence across knowledge questions using Kruskal–Wallis tests. We also conducted linear regression to explore the relationships between training, work experiences, knowledge, and confidence.
Results: Nearly half of participants who are currently working with students with concussion reported having no clinical or training experiences related to concussion. Participants who had more concussion-related training or working experiences reported higher confidence. Participants were confident about general concussion knowledge but less confident about providing assessment and supporting students with concussion as they returned to school. Participants had the lowest confidence and accuracy for the most recent guidelines around rest and activity, as well as the differential impact of concussion on children as compared to adults.
Conclusions: Many school-based SLPs have limited training around concussion management and are often not specifically consulted to work with students following concussion. Despite this, SLPs have good awareness of their knowledge about concussion, but show gaps in knowledge surrounding more recent evidence-based guidelines. Additional investigation is needed to determine better ways to move research into clinical practice and to increase the involvement of SLPs in school-based concussion teams.
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Mild traumatic brain injury (mTBI), or concussion, in youth accounts for approximately 85% of the nearly 700,000 visits to emergency departments annually in the United States (Rivara et al., 2011; Taylor et al., 2017). These numbers are likely an underestimate of the total number of concussions experienced by children and adolescents, as one study reported that nearly 75% of pediatric concussions entered a large, urban hospital system through primary care providers/pediatricians, and not the emergency department (Arbogast et al., 2016). The growing body of research on youth with concussion indicates that the median recovery time is approximately 1 month (Barlow et al., 2015; McCrory et al., 2017), but up to 30% of children may continue to exhibit physical, behavioral, or cognitive symptoms 3 months or more following their injury (Barlow et al., 2010, 2015; Taylor et al., 2015).

Following a concussion, Centers for Disease Control and Prevention (CDC) guidance for Return-to-Learn

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(RTL) suggests that students should return to school within 2–3 days of the injury (Lumba-Brown et al., 2018). Since recommendations now encourage students to return to school before symptoms may be fully resolved, it is essential that school personnel understand the effects of a concussion on a student's academic performance and the general recovery trajectory (Brown et al., 2019; Lundine et al., 2019). There are a wide range of symptoms that students might experience during their recovery that can impact academic performance. Physically, students may have headaches or fatigue. Behavioral sequelae can include problems with social relationships and attention (Taylor et al., 2015; Yeates, 2010). Neurocognitive symptoms may include slowed processing speed, decreased memory, and difficulty with problem solving (Wasserman et al., 2017). It is recommended that students return to academic and physical activities slowly, and in a manner that does not exacerbate symptoms, while also closely monitoring number and severity of symptoms (Lumba-Brown et al., 2018; McAvoy et al., 2018). Furthermore, if RTL is not titrated carefully, students may experience prolonged symptomatology (DeMatteo, Lin, et al., 2019; DeMatteo, Randall, et al., 2019).

In 2015, Duff and Stuck published results from a survey of 258 school-based speech-language pathologists (SLPs) regarding their knowledge and practice patterns for students with concussion. Their findings serve as a baseline for U.S. school-speech-language pathology practice regarding concussion management for children and adolescents. Since 2015, much research has been published and increased attention has been paid to youth concussion specifically. As of 2017, all 50 states have laws addressing returning students to play following a suspected sports-related concussion (Potteiger et al., 2018). In 2018, the CDC published guidelines specifically related to mTBI in children (Lumba-Brown et al., 2018), and in 2020, the most recent International Consensus on Concussion in Sports was published (Rivara et al., 2020). Management guidelines have changed over the last decade from recommending strict rest, also referred to as "cocooning," to only a 24- to 48-hr period of rest, followed by return to moderate levels of activity to slowly increase return to everyday activities without exacerbating symptoms.

The knowledge translation literature suggests that it takes 17 years for research findings to reach standard clinical practice (Green et al., 2009). Considering the research-to-practice gap, clinical practice must somehow respond to the significant changes in concussion management that have developed over the last 10 years. Rapid updates to the research evidence surrounding youth concussion make it difficult for clinicians to stay up-to-date with the newest recommendations (O'Brien, 2020). In a 2019 survey, SLPs reported limited training related to providing intervention for children with TBI (Pelatti et al., 2019), indicating that the perception of insufficient training has changed little over many years (Duff & Stuck, 2015; Hux et al., 1996). Even for SLPs who frequently encounter TBI, knowledge and confidence related to working with this population is mixed (Morrow et al., 2020; Riedeman & Turkstra, 2018).

Researchers and educational personnel must understand where gaps persist in training school-based professionals to respond to students with concussion and best approaches for closing these gaps. SLPs are well positioned to assist students with concussion during their recovery, but it is necessary to understand if their knowledge is keeping up with the latest guidelines. Therefore, this study first aimed to update our understanding of school-based SLPs' knowledge and experience as it relates to students with concussion. In particular, we focused on confidence, both implicit and explicit, and how specific types of training experiences interact with knowledge and confidence. We hypothesized that training and experience working with people with concussion or brain injury in the past would be related to greater accuracy on knowledge items and higher confidence ratings. However, we also anticipated that few participants would have received such training or had relevant experiences, and that knowledge and confidence would not be related to each other. Furthermore, in updating how knowledge and understanding of youth concussion has changed since Duff and Stuck's (2015) study, a secondary aim was to evaluate if the research-to-practice latency (Green et al., 2009) appears to be impacting concussion knowledge and practice for school-based SLPs. Specifically, we hypothesized that more recently published research and clinical guidelines around rest and return to activity following concussion would be least well known or understood by practicing clinicians (e.g., Lumba-Brown et al., 2018; McCrory et al., 2017).

Method

School-based SLPs completed an online survey as a quantitative measure of training, experience, confidence, and knowledge about concussion. All research activities were conducted with the oversight and approval of the institutional review boards at the University of Georgia and The Ohio State University.

Participants

All participants self-reported being currently employed SLPs with schools as their primary setting. A Qualtrics link was distributed through listservs with the American Speech-Language-Hearing Association Special Interest Group on Language Learning and Education (SIG 1), state professional organizations, social media, and local school districts. Participants provided informed consent

prior to completing the survey. Participants' responses were included in the analyses if they were eligible for speech-language pathology licensure, completed both the demographics and knowledge sections of the survey, and had a primary employment setting of schools. No other inclusion or exclusion criteria were applied. In total, 89 participants responded to the survey, and 74 responses were included in data analysis.

Survey Materials

The survey consisted of three blocks addressing the following: (a) background and experiences, (b) training, and (c) confidence and knowledge. Because of embedded logic, participants saw a range of questions from a minimum of 37 to a maximum of 45. The first block addressed demographic and background information, including current and past employment, and current and past experience working with people with concussion or TBI (moderate or severe injuries). Questions were a mix of multiple-choice and constant sum percentages, in which participants entered the percent of time spent working in a setting with the total adding to 100%, for example. This block also asked respondents if they had any training related to concussion. If respondents indicated "yes," then a second block appeared with six questions about type and timing of previous concussion training experiences. All respondents were presented with the third block in which they rated their confidence in their knowledge and ability to provide services to a student with concussion using a sliding scale from 0 (*no confidence*) to 100 (*very high confidence*) along five dimensions.

Lastly, participants responded to 20 statements about concussion and concussion management using a 5-point Likert scale. Ten statements were designed to be true (so that "strongly agree" or "agree" would be accurate), and 10 statements were false (so that "strongly disagree" or "disagree" would be accurate). Statements 1 through 12 were based on those of Duff and Stuck (2015), and eight additional statements were added to reflect the most updated recommendations for management of pediatric concussion (Lumba-Brown et al., 2018; McCrory et al., 2017). Statements were reviewed by the first two authors, one SLP working in the schools, and two additional researchers working in this area, including the first author of the previously published study on which this study was based (Duff & Stuck, 2015). The school-based SLP previously worked in a pediatric brain injury setting and now serves as her school district's TBI mentor, providing guidance to SLPs who have a student with TBI on their caseload. Statements were reviewed for face validity, accuracy, and clarity; as a result, Statement 14 was adjusted to specify the time frame after injury. Next, the survey was piloted with four practicing SLPs and two graduate students. At the completion of the survey, participants were asked if they would like to provide their contact information for possible inclusion in future studies. The complete survey is available in Supplemental Material S1.

Data Analysis

Descriptive statistics (i.e., sample sizes and percentages) were used to describe participants' background, including their professional experiences, current work settings, and concussion-related work and training experiences. Fisher's exact test compared participants' work experiences related to moderate-to-severe TBI and concussion populations. Participants' confidence in providing services to students with concussion was represented by ratings of explicit confidence and implicit confidence. Explicit confidence referred to participants' responses to statements that directly asked about their confidence in working with students with concussion (e.g., "Please rate your confidence about your general knowledge of concussion."). Implicit confidence was transformed from participants' responses to the 20 knowledge-related questions. Specifically, "strongly agree" or "strongly disagree" were coded as 5, indicating greatest confidence in a response; "somewhat agree" or "somewhat disagree" were coded as 3, moderate confidence; and "neither agree nor disagree" was coded as 1, meaning low confidence. Means and standard deviations were calculated to demonstrate participants' levels of confidence and knowledge. As the responses to explicit confidence and knowledge statements were not normally distributed, Kruskal–Wallis tests examined the differences across these responses. To better determine how areas of accuracy and confidence might be targeted in future training, accuracy and implicit confidence were plotted against each other in a quadrant graph to create four domains of knowledge: *secure* (high accuracy and high confidence), *underconfident* (high accuracy and low confidence), *realistic* (low accuracy and low confidence), and *overconfident* (low accuracy and high confidence). To address the knowledge differences between old and new guidelines, we used a t test to compare scores of Items 1–12 and scores of Items 13–20. Using simple linear regression, we examined the relationships between implicit and explicit confidence, knowledge, and concussion-related training and work experiences.

Results

Background Information

Survey respondents included 89 SLPs working in educational settings. Because 13 completed only the background questions and two reported a bachelor's as their

highest degrees (and therefore not eligible for licensure at SLPs), these participants' responses were removed from analysis, resulting in 74 total participants. Elementary and pre-K were the primary past and current work settings for most of the sample. As expected, given inclusion criteria that schools are the primary work setting for participants, just 3% were also currently working in medical settings, and up to 17.6% reported past employment in acute care, rehabilitation settings, or skilled nursing facilities (see Table 1). According to Fisher's exact test, participants had significantly more clinical experience with people with TBI in general (e.g., moderate-to-severe injuries), than those with concussion specifically ($p < .001$). Nearly half of participants reported having no work experiences with people with concussions currently or in the past, whereas the same number of participants reported past work experiences with TBI.

Among the 32 participants who reported experience with students who had concussion, 20 indicated that they interacted with one to five students with concussions each year. Only nine participants reported their school district having a concussion team, and only one participant was a member of the concussion team (see Table 2). Four of eight SLPs who are currently working with students with concussion reported having no training experiences related to providing care to people with concussion, and three also reported not having related clinical experiences with people with concussion. For participants who reported working with students with concussion in the past, about half reported having concussion training ($n = 3$), whereas the rest reported no specific training ($n = 4$; see Table 3).

Table 1. Educational and work experiences of survey participants ($N = 74$).

Variable	*n* (%)
Years of experience	
1–5	21 (28.4)
6–10	12 (16.2)
11–15	9 (12.2)
16–20	8 (10.8)
21+	23 (31.1)
Education level	
Master's	67 (91)
SLPD	3 (4.1)
PhD	2 (2.7)
Other (Eds, MD, specialist degree)	2 (2.7)
Work hours	
≥ 40	38 (27.8)
30–39	27 (36.5)
20–29	5 (6.8)
10–19	3 (4.1)
Composition of current work setting	
Early intervention	8 (10.8)
Elementary and pre-K	58 (78.3)
Middle school/junior high	21 (28.4)
High school	17 (23)
Other (outpatient pediatrics, etc.)	6 (8)
The composition of past work setting	
Early intervention	26 (35.1)
Elementary and pre-K	70 (94.6)
Middle school/junior high	45 (60.8)
High school	30 (40.5)
Private practice–pediatric	19 (25.7)
Private practice–adult	2 (2.7)
Private practice–pediatric and adult	3 (4.1)
Acute care	11 (14.9)
Inpatient rehabilitation–pediatric	4 (5.4)
Inpatient rehabilitation–adult	6 (8.1)
Outpatient rehabilitation–pediatric	2 (2.7)
Outpatient rehabilitation–adult	12 (16.2)
Community re-entry	8 (10.8)
Skilled nursing facility	13 (17.6)
Other	3 (4.1)

Note. These questions asked respondents to estimate the percentage of time they spent in each work setting. We reported the number and percentage of people who had experiences in each setting. SLPD = doctor of speech-language pathology; PhD = doctor of philosophy; EdS = educational specialist; MD = doctor of medicine.

Table 2. Concussion-related work experiences ($N = 74$).

Response	*n* (%)
Clinical experience with concussion	
Yes, currently	1 (1.4)
Yes, in the past	25 (33.8)
Yes, both currently and in the past	6 (8.1)
No	42 (56.8)
Clinical experience with TBI	
Yes, currently	5 (6.8)
Yes, in the past	44 (59.5)
Yes, both currently and in the past	9 (12.2)
No	16 (21.6)
Current work with students with concussion	
Yes, currently	3 (4.1)
Yes, in the past	7 (9.59)
Yes, both currently and in the past	5 (6.8)
No	39 (52.7)
Number of students with concussion	
0	52 (70.3)
1–5	20 (27.0)
Concussion team in school district	
Yes	9 (12.2)
No	35 (47.3)
Not sure	30 (40.5)
Member of concussion team	
Yes	1 (1.4)
Not currently	1 (1.4)
No	7 (9.5)

Table 3. Concussion-related training and experiences of working with students with concussion.

Concussion-related working experiences	Concussion-related training experiences		
	Yes	No	Not sure
Currently	1	2	0
In the past	3	4	0
Both currently and in the past	3	2	0
No	20	36	3

In total, 36.5% of total participants reported receiving concussion-related training or education, which was mostly from graduate school and postgraduate continuing education courses. Three participants received concussion training in their undergraduate programs. Out of the 21 participants who indicated receiving concussion-related training in graduate or undergraduate education, the training typically took the form of single or multiple lectures within a larger class (e.g., lecture(s) in an acquired language disorders class). Only 10 participants had practicum experiences working with individuals who sustained a concussion. Other sources of concussion training were primarily in-service presentations, followed by seminars at conferences, training for parents or coaches, and informal online resources (see Table 4). Most participants received concussion training from up to six resources (i.e., nine participants from one to three sources, 10 participants from four to six sources, whereas three participants from seven to nine resources).

Table 4. Concussion-related training experiences.

Response	*n* (%)
Received concussion-related training (*n* = 74)	
No	44 (59.5)
Not sure	3 (4.1)
Yes	27 (36.5)
Concussion training received at (*n* = 26)	
Undergraduate	3 (11.5)
Graduate	18 (69.2)
Continuing education	13 (50)
Personal interest (not CE or employment related)	6 (23)
Other	8 (30.8)
Clinical practicum experiences with concussion (*n* = 20)	
Yes	10 (50)
No	10 (50)
Type of training experiences for undergraduates (*n* = 3)	
A single lecture	2 (66.7)
More than one lecture	1 (33.3)
Type of training experiences for graduates (*n* = 18)	
A full course on concussion	2 (11.1)
A single lecture	3 (16.7)
Guest lecture outside of class	1 (5.6)
More than one lecture	11 (61.1)
Other	1 (5.6)
Sources of concussion training (*n* = 30)	
Seminar(s) at a conference	8 (26.7)
Online resources from national organizations (like American Speech-Language-Hearing Association or the CDC)	8 (26.7)
Talking with peers or mentors	8 (26.7)
Personal experience of concussion	8 (26.7)
In-service presentations	7 (23.3)
Self-study–reading articles for CE credit	7 (23.3)
Reading journal articles (not for CE credit)	7 (23.3)
Training for parents or coaches related to sports participation	6 (20.0)
Reading books or book chapter	5 (16.7)
Half- or full-day workshop or conference	5 (16.7)
Shadowing another professional	5 (16.7)
Informal online resources such as blogs or social media groups	4 (13.3)
Webinars	4 (13.3)
CDC Heads Up	3 (10.0)
Poster sessions	3 (10.0)
Other	1 (3.3)

Note. Questions related to descriptions of training experiences were not displayed to participants who indicated not having received any concussion trainings. Participants were able to select multiple responses so that the total occurrence of each option was presented in the table, but may not match the number of participants. Number of people who received training from each source are listed in the table. CE = continuing education; CDC = Centers for Disease Control and Prevention.

Confidence About Concussion Knowledge

Means and standard deviations of responses to statements assessing the confidence of SLPs as it relates to concussion are shown in Table 5. No outliers were detected. According to results of a Kruskal–Wallis test, levels of explicit confidence differed significantly across the five confidence statements (Kruskal–Wallis $\chi^2 = 12.35$, $df = 4$, $p = .015$). A Dunn test with Bonferroni correction was used for post hoc analysis. Results showed that levels of explicit confidence for both "My general knowledge about concussion" ($M = 48.9$, $SD = 26.8$) and "My ability to serve as a member of an interdisciplinary team for a student with concussion" ($M = 48.8$, $SD = 31.1$) were significantly higher than for "My ability to provide assessment for a student with concussion" ($M = 33.9$, $SD = 25.7$).

Simple linear regression revealed positive associations between explicit confidence and concussion-related training experiences, adj $R^2 = .16$, $F(2, 59) = 6.95$, $p = .002$. SLPs with more concussion training were likely to report higher confidence working with students with concussions. Moreover, compared to clinicians who have no experiences working with concussion, clinicians who have working experiences with individuals with concussion in the past, or both currently and in the past, are likely to have higher confidence level, adj $R^2 = .32$, $F(3, 58) =$

Table 5. Explicit confidence ratings.

Statements	Levels of confidence *M* (*SD*)
My general knowledge about concussion (*n* = 66)	48.9 (26.8)
My ability to provide assessment for a student with concussion (*n* = 63)	33.9 (25.7)
My ability to provide treatment for a student with concussion (*n* = 63)	41.1 (28.9)
My ability to make recommendations about academic adjustments or accommodations for a student with concussion (*n* = 65)	44.9 (28.8)
My ability to serve as a member of an interdisciplinary team for a student with concussion (*n* = 62)	48.8 (31.1)

Note. Responses were provided using a 0–100 scale.

Table 6. Accuracy on concussion knowledge items (n = 66).

Statements	*M* (*SD*)	Range
1. Loss of consciousness is required for a diagnosis of concussion.	4.32 (0.98)	2–5
2. **A concussion is a brain injury.**	4.78 (0.48)	3–5
3. Children show better recovery from concussion than older individuals.	2.26 (0.97)	1–5
4. **The signs and symptoms of concussion can overlap with symptoms of other disorders such as depression, anxiety, and attention-deficit disorder.**	4.14 (0.84)	2–5
5. Recovery from a concussion is complete when the individual is asymptomatic.	3.83 (0.93)	2–5
6. **Concussion makes an individual more vulnerable for a subsequent injury.**	4.36 (0.64)	1–5
7. **Concussion can affect academic performance.**	4.80 (0.64)	1–5
8. **A standardized protocol or return to play guideline is important for determining when a student returns to competitive play.**	4.48 (0.95)	1–5
9. Concussions result in structural damage that is visible on CT or MRI scans.	3.29 (1.02)	1–5
10. Multiple concussions are required to observe long-term cognitive deficits.	3.70 (1.31)	1–5
11. **Concussions can occur in individual or group recreational sport or activity.**	4.83 (0.45)	3–5
12. **A repeated concussion that occurs before the brain recovers from the first can slow recovery or increase the likelihood of having long-term problems.**	4.71 (0.55)	3–5
13. **It is common for it to take up to a month for students to recover from concussion.**	4.12 (0.95)	1–5
14. Return to any level of cognitive or physical activity in the weeks following concussion is dangerous.	2.80 (1.23)	1–5
15. Best care following concussion is for the student to be "cocooned" in their room with limited stimulation until all symptoms resolve.	3.44 (1.14)	1–5
16. **Students who return to moderate levels of physical and cognitive activity within the first week after their injury tend to have the quickest recovery.**	2.56 (1.02)	1–5
17. Serial testing after concussion (testing each day until the student returns to baseline performance) is the best way to measure recovery.	3.14 (0.85)	1–5
18. In order to receive short term accommodations following concussion, students must go through an IEP process.	4.27 (1.02)	1–5
19. It is typical for a single concussion to result in long-term cognitive deficits.	3.48 (1.22)	1–5
20. **Physical effects of concussion, like headaches or light sensitivity, can impact academics as much as cognitive effects.**	4.48 (0.66)	3–5

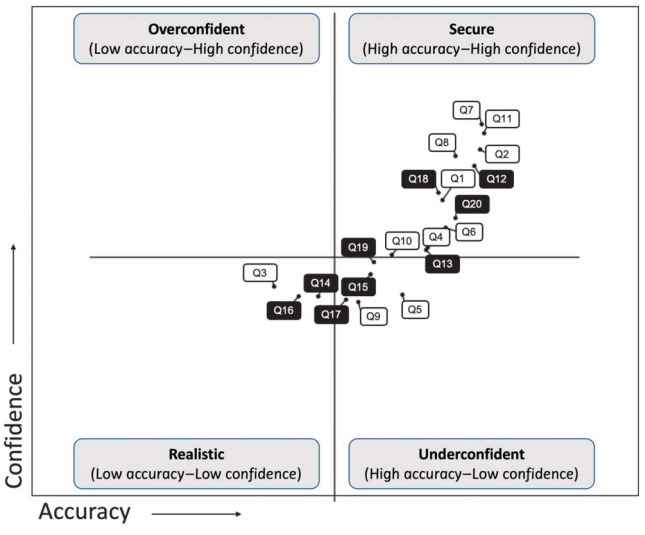
Note. Items were rated on a 5-point scale from strongly disagree to strongly agree. Bolded items are true. Items that were false were reverse scored so that five indicates greater accuracy for all items. Items 1–12 are from Duff and Stuck (2015), whereas Items 13–20 were added for this study.

10.76, $p < .001$. Working clinically with people with concussion explained 32% of the variance in explicit confidence. Explicit confidence was not correlated with having current concussion-related working experience, adj $R^2 = -.03$, $F(3, 58) = 0.39$, $p = .76$, the number of students with concussion with whom SLPs interact in a given year, adj $R^2 = .24$, $F(2, 59) = 10.42$, $p = .76$, nor to participants' working experiences with people with TBI in general, adj $R^2 = .06$, $F(3, 58) = 1.19$, $p = .38$. Additionally, explicit confidence was not significantly associated with accuracy on knowledge statements, adj $R^2 = .04$, $F(1, 55) = 2.35$, $p = .13$.

Concussion Knowledge

A Kruskal–Wallis test was conducted to test differences in participants' responses to the knowledge statements. Results showed that accuracy varied significantly across the 20 items (Kruskal–Wallis $\chi^2 = 535.71$, $df = 19$, $p < .001$; see Table 6). To describe the relationship between accuracy and implicit confidence, mean accuracy was plotted against mean implicit confidence for each item. As depicted in Figure 1, 11 items were found to be *secure,* meaning that both accuracy and confidence was high. Six items fell into the *underconfident* quadrant, with participants showing high accuracy, but low confidence. Underconfident items included, "Concussions result in structural damage that is visible on CT or MRI scans,"

Figure 1. Item level analysis by confidence and accuracy. Item numbers correspond to statements in Table 6. New items (12 through 20) are presented with a black background.



and "Serial testing after concussion (testing each day until the student returns to baseline performance) is the best way to measure recovery." Just three items were in the *realistic* quadrant, indicating low accuracy, but also low confidence. These items were as follows: "Children show better recovery from concussion than older individuals," "Return to any level of cognitive or physical activity in the weeks following concussion is dangerous," and "Students who return to moderate levels of physical and cognitive activity within the first week after their injury tend to have the quickest recovery." No items were found in the *overconfident* quadrant, in which high confidence is erroneously paired with low accuracy.

Items 1–12 are from Duff and Stuck (2015), whereas Items 13–20 were added for this study. To further analyze the knowledge and implicit confidence differences for more recently published research and clinical guidelines compared to the previous guidelines, we conducted a t test between scores from Items 1–12 and Items 13–20. t tests showed that both accuracy, $t(121.84) = 28.91$, $p < .001$, and implicit confidence, $t(107.53) = 13.72$, $p < .001$, were lower for items that represented recent guidelines, indicating the gap in research evidence and information accessible to clinical practitioners (see Table 7).

The only employment, education, or training factor that was related to concussion knowledge levels was current work experiences with people with TBI, adj $R^2 = .03$, $F(3, 59) = 1.66$, $p = .04$. The relationship was negative, indicating that participants who were currently working with the TBI population tended to score lower on knowledge questions. Other variables such as training experience, adj $R^2 = .03$, $F(1, 58) = 3.05$, $p = .09$, and clinical experiences working with persons with concussion were not related to concussion knowledge, adj $R^2 = -.002$, $F(3, 59) = 0.95$, $p = .42$.

Discussion

This study focused on two aims: (a) examine the implicit and explicit confidence of school-based SLPs regarding RTL procedures for students with concussion and how specific training experiences interact with their knowledge and confidence, and (b) evaluate if SLPs demonstrate knowledge differences for more recently published research and clinical guidelines compared to older guidelines. Overall, training experience was more common than clinical experience working with this population of students, but based on this sample of school-based SLPs, training experiences were relatively limited also. Results showed that SLPs who had experience working with people with concussion had higher explicit confidence, but explicit confidence was not related to knowledge. SLPs had the lowest implicit confidence and accuracy on items related to more recently published recommendations, as well as the differential impact of concussion on children as opposed to adults, thus demonstrating both difficulties with updated clinical guidelines as well as long-standing evidence about the risks of brain injury in children. Item-level analysis revealed participants to be overall well calibrated in terms of tending to be less confident about incorrect responses and more confident in correct responses.

Training Experiences

As expected, very few of the SLPs who completed the survey portion of this study had current or past experience working with students who had concussion, and most SLPs reported that their concussion-related training came from "a few lectures" during graduate or undergraduate education. Importantly, in line with Pelatti et al.'s (2019) recent findings that SLPs are more comfortable serving students with TBI when they have greater experience and training, SLPs in our survey who reported more training related to concussion were also likely to report higher levels of confidence in working with students with concussion. However, working with students who had concussion was not similarly related to increased levels of confidence, perhaps indicating that SLPs currently working with students with concussion did not necessarily select that role based on prior experiences. Instead, students

Table 7. Comparison of implicit confidence and accuracy between old item group (Items 1–12) and new item group (Items 13–20).

Variable	Item1–12 (*M*)	Item13–20 (*M*)	*T* score	*p* value
Implicit confidence	3.55	2.95	13.72	< .001
Accuracy	4.13	3.54	28.91	< .001

Note. For implicit confidence, "strongly agree" or "strongly disagree" were coded as five, "somewhat agree" or "somewhat disagree" were coded as three, and "neither agree nor disagree" was coded as one. For accuracy, "strongly agree" was coded as five, "somewhat agree" as four, "neither agree nor disagree" was coded as three, "somewhat disagree" as two, "Strongly disagree" was coded as one. Accuracy of Items 1,3, 5, 9, 10, 14, 15, 17, 18, and 19 were reversely coded. Means of implicit confidence and accuracy were calculated separately for the old item group (Items 1–12) and new item group (Items 13–20).

may have been assigned to their caseload regardless of that SLP having seen children with TBI or concussion in the past, or this may be a new employment setting or service population.

SLPs reported higher levels of explicit confidence for their general knowledge about concussion and their ability to serve on an interdisciplinary team than they did about their ability to assess a student with concussion adequately and appropriately. Williams-Butler and Cantu (2019) identified assessment of persons with concussion as a particular area of need, finding in their survey of SLPs that use of screening tools during assessment was common. Such tools are quick to administer, but do not provide the detail necessary to design intervention and are not particularly sensitive to the subtle deficits that persons with concussion may experience. Using a blend of subjective and objective measures is also common, but even SLPs working primarily with people with concussion report encountering multiple barriers to instrument selection (Hardin et al., 2021). For example, many objective tools are not sensitive to subjective complaints, not all are normed for younger students, few connect meaningfully to RTL or academic activities, and some respondents noted concerns about formal assessment triggering symptom flares. Together, assessment appears to be a particular area of need to define and refine SLP practice in the area of concussion, especially for students under the age of 18 years.

As hypothesized, in our sample of school-based SLPs, explicit confidence about concussion was not related to knowledge about concussion. Similar findings have been observed across both concussion and TBI knowledge (Rieger et al., 2018). In effect, a *feeling* of knowledge does not necessarily equate to having that knowledge. Confidence can often lead people astray, as in a personal experience of concussion may increase a person's confidence without increasing the accuracy of their understanding of concussion effects or management (Weber & Edwards, 2012). Similarly, the well-known Dunning-Kruger effect states that those with the least knowledge often have the greatest confidence by virtue of not knowing what is not known, whereas expertise is more closely associated with low confidence (Kruger & Dunning, 1999). This effect has been found in one direction for health care providers (Oyesanya et al., 2017) who rated themselves as having low experience with TBI but high expertise, whereas the other direction was suggested in a survey of SLPs in which practitioners who regularly serve people with TBI still identified areas of need in their skillset (Riedeman & Turkstra, 2018). Similarly, Morrow et al. (2020) found that only about two thirds of acute care SLPs consider themselves to be the most knowledgeable care team member about cognitive-communication disorders arising from TBI, even though all regularly provided care to this population. Although low to moderate confidence is associated with knowledge-seeking behaviors meant to improve performance (Berner & Graber, 2008; Meyer et al., 2013), persistent low confidence can also erode self-efficacy and even lead to avoidance (Zamani-Alavijeh et al., 2019). Encouragingly, item-level analysis indicates that SLPs in this survey were well calibrated about their needs. Most items fell into the *secure* quadrant and thus were accurately calibrated to be both correct and with participants responding assuredly. No items fell into the *overconfident* quadrant, indicating poor accuracy but high confidence. Six items were classified as representing *underconfidence,* in which answers were largely accurate, but participants were less sure of their response (e.g., "Recovery from a concussion is complete when the individual is asymptomatic"). Those items may indicate areas where these SLPs are seeking knowledge (Berner & Graber, 2008; Meyer et al., 2013). While this analysis focused on items rather than participants, it appears that SLPs in the sample were largely aware of gaps in their knowledge base. Items in the *realistic* quadrant (see Figure 1) are addressed below, as those largely agreed with the hypothesis of our second research aim.

New Knowledge Translation

On concussion knowledge questions, respondents showed some persistent difficulty on items that were originally challenging on the 2015 Duff and Stuck survey and decreased accuracy on questions related to more recently published concussion guidelines, in line with O'Brien's (2020) discussion of both foundational and flexible clinical knowledge posing challenges to clinicians in treatment of pediatric concussion. Three items fell in the *realistic* quadrant, indicating that participants were unsure but aware that they may be incorrect about some critical aspects of concussion management. As in Duff and Stuck's (2015) original study, even SLPs in this study who are currently working with children and adolescents maintain a persistent belief that children show better recovery from concussion than adults. This is despite an increasing body of research focusing on young people with concussion, and that the window of recovery is typically defined as being longer for children than for adults, particularly for adolescents (Davis et al., 2017; Fehr et al., 2019; Lumba-Brown et al., 2018). For example, Field et al. (2003) found that high school students showed prolonged memory difficulties compared to college-age individuals following concussion. In a meta-analysis of 91 studies, Dougan et al. (2014) found that adolescent athletes demonstrated increased neuropsychological symptomatology compared to adults up to 10 days post-concussion. More recent studies are also demonstrating that a small, but not insignificant, percentage of young people demonstrate persistent post-

concussive symptoms, similar to adults (van Ierssel et al., 2020), and that even when comparing younger children to preadolescents and adolescents, rates of recovery may vary within the pediatric population (Ledoux et al., 2019). It is possible that continued misperceptions about young people recovering more quickly than adults lead to lack of urgency in helping children and adolescents return to school and other activities following concussion. If the sustained belief is that children and adolescents with concussion recover quickly and without direct intervention and supports, it may be difficult for SLPs with full caseloads to justify the resources required to assess and monitor a student with concussion. Clinicians may further reduce services if they erroneously believe that concussion and brain injuries are less serious in children.

For questions pertaining to more recently published guidelines, SLPs participating in this survey demonstrated difficulty with the following points: (a) whether returning to cognitive or physical activity following concussion is dangerous and (b) whether return to moderate levels of cognitive and physical activity facilitates recovery. Recently published recommendations provide guidance regarding return to physical and cognitive activity following concussion (Lumba-Brown et al., 2018; Rivara et al., 2020), but responses to knowledge questions from school-based SLPs in this study indicate that these guidelines are not yet part of their everyday practice. This lag in uptake of evidence-based recommendations serves as an example of the persistent challenges inherent in Green's research-to-practice pipeline (Green, 2008). Interestingly, school-based SLPs who completed the survey did show uptake of some new findings, such as that cocooning was not the best practice to aid recovery, but were less sure about what should happen in its place. It is unclear why new guidelines about moderate levels of activity lag behind those discouraging avoiding all activity, although it may be that determining what is an appropriate level of activity for an individual is more nuanced and difficult to determine. Return-to-play rules for athletes clearly define activities allowable at each step and what should occur if activities are or are not tolerated (Doolan et al., 2012; May et al., 2014; McCrory et al., 2017). Definitions of cognitive activity have been more challenging, although they often use metrics around amount of reading, screen use, or academic work (Baker et al., 2014; Master et al., 2020; Santiago, 2016). Findings from this study provide additional evidence that researchers need better methods to translate new findings quickly and efficiently to practicing clinicians who have the best opportunity to assess and treat students with concussion. There are forums focused on synthesizing recent research findings into practical, actionable clinical application (e.g., theinformedslp.com), but it is unclear how practicing clinicians use these forums and whether their use influences intervention fidelity or knowledge accuracy.

Limitations and Future Directions

Generalizability of these results is limited by the small number of SLPs involved in the survey, although response accuracy on items also included in Duff and Stuck (2015) were very similar. For example, just as found here, lowest accuracy was for the items stating that children show better recovery than adults and whether neuroimaging is likely to reveal structural damage from a concussion. Likewise, highest accuracy was for understanding that a concussion is a brain injury and that sustaining a subsequent concussion while the brain is still healing increases the likelihood of long-term problems. Such similarities lend validity to the results while also pointing to stability in SLP knowledge of concussion over time. Knowledge items were specifically selected based on the previous published study with updated recommendations based on research that was published in the intervening years. However, such items may not reflect what is most relevant for clinical care or school-based settings. Additionally, the survey did not include a definition of concussion and instead left the respondents to consider their own understanding of concussion and its potential impact on students. While it is not possible to ensure that all respondents perceived the diagnosis in the same way, the manner in which they responded to questions related to work experience with TBI and concussion indicates that they understood concussion to be a type of brain injury, and that they also differentiated concussion from moderate/severe TBI. Future studies should consider how research findings translate to clinical applicability and measurement methods for implementation of this knowledge. SLPs self-selected into the study and had a range of knowledge and confidence, but may not be representative of school-based SLPs as a whole. Furthermore, it is unclear from this study how confidence about concussion care may relate to other, core areas of assessment and treatment regularly encountered by school-based SLPs, such as articulation or phonological disorders. Given the breadth of needs served by SLPs, research examining how knowledge and confidence interact across practice domains and delivery areas would also be useful in designing more effective training for SLPs more generally.

Future trainings may also need to target directly debunking commonly missed items or new recommendations that conflict with prior practices. For example, refutation texts have been employed as a method to specifically target common misconceptions (Tippett, 2010). Such texts typically include a statement explaining the misconception, evidence directly refuting the misconception, and a third component that explains the new, correct conception. By activating prior knowledge, explicitly stating misconceptions increases comprehension of the new concept. Such texts have been shown to improve resolution of misconceptions over

and above simple expository texts (Guzzetti et al., 1992; Tippett, 2010) including in domains such as dyslexia (Peltier et al., 2020). Research examining the effect of trainings similarly structured in order to correct persistent misconceptions about the differential impact of pediatric brain injury, as well as newer recommendations around rest and recovery may be a fruitful line of inquiry.

Conclusions

Knowledge and confidence of school-based SLPs have remained relatively stable, even as changing clinical guidelines have made it difficult for practicing clinicians to stay abreast of current evidence. SLPs receive training most commonly during graduate school, even as continuing education is likely to be where clinicians encounter more recent evidence as to current best practices for management of this population of learners. Confidence was related to both training and work experiences, although few of the SLP participants in this study had either. Because so many students experience a concussion every year, it is certain that these students are regularly present in schools. Improving SLP training experiences may allow for greater knowledge, confidence, and advocacy for the role of SLPs in meeting the needs of these students, thus generating more experiences working with students with concussion over time. However, given the current service delivery models and increasing caseloads, involving SLPs in care of students with concussion would likely require administrative and district support. The expertise of SLPs in cognition, language, and academic communication (including reading and writing) is valuable to students recovering from concussion. Results from the current investigation and the broader literature suggest that SLPs will benefit from continued development of functional training materials along with clinical opportunities to serve students with concussion.

References

Arbogast, K. B., Curry, A. E., Pfeiffer, M. R., Zonfrillo, M. R., Haarbauer-Krupa, J., Breiding, M. J., Coronado, V. G., & Master, C. L. (2016). Point of health care entry for youth with concussion within a large pediatric care network. *JAMA Pediatrics, 170*(7), e160294. https://doi.org/10.1001/jamapediatrics.2016.0294

Baker, J. G., Rieger, B. P., McAvoy, K., Leddy, J. J., Master, C. L., Lana, S. J., & Willer, B. S. (2014). Principles for return to learn after concussion. *International Journal of Clinical Practice, 68*(11), 1286–1288. https://doi.org/10.1111/ijcp.12517

Barlow, K. M., Crawford, S., Brooks, B. L., Turley, B., & Mikrogianakis, A. (2015). The incidence of postconcussion syndrome remains stable following mild traumatic brain injury in children. *Pediatric Neurology, 53*(6), 491–497. https://doi.org/10.1016/j.pediatrneurol.2015.04.011

Barlow, K. M., Crawford, S., Stevenson, A., Sandhu, S. S., Belanger, F., & Dewey, D. (2010). Epidemiology of postconcussion syndrome in pediatric mild traumatic brain injury. *Pediatrics, 126*(2), e374–e381. https://doi.org/10.1542/peds.2009-0925

Berner, E. S., & Graber, M. L. (2008). Overconfidence as a cause of diagnostic error in medicine. *American Journal of Medicine, 121*(5), S2–S23. https://doi.org/10.1016/j.amjmed.2008.01.001

Brown, J., O'Brien, K., Knollman-Porter, K., & Wallace, T. (2019). The speech-language pathologists' role in mild traumatic brain injury for middle and high school–age children: Viewpoints on guidelines from the Centers for Disease Control and Prevention. *American Journal of Speech-Language Pathology, 28*(3), 1363–1370. https://doi.org/10.1044/2019_AJSLP-18-0296

Davis, G. A., Anderson, V., Babl, F. E., Gioia, G. A., Giza, C. C., Meehan, W., Moser, R. S., Purcell, L., Schatz, P., Schneider, K. J., Takagi, M., Yeates, K. O., & Zemek, R. (2017). What is the difference in concussion management in children as compared with adults? A systematic review. *British Journal of Sports Medicine, 51*(12), 949–957. https://doi.org/10.1136/bjsports-2016-097415

DeMatteo, C. A., Lin, C.-Y. A., Foster, G., Giglia, L., Thabane, L., Claridge, E., Noseworthy, M. D., Hall, G. B., & Connolly, J. F. (2019). Evaluating adherence to return to school and activity protocols in children after concussion. *Clinical Journal of Sport Medicine, 31*(6), e406–e413. https://doi.org/10.1097/JSM.0000000000000800

DeMatteo, C. A., Randall, S., Lin, C.-Y. A., & Claridge, E. A. (2019). What comes first: Return to school or return to activity for youth after concussion? Maybe we don't have to choose. *Frontiers in Neurology, 10,* 792. https://doi.org/10.3389/fneur.2019.00792

Doolan, A. W., Day, D. D., Maerlender, A. C., Goforth, M., & Gunnar Brolinson, P. (2012). A review of return to play issues and sports-related concussion. *Annals of Biomedical Engineering, 40*(1), 106–113. https://doi.org/10.1007/s10439-011-0413-3

Dougan, B. K., Horswill, M. S., & Geffen, G. M. (2014). Athletes' age, sex, and years of education moderate the acute neuropsychological impact of sports-related concussion: A meta-analysis. *Journal of the International Neuropsychological Society, 20*(1), 64–80. https://doi.org/10.1017/S1355617712001464

Duff, M. C., & Stuck, S. (2015). Paediatric concussion: Knowledge and practices of school speech-language pathologists. *Brain Injury, 29*(1), 64–77. https://doi.org/10.3109/02699052.2014.965747

Fehr, S. D., Nelson, L. D., Scharer, K. R., Traudt, E. A., Veenstra, J. M., Tarima, S. S., Liu, X.-C., & Walter, K. D. (2019). Risk factors for prolonged symptoms of mild traumatic brain injury: A pediatric sports concussion clinic cohort. *Clinical Journal of Sport Medicine, 29*(1), 11–17. https://doi.org/10.1097/JSM.0000000000000494

Field, M., Collins, M. W., Lovell, M. R., & Maroon, J. (2003). Does age play a role in recovery from sports-related concussion? A comparison of high school and collegiate athletes. *The Journal of Pediatrics, 142*(5), 546–553. https://doi.org/10.1067/mpd.2003.190

Green, L. W. (2008). Making research relevant: If it is an evidence-based practice, where's the practice-based evidence? *Family Practice, 25*(Suppl. 1), i20–i24. https://doi.org/10.1093/fampra/cmn055

Green, L. W., Ottoson, J. M., García, C., & Hiatt, R. A. (2009). Diffusion theory and knowledge dissemination, utilization, and integration in public health. *Annual Review of Public Health, 30*(1), 151–174. https://doi.org/10.1146/annurev.publhealth.031308.100049

Guzzetti, B. J., Snyder, T. E., & Glass, G. V. (1992). Promoting conceptual change in science: Can texts be used effectively? *Journal of Reading, 35*(8), 642–649.

Hardin, K. Y., Black, C., Caldbick, K., Kelly, M., Malhotra, A., Tidd, C., Vallentin, T., & Turkstra, L. S. (2021). Current practices among speech-language pathologists for mild traumatic brain injury: A mixed-methods modified Delphi approach. *American Journal of Speech-Language Pathology, 30*(4), 1625–1655. https://doi.org/10.1044/2021_AJSLP-20-00311

Hux, K., Walker, M., & Sanger, D. D. (1996). Traumatic brain injury: Knowledge and self-perceptions of school speech-language pathologists. *Language, Speech, and Hearing Services in Schools, 27*(2), 171–184. https://doi.org/10.1044/0161-1461.2702.171

Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology, 77*(6), 1121–1134. https://doi.org/10.1037/0022-3514.77.6.1121

Ledoux, A.-A., Tang, K., Yeates, K. O., Pusic, M. V., Boutis, K., Craig, W. R., Gravel, J., Freedman, S. B., Gagnon, I., Gioia, G. A., Osmond, M. H., Zemek, R. L., & Pediatric Emergency Research Canada (PERC) Concussion Team. (2019). Natural progression of symptom change and recovery from concussion in a pediatric population. *JAMA Pediatrics, 173*(1), e183820. https://doi.org/10.1001/jamapediatrics.2018.3820

Lumba-Brown, A., Yeates, K. O., Sarmiento, K., Breiding, M. J., Haegerich, T. M., Gioia, G. A., Turner, M., Benzel, E. C., Suskauer, S. J., Giza, C. C., Joseph, M., Broomand, C., Weissman, B., Gordon, W., Wright, D. W., Moser, R. S., McAvoy, K., Ewing-Cobbs, L., Duhaime, A.-C., . . . Timmons, S. D. (2018). Centers for Disease Control and Prevention guideline on the diagnosis and management of mild traumatic brain injury among children. *JAMA Pediatrics, 172*(11), e182853–e182853. https://doi.org/10.1001/jamapediatrics.2018.2853

Lundine, J. P., Ciccia, A. H., & Brown, J. (2019). The speech-language pathologists' role in mild traumatic brain injury for early childhood, preschool, and elementary school–age children: Viewpoints on guidelines from the Centers for Disease Control and Prevention. *American Journal of Speech-Language Pathology, 28*(3), 1371–1376. https://doi.org/10.1044/2019_AJSLP-18-0295

Master, C. L., Curry, A. E., Pfeiffer, M. R., Metzger, K. B., Kessler, R. S., Haarbauer-Krupa, J., DePadilla, L., Greenspan, A., Breiding, M. J., & Arbogast, K. B. (2020). Characteristics of concussion in elementary school-aged children: Implications for clinical management. *Journal of Pediatrics, 223,* 128–135. https://doi.org/10.1016/j.jpeds.2020.04.001

May, K. H., Marshall, D. L., Burns, T. G., Popoli, D. M., & Polikandriotis, J. A. (2014). Pediatric sports specific return to play guidelines following concussion. *International Journal of Sports Physical Therapy, 9*(2), 242–255.

McAvoy, K., Eagan-Johnson, B., & Halstead, M. (2018). Return to learn: Transitioning to school and through ascending levels of academic support for students following a concussion. *NeuroRehabilitation, 42*(3), 325–330. https://doi.org/10.3233/NRE-172381

McCrory, P., Meeuwisse, W., Dvorak, J., Aubry, M., Bailes, J., Broglio, S., Cantu, R. C., Cassidy, D., Echemendia, R. J., Castellani, R. J., Davis, G. A., Ellenbogen, R., Emery, C., Engebretsen, L., Feddermann-Demont, N., Giza, C. C., Guskiewicz, K. M., Herring, S., Iverson, G. L., . . . Vos, P. E. (2017). Consensus statement on concussion in sport—The 5th international conference on concussion in sport held in Berlin, October 2016. *British Journal of Sports Medicine, 51*(11), 838–847. https://doi.org/10.1136/bjsports-2017-097699

Meyer, A. N., Payne, V. L., Meeks, D. W., Rao, R., & Singh, H. (2013). Physicians' diagnostic accuracy, confidence, and resource requests: A vignette study. *JAMA Internal Medicine, 173*(21), 1952–1958. https://doi.org/10.1001/jamainternmed.2013.10081

Morrow, E. L., Hereford, A. P., Covington, N. V., & Duff, M. C. (2020). Traumatic brain injury in the acute care setting: Assessment and management practices of speech-language pathologists. *Brain Injury, 34*(12), 1590–1609. https://doi.org/10.1080/02699052.2020.1766114

O'Brien, K. H. (2020). Overcoming knowledge barriers for inclusion of school-based speech-language pathologists in the management of students with mild traumatic brain injury. *Seminars in Speech and Language, 41*(2), 195–208. https://doi.org/10.1055/s-0040-1701687

Oyesanya, T. O., Brown, R. L., & Turkstra, L. S. (2017). Caring for patients with traumatic brain injury: A survey of nurses' perceptions. *Journal of Clinical Nursing, 26*(11 12), 1562–1574. https://doi.org/10.1111/jocn.13457

Pelatti, C. Y., Bush, E. J., Farquharson, K., Schneider-Cline, W., Harvey, J., & Carter, M. W. (2019). Speech-language pathologists' comfort providing intervention to children with traumatic brain injury: Results from a national survey. *American Journal of Speech-Language Pathology, 28*(4), 1611–1624. https://doi.org/10.1044/2019_AJSLP-19-0029

Peltier, T. K., Heddy, B. C., & Peltier, C. (2020). Using conceptual change theory to help preservice teachers understand dyslexia. *Annals of Dyslexia, 70*(1), 62–78. https://doi.org/10.1007/s11881-020-00192-z

Potteiger, K. L., Potteiger, A. J., Pitney, W., & Wright, P. M. (2018). An examination of concussion legislation in the United States. *The Internet Journal of Allied Health Sciences and Practice, 16*(2), Article 6.

Riedeman, S., & Turkstra, L. (2018). Knowledge, confidence, and practice patterns of speech-language pathologists working with adults with traumatic brain injury. *American Journal of Speech-Language Pathology, 27*(1), 181–191. https://doi.org/10.1044/2017_AJSLP-17-0011

Rieger, B., Lewandowski, L., Potts, H., Potter, K., & Chin, L. S. (2018). Parent knowledge and perceptions of concussion related to youth football. *Cureus, 10*(3), e2268. https://doi.org/10.7759/cureus.2268

Rivara, F. P., Koepsell, T. D., Wang, J., Temkin, N., Dorsch, A., Vavilala, M. S., Durbin, D., & Jaffe, K. M. (2011). Disability 3, 12, and 24 months after traumatic brain injury among children and adolescents. *Pediatrics, 128*(5), e1129–e1138. https://doi.org/10.1542/peds.2011-0840

Rivara, F. P., Tennyson, R., Mills, B., Browd, S. R., Emery, C. A., Gioia, G., Giza, C. C., Herring, S., Janz, K. F., LaBella, C., Valovich McLeod, T., Meehan, W., Patricios, J., & Four Corners Youth Consortium. (2020). Consensus statement on sports-related concussions in youth sports using a modified Delphi approach. *JAMA Pediatrics, 174*(1), 79–85. https://doi.org/10.1001/jamapediatrics.2019.4006

Santiago, S. (2016). Adolescent concussion and return-to-learn. *Pediatric Annals, 45*(3), E73–E75. https://doi.org/10.3928/00904481-20160211-01

Taylor, C. A., Bell, J. M., Breiding, M. J., & Xu, L. (2017). Traumatic brain injury–related emergency department visits, hospitalizations, and deaths—United States, 2007 and 2013. *Morbidity and Mortality Weekly Report, 66*(9), 1–16. https://doi.org/10.15585/mmwr.ss6609a1

Taylor, H. G., Orchinik, L. J., Minich, N., Dietrich, A., Nuss, K., Wright, M., Bangert, B., Rusin, J., & Yeates, K. O. (2015). Symptoms of persistent behavior problems in children with mild traumatic brain injury. *Journal of Head Trauma Rehabilitation, 30*(5), 302–310. https://doi.org/10.1097/HTR.0000000000000106

Tippett, C. D. (2010). Refutation text in science education: A review of two decades of research. *International Journal of Science and Mathematics Education, 8*(6), 951–970. https://doi.org/10.1007/s10763-010-9203-x

van Ierssel, J., Ledoux, A.-A., Tang, K., Correll, R., Yeates, K. O., Gioia, G., Freedman, S. B., Sangha, G., Boutis, K., Beer, D., Craig, W., Burns, E., Mikrogianakis, A., Dubrovsky, A. S., Gagnon, I., Gravel, J., McGahern, C., Osmond, M. H., Zemek, R., & Pediatric Emergency Research Canada (PERC) Concussion Team. (2020). Symptom burden, school function, and physical activity one year following pediatric concussion. *The Journal of Pediatrics, 228,* 190–198.e3. https://doi.org/10.1016/j.jpeds.2020.08.061

Wasserman, E. B., Bazarian, J. J., Mapstone, M., Block, R., & van Wijngaarden, E. (2016). Academic dysfunction after a concussion among US high school and college students. *American Journal of Public Health, 106*(7), 1247–1253. https://doi.org/10.2105/AJPH.2016.303154

Weber, M., & Edwards, M. G. (2012). Sport concussion knowledge in the UK general public. *Archives of Clinical Neuropsychology, 27*(3), 355–361. https://doi.org/10.1093/arclin/acs029

Williams-Butler, M. A., & Cantu, R. C. (2019). Concussion practice patterns among speech-language pathologists. *Health, 11*(07), 880–895. https://doi.org/10.4236/health.2019.117071

Yeates, K. O. (2010). Mild traumatic brain injury and postconcussive symptoms in children and adolescents. *Journal of the International Neuropsychological Society, 16*(6), 953–960. https://doi.org/10.1017/S1355617710000986

Zamani-Alavijeh, F., Araban, M., Harandy, T. F., Bastami, F., & Almasian, M. (2019). Sources of health care providers' self-efficacy to deliver health education: A qualitative study. *BMC Medical Education, 19*(1), 16. https://doi.org/10.1186/s12909-018-1448-z