The Physical Educator Vol. 77 • pp. 829–853 • 2020
https://doi.org/10.18666/TPE-2020-V77-I5-10189

RISK MANAGEMENT

Concussion Knowledge, Attitude, and Risk Management Practices of High School Girls' Soccer Coaches

Sungwon Kim, Daniel P. Connaughton, Michael Sagas, Yong Jae Ko

Abstract

Concussion rates in soccer are comparable to those found in high-contact and/or collision sports. Evidence has suggested a higher concussion rate among female soccer players compared to their male counterparts. The purpose of this study was to examine (1) concussion knowledge, attitude, and risk management practices of high school girls' soccer coaches and (2) the interrelationships between knowledge, attitude, and risk management practices. One hundred forty high school girls' soccer coaches completed an online survey. Most coaches demonstrated a high level of knowledge regarding key concussion facts and strongly agreed that it is important to create an environment in which athletes are encouraged to report concussions. A positive attitude toward concussions had a strong influence on employment of risk management practices ($F = 4.20$, $p < .001$). Findings from this study may help develop, revise, and promote effective concussion education programs and safety policies in interscholastic and youth soccer.

Traumatic brain injuries (TBI) are a major public health concern, as approximately 3.4 million people visited a U.S. emergency

Sungwon Kim, College of Professional Studies, St. John's University (New York). Daniel P. Connaughton, Department of Sport Management, University of Florida. Michael Sagas, Department of Sport Management, University of Florida. Yong Jae Ko, Department of Sport Management, University of Florida. Please send author correspondence to kims1@stjohns.edu

department, from 2001 to 2012, due to a sport or recreation–related TBI. During the same period, emergency department visits due to sport and recreation–related TBIs more than doubled (Coronado et al., 2015). An estimated 70% to 90% of all TBIs are mild (mTBI), and these are commonly referred to as concussions (Cassidy et al., 2004). Adolescents (≤ 19 years old), in particular, are more susceptible to concussions and account for approximately 70% of sport or recreation–related TBIs. In high school athletics, an estimated 300,000 concussions are sustained annually (Marar et al., 2012). Moreover, evidence-based research has suggested that adolescents typically take longer to recover from concussions compared to adults, thus requiring more conservative management and care (Grady et al., 2012).

After comparing sports with similar rules, research has suggested female athletes are more vulnerable to concussions than their male counterparts (Gessel et al., 2007). Specifically, studies have found that female high school athletes are more likely to suffer concussions compared to their counterparts (Harmon et al., 2013; Rosenthal et al., 2014). Moreover, compared to male athletes, female athletes experience concussion symptoms that are typically greater with longer recovery times (Baker et al., 2016; Kay et al., 2018). Although more research is warranted, scholars have suggested that body composition and neck strength are primary factors that contribute to a higher concussion risk for females (Gutierrez et al., 2014).

In the United States, soccer is one of the fastest growing sports, with participation rates for high school soccer increasing 4-fold among boys and 35-fold among girls from 1973 to 2014 (National Federation of High School Athletic Associations, 2018). One published report (Marar et al., 2012) suggested the concussion rate in soccer is comparable to those found in traditional high-contact and/or collision sports (e.g., football, ice hockey). Concussions in soccer account for 2% to 4% of all sport-related acute injuries (Gessel et al., 2007), with the highest rate of concussions occurring during games (Comstock et al., 2015; Valovich McLeod, Houston, & Welch, 2015). A competition-based concussion rate among high school girls' soccer was 9.2/10,000 athlete exposures (AEs). This figure was nearly double the rate of concussions for high school boys' soccer, which was 5.3/10,000 AEs (Marar et al., 2012). A more recent investigation

by Comstock et al. (2015) confirmed a higher rate of concussions among female soccer players. They found 627 concussions sustained during 1,393,753 AEs among girls (4.50 concussions/10,000 AEs), which was significantly higher than 442 concussions sustained during 1,592,238 AEs among boys (2.78 concussions/10,000 AEs).

Attempting to reduce and properly manage concussions is an important task for youth sport stakeholders, particularly coaches involved in contact and collision sports. Coaches have a professional and ethical responsibility to (1) be aware of the frequency and severity of concussions, (2) recognize causes and the signs and symptoms of concussions, and (3) properly manage suspected and/or identified concussions (e.g., removing the player from games and practices, adhering to return-to-play guidelines). In recent years, several concussion-related educational initiatives were developed specifically for high school and youth sport coaches. These include, but are not limited to, the CDC's Heads Up (Daugherty et al., 2019), NFHS's Concussion in Sports (National Federation of High School Athletic Associations, 2018), and Brain 101: The Concussion Playbook (Valovich McLeod, Houston, & Welch, 2015). In the majority of states, high school coaches are required to take one or more of these concussion education or training courses. Moreover, between 2009 and 2014, all 50 states and the District of Columbia passed youth sport-related concussion legislation that requires first responders, including coaches and parents, to be educated about prevention and management of concussion (Kim et al., 2017).

The need for concussion education stems from the fact that a concussion diagnosis is not always straightforward, particularly with the absence of a specific diagnostic test or biomarker (Hecimovich & Marais, 2017). In this respect, concussions often go unrecognized, which may lead to underreporting and subsequent catastrophic health consequences, such as second impact syndrome (McLendon et al., 2016). Improving coaches' knowledge regarding concussions is important in the effort to reduce and properly manage concussions, particularly at the high school and youth sport level. A number of studies, however, have suggested that knowledge alone does not typically translate to improved concussion management practices, which warrants the need for assessing attitudes toward concussions as well (Hendricks et al., 2012). Scholars in the scientific community

have theorized that strong knowledge and a positive attitude have potential to help coaches properly recognize and report suspected concussions to appropriate medical personnel (Sefton et al., 2004). In addition to improving knowledge and attitude, coaches have a responsibility to implement proper risk management practices during practices and games in an attempt to reduce concussions. Risk management is a course of action designed to reduce the risk (probability and/or severity) of injuries, lawsuits, and other losses to sport participants and/or organizations (Spengler et al., 2016, p. 42). Given the prevalence of concussions among soccer participants, implementing proper risk management practices aimed at reducing and properly managing concussions is also a soccer coach's ethical and professional responsibility.

Knowledge and attitude have been frequently studied in an effort to explain their relationship with behaviors. The knowledge–attitude–behavior (KAB) model is an important theoretical framework often used to explain behavioral changes affected by knowledge and attitude in the health education context (Schneider & Cheslock, 2003). This model postulates a causal relationship among knowledge, attitude, and behaviors; that is, having strong knowledge on a particular health condition can directly influence attitudinal changes and subsequent improvement in related behaviors. In applying the aforementioned underlying theoretical framework, a strong knowledge and/or positive attitude concerning concussions may lead to improved safety practices (i.e., risk management practices) aimed at reducing and properly managing concussions. In fact, research has suggested that increases in knowledge and attitude regarding concussions are associated with better safety practices, such as concussion reporting and/or related care-seeking behaviors (Setnik & Bazarian, 2007). It is likely that coaches who possess a strong knowledge (i.e., concussion signs and symptoms, return-to-play guidelines) and positive attitude (i.e., perceived importance of athletes reporting concussions, and missing practices and games due to such) are more likely to employ a higher level of concussion-related risk management practices.

Despite the prevalence of concussions among female high school soccer players, no study has specifically examined high school girls' soccer coaches' concussion knowledge, attitude, and risk management practices (KARMP). The purpose of this study was twofold:

(1) to examine concussion knowledge, attitude, and risk management practices of high school girls' soccer coaches and (2) to assess the interrelationships between the knowledge, attitude, and risk management practices. Evaluating coaches on these factors may allow for the development, revision, and promotion of effective concussion educational programs and safety policies and practices at high school and youth levels. Additionally, this study may shed light on the interrelationships between concussion KARMP, which has the potential to influence theoretical and practical implications.

Method

Participants and Procedures

The target population for this study was all 540 high school girls' head soccer coaches in the state of Florida. This population was identified from the Florida High School Athletic Association (FHSAA) directory of member institutions. After conducting an extensive internet search of all 540 schools' websites, we obtained the names and email addresses of 317 head soccer coaches. The remaining 223 schools did not post their soccer coach's email address on their institutional website.

After Institutional Review Board approval from the University of Florida, coaches were emailed a message containing the purpose of the study, a URL to the survey (Qualtrics), and contact information for the primary investigator. A cover letter with informed consent was provided in the front page of the survey and online consent was required for coaches to begin the survey. In an effort to maximize responses, we sent two reminder emails to nonresponders at the 2- and 4-week intervals during the 6-week data collection period. Respondents who successfully completed the survey received a $10 Amazon e-Gift certificate, which was sent to the email address they provided in the survey. A master log of participants who completed the questionnaire was created, which ensured that no individuals completed the survey more than once, as well as helped us to identify nonrespondents. This master log, however, was destroyed after data analysis, preserving respondent anonymity. Forty out of 317 emails sent to head coaches bounced back for unknown reason. Overall, of the 277 emails successfully sent, 140 coaches completed the survey.

Measures

This cross-sectional study utilized a questionnaire that was developed after a comprehensive review of the literature, Florida's concussion statute (Fla. Educ. Code, 2017), and FHSAA's (2017) concussion policy. Additionally, some survey questions were adopted and/or modified from previous studies that examined youth sport coaches' and other relevant stakeholders' (e.g., parents, athletes) concussion knowledge (Gourley et al., 2010; LaRoche et al., 2016; Valovich McLeod, Schwartz, & Bay, 2007), attitude (Kurowski, Pomerantz, Schaiper, Ho, & Gittelman, 2015), and risk management practices (Shenouda et al., 2012). A panel of five experts, including two professors who specialize in sport risk management, two girls' head soccer coaches, and a professor with expertise in survey development and measurement, conducted a test of face and content validity. After the panel members reviewed the survey items for relevance, representativeness, and clarity, we made minor modifications. The survey contained four sections: (1) demographics/professional background (13 multiple-choice items), (2) concussion knowledge (10 Likert-scale items from 1 *definitely false* to 5 *definitely true*), (3) concussion attitude (12 Likert-scale items from 1 *strongly agree* to 7 *strongly disagree*), and (4) risk management practices aimed at reducing and properly managing concussions in soccer (14 Likert-scale items from 1 *never* to 5 *always*).

Statistical Analyses

The data were analyzed via SPSS 21.0. Descriptive statistics (frequency, means, percentages, and standard deviations) were calculated for respondents' demographics/professional background and concussion KARMP. Measures of central tendency were used in evaluating response patterns. Hierarchical regression analyses were performed in examining the interrelationship(s) between concussion KARMP. The aggregate measures of respondents' concussion KARMP were obtained through the addition of coded individual responses (i.e., true/false questions, Likert-scale questions). Statistical significance (α) was defined as $p < .05$ for all statistical tests.

Results

Demographics

Among the survey respondents, 90 (64.3%) were male, with the majority (97.1%) holding a paid coaching position. Slightly more than half (51.4%) of the respondents held a bachelor's degree, whereas 32.9% reported having a master's degree as their highest academic degree. Respondents represented all FHSAA classifications, which are based on the overall number of students enrolled (i.e., 1A, 2A, 3A, 4A, and 5A), with the highest number of respondents employed at 3A institutions (22.9%). Over three quarters (75.7%) of the coaches were employed in public schools (Table 1).

Table 1
Demographics and Professional Background of Respondents (n = 140)

Variable	*n*	(%)
Gender		
Male	90	(64.3)
Female	50	(35.7)
Employment status		
Paid	136	(97.1)
Volunteer	4	(2.9)
Age		
< 29	29	(20.7)
30–39	32	(22.9)
40–49	37	(26.4)
50+	42	(30.0)
Coaching experience (years)		
1–5	70	(50.0)
6–10	25	(17.9)
11–15	21	(15.0)
16+	24	(17.1)

Table 1 (cont.)

Variable	*n*	(%)
Highest degree earned		
High school diploma	6	(4.3)
Associate's degree	12	(8.6)
Bachelor's degree	72	(51.4)
Master's degree	46	(32.9)
Doctorate	4	(2.9)
Classification of school		
Class 1A	18	(12.9)
Class 2A	29	(20.7)
Class 3A	32	(22.9)
Class 4A	26	(18.6)
Class 5A	31	(22.1)
Class Independent	4	(2.9)
School type		
Public	106	(75.7)
Private	34	(24.3)

Knowledge Regarding Concussions

Among the respondents, the majority agreed that a concussion is a type of TBI (4.93 ± .26). The significant majority also correctly identified that losing consciousness is not required for a person to sustain a concussion (4.94 ± .31). Most respondents were also aware that an athlete with a suspected concussion cannot return to play on the same day of injury (4.89 ± .60). However, respondents' knowledge was limited on the causes of a concussion (3.78 ± 1.46) and the methods of diagnosis (2.99 ± 1.47). Furthermore, respondents' knowledge regarding high school–aged students' rate of recovery versus adults' was also deficient (2.89 ± 1.21). See Table 2.

Table 2
Coaches Knowledge Regarding Concussions (A scale of 5)

Key facts about concussions (1 = *definitely false*, 5 = *definitely true*)	***M***	***SD***
A concussion is a type of traumatic brain injury (TBI).	4.93	(.26)
A concussion only occurs when an athlete loses consciousness.[a]	4.94	(.31)
A concussion may be caused by a blow to the neck or elsewhere in the body.	3.7	(1.46)
A suspected concussion requires immediate removal from a game or practice.	4.94	(.38)
A concussion can be detected with CAT scan or MRI.[a]	2.99	(1.47)
An athlete who has a suspected concussion can return to play the same day.[a]	4.89	(.60)
High school–aged students typically take longer to heal from a concussion than older athletes.	2.89	(1.21)
A repeat concussion that occurs before full recovery from the first concussion can slow recovery and increase the chance for long-term problems.	4.80	(.65)
Concussed high school athletes could be allowed to return to play in a slow step-by-step method only if symptom-free.	4.47	(1.14)

[a]Reverse scale (1 = *definitely true* to 5 = *definitely false*).

As Table 3 shows, the most identified typical signs and symptoms were dizziness or balance problems (100%), headache (97.1%), confusion (97.1%), blurred or double vision (96.4%), nausea (95%), sensitivity to light or noise (95%), and concentration or memory problems (94.3%). Items with moderate to high correct responses were feeling sluggish (83.6%), feeling foggy or groggy (82.9%), moving clumsily (77.9%), and behavioral or personality changes (73.6%). Difficulty falling asleep was only selected by 50.7% of the respondents. The most commonly identified distractors included numbness or tingling in upper extremity (19.3%), followed by abnormal sense of smell (15%), and sharp burning pain in the neck (14.3%).

Table 3
Respondents' Concussion Knowledge: Signs and Symptoms

Signs and symptoms	*n*	(%)
Correct signs and symptoms		
Dizziness or balance problems	140	(100)
Confusion	136	(97.1)
Headache	136	(97.1)
Blurred or double vision	135	(96.4)
Sensitivity to light or noise	133	(95.0)
Nausea	133	(95.0)
Concentration or memory problems	132	(94.3)
Feeling sluggish	117	(83.6)
Feeling foggy or groggy	116	(82.9)
Moving clumsily	109	(77.9)
Behavioral and personality changes	103	(73.6)
Difficulty falling asleep	71	(50.7)
Red herrings		
Numbness or tingling in upper extremity	27	(19.3)
Abnormal sense of smell	21	(15.0)
Sharp burning pain in the neck	20	(14.3)
Abnormal sense of taste	19	(13.6)
Shortness of breath	14	(10.0)
Back pain	10	(7.1)
Hearing voices	7	(5.0)
High fever	2	(1.4)
Chest pain	1	(.07)

Attitude Regarding Concussions

The majority of respondents agreed that any suspected concussion must be taken seriously (6.81 ± .68). Additionally, the greater percentage of respondents indicated that the coach plays a critical role in the health and safety of their team (6.83 ± .46). There was also very strong agreement among coaches that creating an environment in which athletes feel comfortable reporting concussion is important

(6.85 ± .41). The majority of coaches also felt that it is important to let their athletes know they take concussions seriously (6.88 ± .39). There was moderate agreement that it is inappropriate to refer to a concussion as a "ding" or "bell ringer" (5.79 ± 1.59) and that recent emphasis on sport-related concussions is overly sensationalized (5.33 ± 1.67; reverse-scale item). Meanwhile, a notable number of respondents disagreed that U.S. Soccer's recent policy on heading restriction for younger participants has improved concussion safety overall (4.28 ± 1.98). Respondents' attitude toward Florida's concussion legislation was also less positive, as a notable percentage of respondents did not agree that such legislation has changed their attitude about managing concussions (4.46 ± 1.68). Table 4 shows the results of the assessed attitude items.

Risk Management Practices

The most commonly employed risk management practices during practice sessions were instructing players to report suspected concussions (4.91 ± .43) and instructing players on proper heading technique (4.61 ± .65). The majority of coaches also ensured proper inflation pressure of soccer balls (4.59 ± .66). Meanwhile, wearing headgear, such as soft helmets or headbands, was uncommon (1.44 ± .76). Similarly, goal posts were not commonly padded (1.45 ± 1.12). Furthermore, most coaches indicated that players were not banned (1.45 ± .79) or discouraged (2.04 ± 1.14) from heading the ball for safety concerns.

Similar results were also reported during games. While most coaches indicated they instructed players to report suspected concussions (4.86 ± .55), players were not banned (1.28 ± .60) or discouraged (1.59 ± .94) from heading the ball during games. Additionally, headgear was not commonly worn during games (1.54 ± .82). Table 5 shows the complete results of risk management practices employed during practices and games.

Interrelationships Between Concussion KARMP

After controlling for demographic variables, aggregate knowledge accounted for 0.4% variance in aggregate attitude variable and 1.1% variance in aggregate risk management practices variable. However, only aggregate knowledge predicted aggregate risk management practices ($F = .252$, $p = .019$). Aggregate attitude accounted

Table 4
Coaches' Attitude Regarding Concussions (A Scale of 1–7)

Attitude items (1 = *strongly disagree*, 7 = *strongly agree*)	***M***	**(*SD*)**
Concussions are a "critical issues" in sports.	6.51	(.91)
Any suspected concussion must be taken seriously.	6.81	(.68)
It is inappropriate to refer to a concussion as a "ding" or "bell ringer."	5.79	(1.59)
The recent emphasis on sport-related concussions has been overly sensationalized.[a]	5.33	(1.67)
Concussions in high school sports are a concern.	6.46	(.84)
The coach plays a critical role in the health and safety of their team.	6.83	(.46)
It is the coach's responsibility to educate athletes about concussions.	6.17	(1.02)
It is important to create an environment in which athletes feel comfortable reporting concussion symptoms.	6.85	(.41)
It is important that my athletes know I take concussions seriously.	6.88	(.39)
My athletes would tell me if they think that they had a concussion.	6.24	(1.11)
I feel that US Soccer's recent policy on heading restriction (for pre-high school soccer participants) has improved concussion safety.	4.28	(1.98)
Florida's concussion legislation changed my attitude/ perception about managing concussions.	4.46	(1.68)

[a]Reverse scale (1 = strongly agree to 7 = strongly disagree).

for a 8.9% variance in aggregate risk management practices after controlling for demographic variables, which was found to be a unique predictor of aggregate risk management practices ($F = 4.20$, $p < .001$). Within the demographic sets, age ($\beta = .288$, $p = .005$) and highest degree earned ($\beta = .183$, $p = .045$) emerged as significant predictors of aggregate risk management practices (Table 6) for both aggregate knowledge and attitude.

Table 5
Risk Management Practices Employed (A Scale of 1–5)

Risk management item (1 = *never*, 5 = *always*)	***M***	**(*SD*)**
Risk management during practices		
Players wear headgear (i.e., soft helmet, headband)	1.44	(.76)
Goal posts are padded on the field	1.45	(1.12)
Players are encouraged to perform neck-strengthening exercises at, or after, practices	2.50	(1.26)
Players are instructed on proper heading technique	4.61	(.65)
Players are discouraged from heading the ball for safety concerns	2.04	(1.14)
Players are banned from heading the ball for safety concern	1.45	(.79)
Players are instructed to report suspected concussions	4.91	(.43)
Proper inflation pressure of the soccer ball is ensured	4.59	(.66)
Players limit physical contact with other players	2.59	(1.18)
Risk management during games		
Players wear headgear (i.e., soft helmet, headband)	1.54	(.82)
Players are discouraged from heading the ball for safety concerns	1.59	(.94)
Players are banned from heading the ball for safety concern	1.28	(.60)
Players are instructed to report suspected concussions	4.86	(.55)
Proper inflation pressure of the soccer ball is ensured	4.70	(.67)

Discussion

The primary aims of this study were to examine concussion KARMP of high school girls' soccer coaches and to assess the interrelationships between the KARMP. Regarding the first aim, the results of the study suggest that high school girls' soccer coaches have strong, overall, foundational knowledge regarding concussions. This finding is consistent with studies that examined high school and

Table 6
Hierarchical Regression Analysis of the Interrelationships Between Concussion Knowledge, Attitude, and Risk Management Practices (KARMP)

Outcome variable and predictor variable	β	R^2	ΔR^2	F
Attitude (aggregate)				
Step 1: Demographics		.047		1.00
Gender	.034			
School type	-.131			
Classification of school	-.061			
Age	.145			
Highest degree earned	.123			
Years of coaching experience	-.118			
Step 2: Knowledge (aggregate)[a]	.066	.051	.004	.930
Risk management (aggregate)[b]				
Step 1: Demographics		.108		2.44*
Gender	.033			
School type	-.097			
Classification of school	-.090			
Age	.288*			
Highest degree earned	.183*			
Years of coaching experience	-.041			
Step 2: Knowledge (aggregate)[a]	-.146	.128	.011	2.52*
Risk Management (aggregate)[b]				
Step 1: Demographics		.108		2.44*
Gender	.033			
School type	-.097			
Classification of school	-.090			
Age	.288*			
Highest degree earned	.183*			
Years of coaching experience	-.041			
Step 2: Attitude (aggregate)	.306**	.197	.089	4.20**

[a]Aggregate scores of concussion facts and signs and symptoms. [b]Aggregate scores of risk management practices during practices and games.
*$p < .05$. **$p < .001$.

youth sport coaches' knowledge on concussions (Chrisman et al., 2014; Esquivel et al., 2013; Mrazik et al., 2011; Naftel et al., 2014).

However, it was concerning that many respondents did not know that high school–aged athletes typically take longer to recover from concussions than adults. Similar to the current findings, a previous study (O'Donoghue et al., 2009) also noted that 43% of coaches surveyed did not know an athlete's age was often a factor in recovering from a concussion. Another knowledge deficit for the respondents was regarding the procedures utilized in detecting and/or diagnosing concussions. The methods used for properly diagnosing concussions are commonly misunderstood. A study involving school speech-language pathologists found that close to 73% either did not know or were unsure about the ineffectiveness of CAT scans or MRIs in detecting concussions (Duff & Stuck, 2015). Whereas concussed athletes and their parents may expect an MRI or a CAT scan after a head injury, these types of neuroimaging mechanisms typically do not show abnormal brain activities following a concussive incident (Jagoda et al., 2002). Furthermore, respondents' knowledge regarding the potential causes of concussion was deficient as well. Our finding was not as positive as that in other studies (Chrisman et al, 2014; Mrazik et al., 2011) in which over 80% of youth sport coaches correctly identified that a concussion can stem from contact sustained from body parts other than the head. Understanding the mechanisms of concussions is pivotal for coaches because they are often responsible, particularly in the absence of athletic trainers and/or other medical personnel, for removing an athlete with a suspected concussion from play.

In regard to the signs and symptoms associated with concussions, we found that many coaches did not properly identify sleep problems, behavioral/personality changes, and clumsy movements as possible signs and symptoms of a concussion. In fact, a notable number of respondents (i.e., athletes, coaches, and parents) in other studies also did not realize emotional and sleep-related problems were also signs or symptoms of a concussion (Cournoyer & Tripp, 2014; Kurowski, Pomerantz, Schaiper, & Gittelman, 2014; Mannings et al., 2014). This suggests that youth sport stakeholders are not fully aware of the cognitive, emotional, and sleep-related issues associated with concussions. These findings stress the need for an added

emphasis on the subtle and/or less distinct signs and symptoms in future educational initiatives.

Overall, the respondents demonstrated positive and/or favorable attitudes regarding concussions. Such promising results may have been spurred by recent media attention, knowledge translation, and legislative efforts, all of which may have helped create positive social norms about the importance of prudent concussion management. Notably, the overwhelming majority of coaches agreed that creating an environment in which athletes feel comfortable reporting concussions is important. This is imperative for coaches given that many athletes are unwilling to report concussions primarily due to fear of being removed from play and/or the cultural norms in sports, such as not wanting to let teammates down (McCrea et al., 2004). Moreover, a larger percentage of coaches felt confident that their athletes would tell them if they had a potential concussion, which provides optimism, because previous studies (Guilmette et al., 2007; Hossler et al., 2013) reported a less positive attitude of coaches regarding their athletes' willingness to report concussions. Specifically, Guilmette et al. (2007) found only 41% of coaches believed their players would report a suspected concussion. Similarly, Hossler et al. (2013) noted that close to 50% of athletes were unlikely to report a suspected concussion to their coach. Although more research regarding a coach's influence on their athletes' reporting behaviors is warranted, coaches should nevertheless create a culture whereby athletes are strongly encouraged and feel comfortable reporting suspected concussions. Furthermore, the perceived social norm can be an important predictor for increased injury reporting among athletes (Kroshus et al., 2014). Taylor and Sanner (2017) suggested that high school athletes were less likely to report potential concussions if the school had negative subjective norms about reporting. Therefore, all coaches involved in high school and youth sports have a social and ethical responsibility to shift the attitude of "winning at all costs" to one that stresses the athletes' health and safety above all.

Recently, in an attempt to reduce the frequency and severity of head impacts, U.S. Soccer implemented a policy that restricts heading for pre–high school soccer players. Respondents in this study, however, had mixed attitudes regarding whether this policy has improved concussion safety. Negative attitudes toward this heading

restriction policy may have been spurred by several research studies that did not associate heading with an increased concussion risk (Koutures & Gregory, 2010; Pickett et al., 2005; Putukian, 2004). Some studies have suggested factors other than heading as the primary causes of concussions in soccer, including collisions with other players and falling to the ground (Andersen et al., 2004; Comstock et al., 2015). In fact, banning heading during a young athlete's development may put them at a greater risk of sustaining concussions later in their athletic career. The lack of instruction and/or experience on proper heading technique may lead athletes to react tentatively to a ball in the air when they are going for a header. The scientific community should continue to investigate the concussive injury risk from heading and collaborate with U.S. Soccer to establish the most effective heading policies for younger participants.

The selected risk management practices in this study were not largely employed by high school girls' soccer coaches. Such findings are not surprising, as a similar study conducted by Shenouda et al. (2012) also revealed a low level of risk management practices in the community youth soccer setting, including a lack of utilizing headgear, instructing neck-strengthening exercises, and limiting heading. The less extensive risk management practices employed in this study are also understandable given the inconclusive evidence on the effectiveness of soccer-related practices in preventing or reducing concussions. For instance, there is an ongoing debate regarding the use of headgear in the soccer community. Research suggests that headgear is not always effective in reducing head impact from purposeful heading, but it has been shown to reduce head trauma that occurred from head-to-head collisions (Delaney et al., 2008). Furthermore, banning heading during high school girls' soccer practices was not common. It has been suggested that most soccer-related concussions occur from player-to-player contact (Yard et al., 2008), and therefore, scholars postulate that banning heading may not have a significant effect in preventing concussions unless such a ban would reduce player-to-player contact (Comstock et al., 2015). Additional research in this area is warranted, including an examination of the relationship between cumulative heading and increased concussion risk.

To our knowledge, this study is the first to examine the associations between concussion KARMP. However, given the exploratory nature of this study, interrelationships between these variables should be interpreted with caution. The overall results suggest partial relationships between these three variables. First, respondents' knowledge did not significantly predict their attitudes, which was not surprising as scholars have noted that knowledge can be a positive, but weak, predictor of attitudinal and/or behavioral changes (Koerber et al., 2006; Singh, 2009). However, both knowledge and attitude were associated with the employment of risk management practices. Attitudes regarding concussion, in particular, were strongly associated with risk management practices. Based on this relationship, it is recommended that coaches' concussion educational materials be developed from a theoretical basis, which may help create a more positive attitude and subsequently promote behavioral changes (Caron et al., 2018).

This study is not without limitations. First, participants were limited to girls' high school soccer coaches in Florida, and therefore, generalization of the findings to local, regional, and national levels should be made with some degree of caution. Second, the use of self-reported data also limited our study, since surveys do not typically allow for the verification of participants' responses. Third, our study may have been limited by participation bias in which coaches with an interest and/or greater familiarity with concussions may have been more likely to respond to the survey request. Finally, the lower response rate may limit the generalizability of this study.

Conclusion

The results of this study suggest that high school girls' soccer coaches, overall, have a solid foundation of concussion knowledge and a positive attitude regarding concussions. Despite the promising findings, gaps in knowledge exist in the areas of the causes, diagnosis, less-distinct signs and symptoms (i.e., sleep problems, behavioral or personality changes), and conservative management for young athletes with a concussion. Future educational interventions should address these knowledge gaps among high school soccer coaches. Although the coaches' overall attitude toward concussions

was positive, such as their role in managing concussions, a significant majority of respondents did not believe that U.S. Soccer's heading restriction policy had a positive impact on reducing concussions. Policy makers should consider these findings in an attempt to better address future concussion-related policy in the interscholastic and youth soccer context. The low level of soccer-related risk management practices found in this study is not surprising given the inconclusive evidence on the effectiveness of such. More research in this area is warranted, which may assist coaches in adopting practices that are known to reduce concussions and can help them properly manage concussions in soccer. Finally, although this study supported a salient relationship between attitude regarding concussions and the employment of risk management practices, the relationship between knowledge and risk management practices was less strong. Coaches' knowledge, however, was not significantly associated with their attitude. Future research should further examine the interrelationships between these variables.

References

Andersen, T. E., Arnason, A., Engebretsen, L., & Bahr, R. (2004). Mechanisms of head injuries in elite football. *British Journal of Sports Medicine*, *38*(6), 690–696. https://doi.org/10.1136/bjsm.2003.009357

Baker, J. G., Leddy, J. J., Darling, S. R., Shucard, J., Makdissi, M., & Willer, B. S. (2016). Gender differences in recovery from sports-related concussion in adolescents. *Clinical Pediatrics*, *55*(8), 771–775. https://doi.org/10.1177/0009922815606417

Caron, J. G., Rathwell, S., Delaney, J. S., Johnston, K. M., Ptito, A., & Bloom, G. A. (2018). Development, implementation, and assessment of a concussion education programme for high school student-athletes. *Journal of Sports Sciences*, *36*(1), 48–55. https://doi.org/10.1080/02640414.2017.1280180

Cassidy, J. D., Carroll, L., Peloso, P., Borg, J., Von Holst, H., Holm, L., Kraus, J., & Coronado, V. (2004). Incidence, risk factors, and prevention of mild traumatic brain injury: Results of the WHO Collaborating Centre Task Force on Mild Traumatic Brain Injury. *Journal of Rehabilitation Medicine*, *36*(0), 28–60. https://doi.org/10.1080/16501960410023732

Chrisman, S. P., Schiff, M. A., Chung, S. K., Herring, S. A., & Rivara, F. P. (2014). Implementation of concussion legislation and extent of concussion education for athletes, parents, and coaches in Washington State. *The American Journal of Sports Medicine*, *42*(5), 1190–1196. https://doi.org/10.1177/0363546513519073

Comstock, R. D., Currie, D. W., Pierpoint, L. A., Grubenhoff, J. A., & Fields, S. K. (2015). An evidence-based discussion of heading the ball and concussions in high school soccer. *JAMA Pediatrics*, *169*(9), 830–837. https://doi.org/10.1001/jamapediatrics.2015.1062

Coronado, V. G., Haileyesus, T., Cheng, T. A., Bell, J. M., Haarbauer-Krupa, J., Lionbarger, M. R., Flores-Herrera, J., McGuire, L. C., & Gilchrist, J. (2015). Trends in sports-and recreation-related traumatic brain injuries treated in US emergency departments: The National Electronic Injury Surveillance System-All Injury Program (NEISS-AIP) 2001–2012. *The Journal of Head Trauma Rehabilitation*, *30*(3), 185–197. https://doi.org/10.1097/HTR.0000000000000156

Cournoyer, J., & Tripp, B. L. (2014). Concussion knowledge in high school football players. *Journal of Athletic Training*, *49*(5), 654–658. https://doi.org/10.4085/1062-6050-49.3.34

Daugherty, J., DePadilla, L., & Sarmiento, K. (2019). Effectiveness of the US Centers for Disease Control and Prevention HEADS UP coaches' online training as an educational intervention. *Health Education Journal*, *78*(7), 784–797. https://doi.org/10.1177/0017896919846185

Delaney, J. S., Al-Kashmiri, A., Drummond, R., & Correa, J. A. (2008). The effect of protective headgear on head injuries and concussions in adolescent football (soccer) players. *British Journal of Sports Medicine, 42*(2), 110-115. https://doi.org/10.1136/bjsm.2007.037689

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

Esquivel, A., Haque, S., Keating, P., Marsh, S., & Lemos, S. (2013). Concussion management, education, and return-to-play policies in high schools: A survey of athletic directors, athletic trainers, and coaches. *Sports Health*, *5*(3), 258–262. https://doi.org/10.1177/1941738113476850

Fla. Educ. Code § 1006.20 (2017).
Florida High School Athletic Association. (2017). *Bylaws of the Florida High School Athletic Association, Inc*. https://www.fhsaa.org/sites/default/files/1718_handbook_full_amended_0.pdf
Gessel, L. M., Fields, S. K., Collins, C. L., Dick, R. W., & Comstock, R. D. (2007). Concussions among United States high school and collegiate athletes. *Journal of Athletic Training*, *42*(4), 495–503.
Gourley, M. M., Valovich McLeod, T. C., & Bay, R. C. (2010). Awareness and recognition of concussion by youth athletes and their parents. *Athletic Training and Sports Health Care*, *2*(5), 208–218. https://doi.org/10.3928/19425864-20100524-03
Grady, M. F., Master, C. L., & Gioia, G. A. (2012). Concussion pathophysiology: Rationale for physical and cognitive rest. *Pediatric Annals*, *41*(9), 377–382. https://doi.org/10.3928/00904481-20120827-12
Guilmette, T. J., Malia, L. A., & McQuiggan, M. D. (2007). Concussion understanding and management among New England high school football coaches. *Brain Injury*, *21*(10), 1039–1047. https://doi.org/10.1080/02699050701633080
Gutierrez, G. M., Conte, C., & Lightbourne, K. (2014). The relationship between impact force, neck strength, and neurocognitive performance in soccer heading in adolescent females. *Pediatric Exercise Science*, *26*(1), 33–40. https://doi.org/10.1123/pes.2013-0102
Harmon, K. G., Drezner, J. A., Gammons, M., Guskiewicz, K. M., Halstead, M., Herring, S. A., Kutcher, J. S., Pana, A., Putukian, M., & Roberts, W. O. (2013). American Medical Society for Sports Medicine position statement: Concussion in sport. *British Journal of Sports Medicine*, *47*(1), 15–26. https://doi.org/10.1136/bjsports-2012-091941
Hecimovich, M., & Marais, I. (2017). Examining the psychometric properties of a sport-related concussion survey: A Rasch measurement approach. *BMC Research Notes*, *10*(1), Article 228. https://doi.org/10.1186/s13104-017-2559-z
Hendricks, S., Jordaan, E., & Lambert, M. (2012). Attitude and behaviour of junior rugby union players towards tackling during training and match play. *Safety Science*, *50*(2), 266–284. https://doi.org/10.1016/j.ssci.2011.08.061

Hossler, P., Phang, K. A., & Passannante, M. (2013). New Jersey coaches' knowledge in recognizing and managing concussion. *Internet Journal of Allied Health Sciences and Practice*, *11*(1), 1–9. https://nsuworks.nova.edu/ijahsp/vol11/iss1/10/

Jagoda, A. S., Cantrill, S. V., Wears, R. L., Valadka, A., Gallagher, E. J., Gottesfeld, S. H., Pietrzak, M. P., Bolden, J., Bruns, J. J., Jr., & Zimmerman, R. (2002). Clinical policy: Neuroimaging and decision making in adult mild traumatic brain injury in the acute setting. *Annals of Emergency Medicine*, *40*(2), 231–249. https://doi.org/10.1067/mem.2002.125782

Kay, J. J. M., Melton, C., Holloway, J., & Moore, D. (2018). Gender differences in outcome following pediatric concussion. *Neurology*, *91*(23 Suppl. 1). https://doi.org/10.1212/01.wnl.0000550680.93221.7c

Kim, S., Connaughton, D. P., Spengler, J., & Lee, J. H. (2017). Legislative efforts to reduce concussions in youth sports: An analysis of state concussion statutes. *Journal of Legal Aspects of Sport*, *27*(2), 162–186. https://doi.org/10.1123/jlas.2016-0007

Koerber, A., Graumlich, S., Punwani, I. C., Berbaum, M. L., Burns, J. L., Levy, S. R., Cowell, J. M., & Flay, B. R. (2006). Covariates of tooth-brushing frequency in low-income African Americans from grades 5 to 8. *Pediatric Dentistry*, *28*(6), 524–530. https://europepmc.org/article/MED/17249434

Koutures, C. G., & Gregory, A. J. (2010). Injuries in youth soccer. *Pediatrics*, *125*(2), 410–414. https://doi.org/10.1542/peds.2009-3009

Kroshus, E., Kubzansky, L. D., Goldman, R. E., & Austin, S. B. (2014). Norms, athletic identity, and concussion symptom under-reporting among male collegiate ice hockey players: A prospective cohort study. *Annals of Behavioral Medicine*, *49*(1), 95–103. https://doi.org/10.1007/s12160-014-9636-5

Kurowski, B., Pomerantz, W. J., Schaiper, C., & Gittelman, M. A. (2014). Factors that influence concussion knowledge and self-reported attitudes in high school athletes. *The Journal of Trauma and Acute Care Surgery*, *77*(3), S12–S17. https://doi.org/10.1097/TA.0000000000000316

Kurowski, B. G., Pomerantz, W. J., Schaiper, C., Ho, M., & Gittelman, M. A. (2015). Impact of preseason concussion education on knowledge, attitudes, and behaviors of high school athletes. *The Journal of Trauma and Acute Care Surgery*, *79*, S21–S28. https://doi.org/10.1097/TA.0000000000000675

LaRoche, A. A., Nelson, L. D., Connelly, P. K., Walter, K. D., & McCrea, M. A. (2016). Sport-related concussion reporting and state legislative effects. *Clinical Journal of Sport Medicine*, *26*(1), 33–39. https://doi.org/10.1097/JSM.0000000000000192

Mannings, C., Kalynych, C., Joseph, M. M., Smotherman, C., & Kraemer, D. F. (2014). Knowledge assessment of sports-related concussion among parents of children aged 5 years to 15 years enrolled in recreational tackle football. *Journal of Trauma and Acute Care Surgery*, *77*(3), S18–S22. https://doi.org/10.1097/TA.0000000000000371

Marar, M., McIlvain, N. M., Fields, S. K., & Comstock, R. D. (2012). Epidemiology of concussions among United States high school athletes in 20 sports. *The American Journal of Sports Medicine*, *40*(4), 747–755. https://doi.org/10.1177/0363546511435626

McCrea, M., Hammeke, T., Olsen, G., Leo, P., & Guskiewicz, K. (2004). Unreported concussion in high school football players: Implications for prevention. *Clinical Journal of Sport Medicine*, *14*(1), 13–17. https://doi.org/10.1097/00042752-200401000-00003

McLendon, L. A., Kralik, S. F., Grayson, P. A., & Golomb, M. R. (2016). The controversial second impact syndrome: A review of the literature. *Pediatric Neurology*, *62*, 9–17. https://doi.org/10.1016/j.pediatrneurol.2016.03.009

Mrazik, M., Bawani, F., & Krol, A. L. (2011). Sport-related concussions: Knowledge translation among minor hockey coaches. *Clinical Journal of Sport Medicine*, *21*(4), 315–319. https://doi.org/10.1097/JSM.0b013e31821e2b78

Naftel, K. G., Yust, E. M., Nichols, M. H., King, W. D., & Davis, D. (2014). Knowledge and management of sports concussions among coaches and certified athletic trainers in Alabama. *Southern Medical Journal*, *107*(7), 418–423. https://doi.org/10.14423/SMJ.0000000000000136

National Federation of High School Athletic Associations. (2018). *Participation statistics.* http://www.nfhs.org/ParticipationStatics/ParticipationStatics.aspx/

O'Donoghue, E. M., Onate, J. A., Van Lunen, B., & Peterson, C. L. (2009). Assessment of high school coaches' knowledge of sport-related concussions. *Athletic Training and Sports Health Care*, *1*(3), 120–132. https://doi.org/10.3928/19425864-20090427-07

Pickett, W., Streight, S., Simpson, K., & Brison, R. J. (2005). Head injuries in youth soccer players presenting to the emergency department. *British Journal of Sports Medicine*, *39*(4), 226–231. https://doi.org/10.1136/bjsm.2004.013169

Putukian, M. (2004). Heading in soccer: Is it safe? *Current Sports Medicine Reports*, *3*(1), 9–14. https://doi.org/10.1249/00149619-200402000-00003

Rosenthal, J. A., Foraker, R. E., Collins, C. L., & Comstock, R. D. (2014). National high school athlete concussion rates from 2005–2006 to 2011–2012. *The American Journal of Sports Medicine*, *42*(7), 1710–1715. https://doi.org/10.1177/0363546514530091

Schneider, B., & Cheslock, N. (2003). *Measuring results: Gaining insight on behavior change strategies and evaluation methods from environmental education, museum, health, and social marketing programs*. CoEvolution Institute.

Sefton, J. M., Pirog, K., Capitao, A., Harackiewicz, D., & Cordova, M. L. (2004). An examination of factors that influence knowledge and reporting of mild brain injuries in collegiate football. *Journal of Athletic Training*, *39*(Suppl.), S52–S53.

Setnik, L., & Bazarian, J. J. (2007). The characteristics of patients who do not seek medical treatment for traumatic brain injury. *Brain Injury*, *21*(1), 1–9. https://doi.org/10.1080/02699050601111419

Shenouda, C., Hendrickson, P., Davenport, K., Barber, J., & Bell, K. R. (2012). The effects of concussion legislation one year later—What have we learned: A descriptive pilot survey of youth soccer player associates. *PM&R*, *4*(6), 427–435. https://doi.org/10.1016/j.pmrj.2012.02.016

Singh, A. (2009). Oral health knowledge, attitude, and practice among NCC Navy Cadets and their correlation with oral hygiene in South India. *Oral Health & Preventive Dentistry*, *7*(4), 363–367.

Spengler, J. O., Anderson, P. M., Connaughton, D. P., & Baker, T. A., III. (2016). *Introduction to sport law*. Human Kinetics.

Taylor, M. E., & Sanner, J. E. (2017). The relationship between concussion knowledge and the high school athlete's intention to report traumatic brain injury symptoms: A systematic review of the literature. *The Journal of School Nursing*, *33*(1), 73–81. https://doi.org/10.1177/1059840515619683

Valovich McLeod, T. C., Houston, M. N., & Welch, C. E. (2015). A pediatric perspective on sport-related concussion. *Kinesiology Review*, *4*(2), 131–155. https://doi.org/10.1123/kr.2015-0007

Valovich McLeod, T. C., Schwartz, C., & Bay, R. C. (2007). Sport-related concussion misunderstandings among youth coaches. *Clinical Journal of Sport Medicine*, *17*(2), 140–142. https://doi.org/10.1097/JSM.0b013e31803212ae

Yard, E. E., Schroeder, M. J., Fields, S. K., Collins, C. L., & Comstock, R. D. (2008). The epidemiology of United States high school soccer injuries, 2005–2007. *The American Journal of Sports Medicine*, *36*(10), 1930–1937. https://doi.org/10.1177/0363546508318047