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Physical Education Teachers’ Awareness and Understanding of Concussions, and Concussion Policies and Protocols

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**ABSTRACT**

**Purpose:** Our primary aim was to determine physical educators’ current level of understanding of concussion symptoms and response guidelines. **Method:** Participants included 404 in-service physical educators (137 male, 266 female, 1 other) recruited through 3 SHAPE America – Society of Health and Physical Educators communication outlets. Participants were asked to complete an online survey. The survey included 8 questions related to previous concussion training, 6 items to measure awareness of concussion policies, 20 items related to concussion symptoms, and 14 items for concussion knowledge. Analyses included descriptive statistics and 2 × 2 (Coaching × Concussion) factorial analyses of variance to examine differences in study variables by coaching status and participants’ personal concussion experiences. **Results:** Participants reported they did not have any formal role or responsibility related to concussion management, and more than half reported their districts did not require concussion training. Nevertheless, many physical educators were receiving training (\(n = 291, 72\%\)). Participants who also coached were more aware of concussion policies and systems than were their counterparts, but there were no differences related to concussion facts. **Conclusion:** School districts are generally not requiring concussion management training for physical education teachers or giving them specific responsibilities in the management process, yet many physical educators are getting trained. This training often occurs online and may be required for secondary responsibilities such as coaching. Participants reported being aware of concussion policies and procedures but were less likely to agree that this awareness has resulted in changes in how they teach physical education. Participants also knew more about concussion facts than about the legitimacy of symptoms.

Brain research and epidemiology have prompted a rapid increase in concussion legislation in recent years (Potteiger & Wright, 2016). While most of these laws have focused on youth sport and require concussion education for coaches, it is also important that physical educators are adequately informed. Physical educators are in a unique position to prevent concussion through safety measures, recognize and report potential concussions, and contribute to concussion management (Roetert & Richardson, 2014; Schmies, 2014). While some research has examined concussion awareness among coaches and school nurses, less is known about physical educators’ awareness of concussion protocols, symptoms, and management procedures. In this exploratory study, we sought to address this gap in the literature by surveying physical educators’ concussion-related knowledge.

The Zurich Consensus Statement defines concussion as “a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces” (McCrory et al., 2013, p. 250). Concussions may be caused either by a direct blow to the head, face, or neck or by a blow elsewhere on the body with an “impulsive” force transmitted to the head. The acute clinical symptoms of a concussion vary widely between individuals, which complicates diagnosis (McCrory et al., 2013). Some common indicators of a concussion include physical signs (e.g., difficulty balancing, loss of coordination), behavioral changes (e.g., irritability, difficulty regulating emotions), cognitive impairment (e.g., slowed reaction time, difficulty focusing), or sleep disturbances (e.g., drowsiness; McCrory et al., 2013).

Sports-related concussions within an athletic population have an incidence rate of 1.6 million to 3.8 million per year (Langlois, Rutland-Brown, & Wald, 2006). However, McCrea and colleagues (2003) noted that more than 50% of concussions likely go unreported to health care professionals. Currently, there are gaps in the literature related not...
only to the incidence of concussion in physical education, but also to physical educators’ knowledge of concussion and related issues such as relevant legislation and concussion management. Research focused on coaches’ concussion knowledge has been conducted in recent years (e.g., Guilmette & Mcquiggan, 2007; Mrazik & Jubinville, 2011; O’Donoghue, Onate, Van Lunen, & Peterson, 2009), because the majority of concussion policies include educational requirements for this group (Potteiger & Wright, 2016). O’Donoghue et al. (2009) reported that high school coaches had more knowledge about some aspects of concussion depending on whether or not they had attended concussion education workshops and/or had suffered a concussion themselves. However, no research has examined whether physical educators who also coach have different levels of concussion knowledge than those who do not or whether personal history of concussion may influence physical educators’ level of concussion knowledge.

Physical educators work with youth in activity environments in which concussions could occur and therefore need a basic understanding of the topic (Potteiger & Wright, 2016; Roetert & Richardson, 2014; Schmies, 2014). Our primary aim, therefore, was to determine the current level of understanding of concussion symptoms, policies, and facts among school-based physical educators. Research questions included: (a) Are physical education teachers aware of policies and procedures related to concussions in their particular context? (b) To what extent are physical educators aware of symptoms and facts associated with concussions? And (c) how does physical educators’ awareness of concussion policies, symptoms, and facts vary by coaching status and whether or not they have previously experienced a concussion?

Method

Participants and settings

Participants included 404 in-service physical education teachers (137 male, 266 female, 1 other) from 48 U.S. states and the District of Columbia. Participants were predominantly White (n = 372, 92.1%), and other notable racial affiliations included Mixed Race (n = 10, 2.5%), African American (n = 8, 2.0%), and Hispanic (n = 5, 1.2%). In addition to teaching physical education, many of the participants had experience coaching extracurricular school sports (n = 146, 36.1%), and more than half reported previously having experienced a concussion (n = 226, 55.9%). The average participant was 46.62 years old (SD = 11.21 years) and had been teaching for 19.70 years (SD = 10.58 years). The participants worked in elementary (n = 163, 40.3%), middle (n = 66, 16.3%), and high school (n = 91, 22.5%) environments, with some also reporting that they worked in K-8 (n = 39, 9.6%) and K–12 schools (n = 45, 11.1%). These schools were set in suburban (n = 181, 44.8%), urban (n = 120, 29.7%), and rural (n = 103, 25.5%) environments, most of which did not have athletic trainers (n = 281, 69.6%) but did have full- or part-time nurses (n = 375, 92.8%).

Procedures and instrumentation

Prior to the initiation of research, exempt status was obtained through the first author’s institutional review board. Participants were recruited through an open sampling procedure (Strauss & Corbin, 2015), which is a variant of convenience sampling as anyone who meets the inclusion criteria (i.e., current K–12 physical educator) and expresses interest is invited to participate. The researchers partnered with SHAPE America – Society of Health and Physical Educators to reach potential participants through three outlets: (a) posts in the Exchange online discussion board; (b) an invitation in the electronic membership newsletter, Momentum; and (c) direct email messages to physical educators who were organization members. Those interested in participating were asked to follow a URL link to an online survey and provided consent before following prompts to begin the research. There were 67 total items on the survey, including a 27-item background questionnaire, 6 items to measure awareness of concussion policies, 20 items related to concussion symptoms, and 14 items for concussion knowledge.

Awareness of concussion policies

Physical educators’ awareness of concussion policies was measured using six items created for the purposes of this study. The items were written to reflect awareness of state- and school-level policies related to concussions that influence physical education and reflect relevant concussion trends such as return-to-play procedures (Halstead et al., 2013; Olympia, Ritter, Brady, & Bramley, 2015; Potteiger & Wright, 2016). Prior to implementation, a panel of four experts checked the items for content representativeness (Schutz & Park, 2004). The six items were set to a 5-point, Likert-type scale ranging from strongly disagree (1) to strongly agree (5). A confirmatory factor analysis supported factorial validity, χ²(9) = 28.43, p < .001; the root mean square error of approximation = .07 (90% CI [0.043, 0.104], p = .092), standardized root mean residual = .03, Non-Normed Fit Index = .97, Comparative Fit Index = .98, and internal consistency reliability were good (Cronbach’s α = .83).
Concussion symptoms
Awareness of concussion symptoms was measured using 20 items adopted from Register-Mihalik and colleagues’ (2013) survey for measuring concussion knowledge in high school athletes. This particular survey was targeted because it includes questions related to the basic signs and symptoms of concussions. Participants responded to the items using a binary (i.e., true/false) scale, and example items include “abnormal sense of smell” (false), “blurred vision” (true), and “nausea” (true). Internal consistency reliability has been documented in previous research (Cronbach’s α = .72; Register-Mihalik et al., 2013) and was adequate in the current study (Cronbach’s α = .70).

Concussion knowledge
Concussion knowledge was evaluated with 14 items adapted from the Concussion Knowledge Index (Rosenbaum & Arnett, 2010). These 14 items were selected because they deal directly with misconceptions related to concussions. The items present a series of facts and misconceptions related to concussions and ask participants to identify if each item is true or false on a binary rating scale. Sample items include, “After a concussion, people can forget who they are and not recognize others but be perfect in every other way” (false), “Symptoms of a concussion can last for several weeks” (true), and “A concussion can only occur if there is a direct hit to the head” (false). Rosenbaum and Arnett (2010) did not report internal consistency reliability for the Concussion Knowledge Index, but internal consistency for the 14 items used in this study was adequate (Cronbach’s α = .74).

Data analysis
The data analysis began with standard procedures for data cleaning and screening (Tabachnick & Fidell, 2013). Composite scores were then created by adding correct responses related to each of the concussion symptoms and concussion knowledge to create two variables representing the total number of correct responses for each variable (concussion symptoms maximum = 20, concussion knowledge maximum = 14). The composite score for awareness of concussion policies was created by averaging the six associated items. Analyses then included a series of descriptive and inferential statistics. Descriptive statistics were collected at the item level related to concussion symptoms and knowledge and focused on the percent correct responses. Inferential statistics included 2 × 2 (Coaching × Concussion) factorial analyses of variance (ANOVAs) to examine differences in composite scores based on whether or not participants coached extracurricular sports and had a previous concussion. Partial η² is presented as a measure of effect size for ANOVAs (Warner, 2012), and the a-priori level of significance was set to α = .05.

Results

Concussion training
Many participants (n = 309, 76.5%) reported they did not have any formal responsibility for concussion management, and more than half reported their districts did not require concussion training for physical education teachers (n = 246, 60.9%). However, most of the participants had received some training in the previous 2 years (n = 291, 72%). The average reported training was 79.28 min (SD = 69.74 min) and was more likely to be conducted online (n = 178, 61.2%) than in person (n = 44, 15.1%) or in a hybrid format (n = 69, 23.7%). This training was administered by a variety of entities including state associations for athletics (n = 87, 29.9%), participants’ school districts (n = 82, 28.2%) or schools (n = 36, 12.4%), the Centers for Disease Control and Prevention (n = 29, 10.0%), a national organization for sport or physical education (n = 28, 9.6%), a specific sport league (n = 19, 6.5%), or other entities (n = 10, 3.4%).

Awareness of concussion policy
Table 1 provides an overview of participants’ responses to six questions related to awareness of concussion policies. On the 5-point scale, most responses were moderate to high. The highest responses were related to knowing where to take a student if a concussion was suspected (Item 4, M = 4.49, SD = 0.88) and understanding of concussion education requirements (Item 3, M = 4.07, SD = 1.35). The lowest-rated items related to participants reporting that concussion policies changed how they teach physical education (Item 6, M = 3.12, SD = 1.34) and understanding state policies related to concussions (Item 1, M = 3.51, SD = 1.23). A 2 × 2 (Coaching × Concussion) factorial ANOVA related to awareness of concussion policies included a main effect for coaching status, F(1, 400) = 26.45, p < .001, partial η² = .062. This result indicated that physical educators who coached (M = 4.06, SD = 0.73) were more aware of policies than those who did not coach (M = 3.59, SD = 1.00).
Knowledge of concussion symptoms

Participants responded to 20 true/false questions related to whether or not certain symptoms were associated with concussions (see top panel of Table 2). Four items were more often answered incorrectly than correctly. These items included “bleeding from the ear” (30.3% correct), “weakness in neck movements” (33.2% correct), “sharp burning pain in neck” (43.1% correct), and “bleeding from the nose” (45.7% correct). The most accurately answered questions included “blurred vision” (100.0% correct), “dizziness” (99.8% correct), and “confusion” (99.8% correct). The aggregate mean score was 14.27 (SD = 3.09), or 71.4%, and scores ranged from 4.0 (20.0%) to 20.0 (100%). The 2 × 2 (Coaching × Concussion) factorial ANOVA for knowledge of concussion symptoms included a significant main effect for coaching status, F(1, 400) = 16.57, p < .001, partial η² = .040. This main effect indicated that participants who also coached (M = 15.07, SD = 2.95) were more likely to correctly identify the symptoms of a concussion than those who did not coach (M = 13.80, SD = 3.08).

Knowledge of concussion facts

Participants responded to 14 true/false-style questions related to concussion facts (see bottom panel of Table 2). Three questions were answered incorrectly more often than they were answered correctly. They included Questions 13 (9.3% correct), 10 (24.5% correct), and 8 (47.0% correct). The most accurately answered questions included Questions 6 (99.8% correct), 3 (99.3% correct), and 9 (99.0% correct). The aggregate mean score was 11.43 (SD = 1.30), or 81.6%. Scores ranged from a low of 5.0 (35.7%) to a high of 14.0 (100.0%). The 2 × 2 (Coaching × Concussion) factorial ANOVA for knowledge of concussion facts revealed that the main effects for coaching and concussion and the

Table 1. Participants’ awareness of policies and procedures related to concussion management.

<table>
<thead>
<tr>
<th>Item</th>
<th>M</th>
<th>SD</th>
<th>Median</th>
<th>IQR</th>
<th>Min</th>
<th>Max</th>
<th>Skew</th>
<th>Kurt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I understand my state’s current concussion legislation.</td>
<td>3.51</td>
<td>1.23</td>
<td>4.00</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>−0.65</td>
<td>−0.44</td>
</tr>
<tr>
<td>2. I understand my school district’s current concussion policy/action plan.</td>
<td>3.78</td>
<td>1.30</td>
<td>4.00</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>−0.95</td>
<td>−0.20</td>
</tr>
<tr>
<td>3. I know what concussion education requirements I must follow, given my current roles and responsibilities at my school.</td>
<td>3.88</td>
<td>1.35</td>
<td>4.00</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>−1.05</td>
<td>−0.13</td>
</tr>
<tr>
<td>4. I know what steps I should take if I suspect a student in my physical education class may have suffered a concussion.</td>
<td>4.49</td>
<td>0.88</td>
<td>5.00</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>−2.37</td>
<td>6.15</td>
</tr>
<tr>
<td>5. I know if my school/district has a return-to-play protocol in place.</td>
<td>3.80</td>
<td>1.36</td>
<td>4.00</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>−0.84</td>
<td>−0.47</td>
</tr>
<tr>
<td>6. I have made changes to the way I teach physical education to reduce the risk for concussion.</td>
<td>3.12</td>
<td>1.44</td>
<td>4.00</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>−0.19</td>
<td>−1.38</td>
</tr>
</tbody>
</table>

Note. N = 404 in-service physical education teachers; IQR = interquartile range; min = minimum; max = maximum; skew = skewness; kurt = kurtosis.

Table 2. Participants’ knowledge of concussion symptoms and facts.

<table>
<thead>
<tr>
<th>Concussion Symptoms</th>
<th>%C</th>
<th>%IC</th>
<th>Concussion Symptoms</th>
<th>%C</th>
<th>%IC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Abnormal sense of smell</td>
<td>55.8%</td>
<td>44.2%</td>
<td>11. Fever</td>
<td>80.4%</td>
<td>19.6%</td>
</tr>
<tr>
<td>2. Abnormal sense of taste</td>
<td>58.4%</td>
<td>41.6%</td>
<td>12. Dizziness</td>
<td>99.6%</td>
<td>0.2%</td>
</tr>
<tr>
<td>3. Amnesia</td>
<td>95.2%</td>
<td>4.8%</td>
<td>13. Headache</td>
<td>99.3%</td>
<td>0.7%</td>
</tr>
<tr>
<td>4. Joint stiffness</td>
<td>64.4%</td>
<td>35.6%</td>
<td>14. Insomnia</td>
<td>72.5%</td>
<td>27.5%</td>
</tr>
<tr>
<td>5. Blurred vision</td>
<td>100%</td>
<td>0.0%</td>
<td>15. Loss of consciousness</td>
<td>97.8%</td>
<td>2.2%</td>
</tr>
<tr>
<td>6. Black eye</td>
<td>51.5%</td>
<td>48.5%</td>
<td>16. Nausea</td>
<td>98.8%</td>
<td>1.2%</td>
</tr>
<tr>
<td>7. Bleeding from the ear</td>
<td>30.3%</td>
<td>69.7%</td>
<td>17. Numbness or tingling of arms</td>
<td>61.9%</td>
<td>38.1%</td>
</tr>
<tr>
<td>8. Bleeding from the mouth</td>
<td>57.9%</td>
<td>42.1%</td>
<td>18. Skin rash</td>
<td>94.9%</td>
<td>5.1%</td>
</tr>
<tr>
<td>9. Bleeding from the nose</td>
<td>45.7%</td>
<td>54.3%</td>
<td>19. Sharp burning pain in neck</td>
<td>43.1%</td>
<td>56.9%</td>
</tr>
<tr>
<td>10. Confusion</td>
<td>99.8%</td>
<td>0.2%</td>
<td>20. Weakness in neck movements</td>
<td>33.2%</td>
<td>66.8%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concussion Facts</th>
<th>%C</th>
<th>%IC</th>
<th>Concussion Facts</th>
<th>%C</th>
<th>%IC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sometimes a second concussion can help a person remember things that were forgotten after the first concussion.</td>
<td>92.2%</td>
<td>7.8%</td>
<td>8. After a concussion occurs, brain imaging typically shows visible physical damage (e.g., bruise, blood clot) to the brain.</td>
<td>47.0%</td>
<td>53.0%</td>
</tr>
<tr>
<td>2. After a concussion, people can forget who they are and not recognize others but be perfect in every other way.</td>
<td>63.3%</td>
<td>36.7%</td>
<td>9. If you receive one concussion and you have never had a concussion before, you will become less intelligent.</td>
<td>99.0%</td>
<td>1.0%</td>
</tr>
<tr>
<td>3. To be diagnosed with a concussion, you have to be knocked out.</td>
<td>99.3%</td>
<td>.7%</td>
<td>10. After 10 days, symptoms of a concussion are usually completely gone.</td>
<td>24.5%</td>
<td>75.5%</td>
</tr>
<tr>
<td>4. A concussion can only occur if there is a direct hit to the head.</td>
<td>91.1%</td>
<td>8.9%</td>
<td>11. There is a possible risk for death if a second concussion occurs before the first one heals.</td>
<td>89.5%</td>
<td>10.5%</td>
</tr>
<tr>
<td>5. Being knocked unconscious always causes permanent damage to the brain.</td>
<td>86.8%</td>
<td>13.2%</td>
<td>12. Concussions can sometimes lead to emotional disruptions.</td>
<td>96.5%</td>
<td>3.5%</td>
</tr>
<tr>
<td>6. Symptoms of a concussion can last for several weeks.</td>
<td>99.8%</td>
<td>.2%</td>
<td>13. An athlete who gets knocked out after getting a concussion is experiencing a coma.</td>
<td>9.3%</td>
<td>90.8%</td>
</tr>
<tr>
<td>7. People who have had one concussion are more likely to have another concussion.</td>
<td>86.6%</td>
<td>13.2%</td>
<td>14. There is rarely a risk to long-term health and well-being from multiple concussions.</td>
<td>90.5%</td>
<td>9.5%</td>
</tr>
</tbody>
</table>

Note. N = 404 in-service physical education teachers. Items in italics are misconceptions about concussions and should have been answered "false." %C = percentage of participants answering correctly; %IC = percentage of participants answering incorrectly.
Coaching × Concussion interaction effect were all not significant, indicating there were no differences in knowledge of concussion facts.

Discussion and conclusions

The results of this cross-sectional, exploratory survey indicate several findings of interest to the physical education community. First, although school districts are generally not requiring concussion management training for physical educators or giving them specific responsibilities in the management process, many physical educators are getting trained. This training is primarily occurring online and may be driven by secondary responsibilities (e.g., coaching). Second, participants reported being fairly aware of concussion policies and procedures but were less likely to agree that this awareness has translated into any changes in how they teach. Thus, physical educators may benefit from targeted trainings to illustrate how concussion management should influence teaching practices. Third, while many participants demonstrated knowledge of concussion symptoms and facts, some common misconceptions need to be clarified. These findings should be interpreted with the understanding that the teachers in this study were generally older and skewed toward having more years of experience. Younger teachers may be more aware of concussion trends, symptoms, and protocols.

Concussion laws in most states specify training for coaches (Potteiger & Wright, 2016), so it is not surprising that participants who also coached were more likely to have received such training, were more aware of policies, and could more accurately identify symptoms. However, according to Roetert and Richardson (2014), “Concussions often occur in sports, but keep in mind that the possibility of impact also exists in physical education classes and other physical activity settings” (p. 18). The risk for concussion is inherently high in physical education, so physical educators should be among the most well-educated members of the school community on this topic. Physical educators could be an important part of the concussion care team but are often overlooked. Guidelines and best practice for increasing physical educators’ involvement are available at https://www.shapeamerica.org/standards/guidelines/Concussion/default.aspx.

The results reported here address a gap both in the research literature and in concussion policies related to physical educators’ knowledge. To protect the safety and health of students in physical education, further research, professional development, and guidelines are necessary. The current study should, however, be considered with a few limitations. The survey was distributed through various outlets maintained by SHAPE America, so we were not able to calculate a response rate. It is also possible that physical educators who are not members of SHAPE America may have different views. The data presented in this study are largely descriptive and do not allow us to look at knowledge changes over time. Further, due to the cross-sectional nature of the study, test–retest reliability of the survey items was not examined and should be considered in future research. Finally, although some of the instruments had been previously validated, they had not been used with physical educators and the items on awareness of concussion policy were created for this study.

What does this article add?

In conclusion, we are reminded that the risk for concussion in physical activity is high, whether it is in organized sport activities or in a physical education class. It is therefore important that not only coaches, but also physical educators understand the signs and symptoms of a concussion as well as prevention strategies and the importance of joining the concussion management team. The results reported here address a gap that exists in both the research literature and in physical educators’ knowledge related to concussion. It is vitally important to protect the safety and health of students in physical education. Therefore, further research, professional development opportunities, and policies for physical education are necessary.

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