

## Consensus Statement on Sports-Related Concussions in Youth Sports Using a Modified Delphi Approach

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**IMPORTANCE** Given the importance of sports-related concussions among youth athletes, the rapid progress of research on this topic over the last decade, and the need to provide further guidance to youth athletes, their families, medical professionals, and athletic personnel and organizations, a panel of experts undertook a modified Delphi consensus process to summarize the current literature and provide recommendations regarding the prevention, assessment, and management of sports-related concussions for young athletes.

**METHODS** A consensus panel of 11 experts was created to represent a broad spectrum of expertise in youth sports and concussions. The specific questions to be addressed were developed through an iterative process consisting of 3 rounds, and a review of the literature was conducted to identify research studies related to each question. The consensus panel used a modified Delphi process to reach consensus on the conclusions and recommendations for each question.

**RESULTS AND CONCLUSIONS** In 3 Delphi consensus rounds, 7 questions were addressed by the consensus panel of 11 experts, and 26 recommendations for the prevention, assessment, and management of sports-related concussions among young athletes were developed. For many of the questions addressed in this consensus statement, limitations existed in the quantity and quality of the evidence available to develop specific recommendations for youth sports stakeholders.

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### + Supplemental content

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In the last few years, substantial attention has been given to the problem of sports-related traumatic brain injury, including concussion. Most of the research has focused on athletes at the professional and collegiate levels, with limited studies conducted among youth athletes. The Institute of Medicine<sup>1</sup> produced a consensus report on sports-related concussions (SRCs) in youths, which reviewed the existing literature on the topic and made general recommendations about areas for further research. However, this report was released more than 5 years ago, and it did not provide specific recommendations to guide youth athletes and their families, medical professionals, and athletic personnel and organizations. The latest Consensus Statement on Concussion in Sport<sup>2</sup> addressed some of the pertinent issues regarding SRCs incurred by younger athletes. The recent Centers for Disease Control and Prevention guidelines<sup>3</sup> on mild traumatic brain injury among children and adolescents focused on the diagnosis, prognosis, and management of these injuries but did not include any recommendations related to prevention.

Concerns about concussions in youth athletes are occurring against the backdrop of an obesity epidemic among children and adolescents in the United States and many high-income countries, owing in part to increases in screen time and sedentary behavior.<sup>4</sup> The 2018 *Physical Activity Guidelines for Americans* by the US Department of Health and Human Services<sup>4</sup> examined the evidence for and

benefits of health-related physical activity across the lifespan, recommending moderate to vigorous physical activity every day and vigorous activity at least 3 times per week.

Organized sports offer a way for children and adolescents to engage in moderate to vigorous physical activity, but fear of injury may cause some parents to choose not to enroll their children in contact or collision sports, which may lead to fewer children meeting the recommended guidelines for physical activity. Thus, understanding what the scientific evidence tells us about the risk of injury is important for youth athletes and their families.

Given the importance of SRCs among youth athletes, the rapid progression of research on this topic during the last decade, and the need to provide further guidance to youth athletes and their families, medical professionals, and athletic personnel and organizations, we undertook a consensus process to summarize the current literature from January 1, 1980, through December 31, 2018, and provide recommendations regarding the prevention, assessment, and management of SRCs in youth athletes.

### Methods

A consensus panel was created to represent a broad spectrum of expertise in the fields of youth sports and concussion. This panel in-

cluded 11 experts in pediatrics, pediatric neurology, pediatric neurosurgery, pediatric neuropsychology, physical medicine and rehabilitation, sports and exercise medicine, athletic training, physical activity, and sports injury epidemiology and prevention.

The panel convened to develop evidence-based consensus recommendations on the epidemiology, prevention, and outcomes of SRCs in youth athletes, defined as individuals younger than 19 years, including those in high school, junior high school, and elementary school. The funders of the consensus panel had no role in the development of the questions, conclusions, or recommendations.

The specific questions to be addressed were developed through an iterative process of 3 rounds involving telephone calls and email communications between panel members. After the questions were determined (**Box**), a review of the literature was conducted from September 1, 2017, to March 30, 2019, to identify research studies related to each question. This review was performed with the assistance of a reference librarian, and it included research published from January 1, 1980, through December 31, 2018, which was supplemented with literature recommended by the panel experts. Specific search terms, inclusion and exclusion criteria, and databases searched are shown in eTable 1 in the **Supplement**.

The panel used a modified Delphi process to reach consensus on the conclusions and recommendations for each question. The Delphi process is a validated method of achieving consensus<sup>5,6</sup> that has been widely used by experts in a variety of fields, including injury control<sup>7</sup> and traumatic brain injury.<sup>8,9</sup>

For each question, a summary of the evidence and a list of relevant studies were compiled (eAppendix in the **Supplement**). Evidence summaries, lists of all studies reviewed, and draft conclusions based on the evidence were developed by a study team (F.P.R. and R.T.) and sent to the consensus panel (eFigure 1, eFigure 2, and eTables 2-4 in the **Supplement**). Panel members then ranked each of the conclusions on a scale of 1 to 9, in which 1 represented the lowest level of support and 9 the highest. Panel members were also asked to comment on each conclusion and suggest wording alterations or additional conclusions. Conclusions that received a mean score of less than 7 were removed from further consideration. Revised conclusions were then sent to the consensus panel and votes were compiled. Any revised conclusions that received a mean score of less than 7 were removed. This same process was followed for evidence-based recommendations, which comprised actions that youth sports professionals should perform to aid in the prevention of injury.

After a penultimate draft of the conclusions and recommendations was developed, a 1-day in-person meeting was held with all panel members. The findings for each question were reviewed, draft conclusions were discussed, and wording was edited before a confidential electronic vote was held. Any conclusions that received a mean score of less than 5 were removed, and those that received a mean score of 7 or greater were adopted. Conclusions that received an intermediate score of 5 or 6 were further discussed and revised to improve clarity or better represent the state of the evidence. Another confidential electronic vote was taken, and only conclusions with a final mean score of 7 or greater were adopted.

The same process was then used to develop and achieve consensus on recommendations. Each recommendation was discussed at length, wording changes were made as suggested, and additional recommendations were added. Confidential electronic votes

#### Box. Questions Considered by the Consensus Panel

##### Question 1

What is the risk of concussion in youth sports participants by sport, sex, level of play, and age as measured by concussions per 100 participants per season, concussions per 1000 participant exposures, or some other concussion rate? Is this risk modified by sex, attention-deficit/hyperactivity disorder, previous learning problems, preexisting anxiety, and/or preexisting depression?

##### Question 2

What evidence exists to suggest that a specific age or time in the growth and development of youth athletes is safer, in terms of lower risk of concussion and lower risk of mid-term and long-term health problems, for introducing them to contact or collision sports? What evidence exists regarding the developmental readiness of youth athletes to learn and safely perform proper contact-related techniques?

##### Question 3

What evidence exists to suggest that the use of modified sports rules, policies, and practices (eg, field size, equipment, rules of play, size of balls, team size, and coaching techniques) is associated with improved safety, especially with regard to concussion, among youth athletes participating in developmental sports leagues? What evidence exists to suggest that teaching contact or collision techniques (eg, how to make and receive tackles in American football) at a younger age is associated with increased efficacy and decreased risk of injury?

##### Question 4

What evidence exists to suggest that (a) repetitive head impact exposure or (b) multiple documented concussions incurred during youth participation in contact or collision sports are associated with long-term cognitive and neurological harm (eg, prolonged recovery from concussion, cognitive impairment, mental health problems including depression and anxiety, chronic headaches, and chronic degenerative neurological diseases identified through imaging tests or at autopsy, such as chronic traumatic encephalopathy)?

##### Question 5

What evidence exists to suggest that the use of protective equipment is associated with a reduced risk of concussion in youth athletes?

##### Question 6

What proportion of youth athletes playing contact or collision sports goes on to participate in noncontact sports after the option to play contact or collision sports is removed?

##### Question 7

What evidence exists to recommend that a youth athlete should discontinue playing a sport (or redirect to playing other sports) when multiple concussions were incurred in the sport setting?

were conducted, and only those recommendations with a mean score of 7 or greater were included. Only panel members were eligible to vote, and staff members who provided support during the study process were not eligible.

The full summaries of evidence for each question are shown in the eAppendix in the **Supplement**. This report includes the consensus panel conclusions. The questions, conclusions, and recommendations are presented verbatim from the actual modified Delphi consensus process.

## Results

### Question 1

What is the risk of concussion in youth sport participants by sport, sex, level of play, and age, stated as concussions per 100 participants per season, per 1000 participant exposures or some other rate? Is this risk modified by sex, attention-deficit/hyperactivity disorder (ADHD), prior learning problems, preexisting anxiety and/or depression?

#### Conclusions

Extensive research exists on the overall rates of SRCs, including data by sport, sex, and age. The panel concluded the following:

1. There has been an increase in the reporting of SRCs in recent years.
2. Contact and collision sports have higher rates of SRCs than non-contact sports.
3. Males, regardless of age, have a higher rate of reported SRCs than females in youth sports overall.
4. Adolescent females have a higher rate of reported SRCs than their male counterparts in sports that are played by both sexes by the same rules (eg, soccer, basketball) given comparable playing rules and conditions.
5. The data on whether age per se modifies the risk of concussion is inconclusive.
6. There is a strong association of risk of SRCs with history of prior SRCs.
7. It is unclear how preexisting mental health conditions, including anxiety, depression and ADHD, influence the risk of SRCs occurring in youth.

#### Recommendations

Based on this evidence, the panel makes the following recommendations:

**Recommendation 1a** | Parents, youth sport participants, coaches, and other stakeholders should be educated that contact and collision sports are associated with an increased risk of concussions compared to noncontact sports in both male and female youth.

**Recommendation 1b** | Parents, youth sport participants, coaches, and other stakeholders should be educated that a history of concussion(s) (compared to no prior concussions) is associated with an increased risk of subsequent concussions.

**Recommendation 1c** | Further prospective studies using validated surveillance methods are needed to understand the contribution of age, sex, and preexisting mental health conditions to concussion risk in youth sport participants.

### Question 2

What is the evidence that a specific age or time in the growth and development of youth is safer, in terms of lower risk of concussion and lower risk of mid- and long-term problems, for introducing them to contact or collision sports? What evidence exists for the developmental readiness of children to learn and perform proper contact-related techniques safely?

#### Conclusions

The literature described a complex association between SRC risk and age depending on the sport. We were unable to identify specific literature that investigated the ways in which youth sports participants learned and conducted proper contact techniques across age levels. The panel concluded the following:

1. The data on association of age and risk of SRCs are inconclusive.
2. There is no evidence that growth or development affect the risk of SRCs in youth sports participants.
3. There is a lack of evidence on how sex may interact with age and risk of SRCs.
4. It is unclear at what age youth are best able to learn and perform proper contact techniques.
5. The age at which youth are best able to learn and perform proper contact techniques may differ by sport.
6. The age and level of play at which full contact is optimally introduced is sport-specific and requires more research.
7. The effect of full-contact experience on risk of concussion in collision sport may be sport-specific and remains unclear.

#### Recommendations

Based on this evidence, the panel makes the following recommendations:

**Recommendation 2a** | There is not a recommended age or developmental stage at which contact and collision are most safely introduced for practice or competition. This is true for both female and male youth.

**Recommendation 2b** | Youth should be taught sport-specific contact techniques before contact or collision is introduced.

**Recommendation 2c** | Research is needed to evaluate developmental readiness to learn and perform sport-specific contact and collision techniques.

**Recommendation 2d** | Research is needed to evaluate methods of teaching sport-specific contact and collision techniques.

### Question 3

What evidence exists to suggest that employing modified sports rules, policies and practices (eg, field size, equipment, rules of play, size of balls, team size, coaching practices) will make "developmental sports leagues" safer for children and adolescents, especially with regard to concussions? What evidence exists that teaching contact or collision techniques (eg, making and taking tackles) at a younger age improves efficacy and diminishes injury risk?

#### Conclusions

It is important to realize that new SRC reporting and assessment rules may be associated with the increase in SRC reporting during the last decade. Thus, assessing the association between changes in sports rules and the risk of SRCs was difficult, except in specific instances. The panel concluded the following:

1. Disallowing body checking (ie, using the hips or entire body to make contact with an opposing player) in games in boys' ice hockey reduces the risk of SRCs in youth younger than 13 years. This rule change may be associated with an increased risk of in-

- juries (those resulting in more than 7 days of time loss) once checking is introduced in older youth (13- to 14- year-olds), but not SRCs or all injuries overall. The number of injuries resulting in time loss more than 7 days may be lower than that averted by delaying body checking to older ages.
2. Limiting contact in practices in American tackle football reduces head impacts but it is unclear that this reduces the overall rate of SRCs.
  3. There is no evidence that limiting heading (ie, hitting the ball with the top front of the head) in youth soccer reduces the risk of SRCs.
  4. There is limited evidence that fair play rules reduce SRCs in youth sports.
  5. There is limited and inconclusive evidence on whether teaching safer training techniques by itself significantly reduce SRC risk.
  6. There is limited evidence on the effectiveness of training and conditioning in reducing the risk of SRCs in youth.

### Recommendations

Based on this evidence, the panel makes the following recommendations:

**Recommendation 3a** | Body checking should be delayed in games until age 13 years for ice hockey players to decrease the risk of concussion.

**Recommendation 3b** | Limiting contact and collision in practice in American tackle football should be considered.

**Recommendation 3c** | Research evaluating policy and training for sport-specific contact and collision techniques is needed across age groups and levels of play.

**Recommendation 3d** | Research evaluating sport-specific rule enforcement and fair play is needed across age groups and levels of play.

### Question 4

What evidence exists to suggest that (a) repetitive head impact exposure or (b) multiple documented concussions incurred during youth participation in collision/contact sports results in long-term cognitive and neurological harm (eg, prolonged recovery from concussion, cognitive impairment, mental health problems including depression and anxiety, chronic headaches, and chronic degenerative neurological diseases seen on imaging or at autopsy such as chronic traumatic encephalopathy)?

### Conclusions

The technologies used to measure the outcomes discussed in this question have evolved over the last decade and continue to do so. In addition, it is difficult to identify associations between the longitudinal evidence and outcomes from studies of former players and those of current youth athletes because the rules, equipment, and cultures surrounding contact and collision sports, including US tackle football (the most studied sport in this literature), have changed. It is unclear whether youth athletes who play contact or collision sports are currently at a greater risk of repetitive head impact than they were in previous decades. Larger and faster players and the use of protective equipment as a weapon may be associated with an increased risk of concussion for current players; conversely, a lack of

protective equipment, fewer protective rules, and underidentification of concussive impacts may have been associated with an increased risk of concussion for those playing contact or collision sports in previous decades. The panel concluded the following:

1. The association between repetitive head impact exposure and changes on neuroimaging in youth is inconsistent and the clinical implications of these changes are unknown.
2. High-quality data show no association between repetitive head impact exposure in youth and long-term neurocognitive outcomes.
3. Experiencing multiple concussions in youth is one risk factor among many that may be associated with more long-lasting symptoms and longer recovery.
4. The evidence is inconclusive as to whether multiple concussions in youth are associated with long-term neurological changes.
5. There is little evidence that age at first exposure to repetitive head impacts in sports is independently associated with neurodegenerative changes.

### Recommendations

Based on this evidence, the panel makes the following recommendations:

**Recommendation 4a** | A history of concussion(s) should be taken into consideration when recommending if and when a player should return to play.

**Recommendation 4b** | Technologies to measure head impact exposure are research tools that require further development and validation prior to clinical use.

**Recommendation 4c** | Advanced neuroimaging methods are research tools that require further development and validation prior to clinical use.

**Recommendation 4d** | Prospective, longitudinal studies to assess both short- and long-term neurological and neuropsychological outcomes related to repetitive head impact exposure are needed.

**Recommendation 4e** | Prospective, longitudinal studies to assess both short- and long-term neurological and neuropsychological outcomes related to multiple documented concussions are needed.

### Question 5

What is the evidence that equipment can reduce the risk of concussion in youth athletes?

### Conclusions

Our review found 2 potential strategies for reducing SRCs through the use of protective equipment—specifically headgear/helmets, and mouth guards—among youth athletes. Studies have examined the effectiveness of padded headgear, full helmets, and mouth guard use in protecting the head from direct trauma. One concern discussed in the literature has been related to risk compensation. For example, it has been suggested that athletes who wear protective equipment may increase their risky behavior such that their level of risk while wearing protective equipment is no different than it is while not wearing protective equipment. The available data do not sup-

port the theory of risk compensation through the use of protective equipment in youth sports. The panel concluded the following:

1. There is limited evidence that modern helmets differ in their ability to reduce the risk of concussion for youth playing American football.
2. The available evidence indicates that current headgear does not reduce the risk of SRCs in youth rugby.
3. There is little evidence that current headgear reduces the risk of SRCs in youth soccer.
4. There is little evidence that mouth guards reduce the risk of SRCs in youth sports.
5. There are no data to suggest that using equipment perceived as being more protective increases the risk of SRCs in youth by creating a false sense of security leading to more dangerous behavior.

#### Recommendations

Based on this evidence, the panel makes the following recommendations:

**Recommendation 5a |** Helmets should be worn in sports with a high risk of contact to the head, such as American tackle football, ice hockey, boys' lacrosse, downhill skiing, snowboarding, skateboarding, and bicycling.

**Recommendation 5b |** There is little evidence to recommend the use of current headgear to prevent concussion in rugby.

**Recommendation 5c |** There is little evidence to recommend the use of current headgear to prevent concussion in soccer.

**Recommendation 5d |** Research evaluating the effect of protective equipment (eg, headgear, mouth guards) fit, type, and condition on risk of concussion is needed.

#### Question 6

What proportion of contact or collision sport athletes go on to participate in noncontact sports after contact or collision options are removed?

#### Conclusions

We did not find any peer-reviewed analyses or resources that addressed this question. The panel concluded the following:

1. Due to a lack of peer-reviewed evidence, it is unclear whether the removal of contact or collision sports will change activity levels for youth.
2. Due to a lack of peer-reviewed evidence, it is unclear whether the removal of contact or collision sports will lead youth to participate in noncontact or noncollision sports or noncollision/noncontact forms of the removed sport.

#### Recommendations

Based on this evidence, the panel makes the following recommendations:

#### Recommendation 6a |

In the absence of medical contraindication, youth should not be restricted in their choice of sport.

#### Recommendation 6b |

Research is needed to examine the relationship between policy change disallowing contact or collision and subsequent sport participation or physical activity.

#### Question 7

What is the evidence to recommend youth player retirement (or redirection to other sports) in the setting of multiple concussions?

#### Conclusions

No clear evidence existed regarding the specific number of concussions that should lead to a recommendation that a youth athlete discontinue playing a sport, and limited evidence existed regarding whether the discontinuation or continuation of participation in a sport was associated with long-term brain health and well-being. The panel concluded the following:

1. There are some relative contraindications to continuing to play a contact or collision sport, including: trauma-related structural brain abnormalities identified on neuroimaging, persistent neurological abnormalities on physical examination, persistent post-concussive symptoms, permanent deficit on neuropsychological testing, prior history of intracranial hemorrhage, arachnoid cyst, Chiari malformation, and other relevant neurological diseases.
2. There is no evidence for deciding a maximum number of lifetime concussions necessitating retirement from contact or collision sports.

#### Recommendations

Based on this evidence, the panel makes the following recommendations:

#### Recommendation 7a |

Retirement decisions from contact or collision sports in youth should not be based solely on the number of concussions.

#### Recommendation 7b |

Retirement decisions from contact or collision sports should typically be a shared decision involving the youth, parents, and medical providers based on multiple factors, including the risks and benefits of continuing the sport.

#### Recommendation 7c |

Discussions with youth athletes and parents about retiring or taking time off from contact or collision sports should consider factors including the specific sport(s), number of concussions, multiple concussions within a single season, persistent post-concussive symptoms, worsening post-concussive symptoms with subsequent concussions, diminished academic performance, diminished athletic performance, medical and neurological conditions, and increasing susceptibility to SRC with decreasing impacts (ie, lowering threshold for concussion).

#### Recommendation 7d |

Research is needed to produce a risk-benefit model to make informed, individualized decisions about retirement or redirection from contact or collision sports.

## Discussion

These consensus recommendations are intended to provide guidance to youth athletes and their families, medical professionals, and athletic personnel and organizations. These recommendations also identify key areas in which further research is needed. Youth sports, and the physical and psychosocial benefits gained from participation in youth sports, are critical to the development of healthy children and lifelong physically active individuals. The concerns regarding concussions that are associated with participation in contact or collision sports need to be balanced with the numerous benefits of an active lifestyle. Recommendations for policy, legislation, and rules should be based on evidence from high-quality studies. Unfortunately, for many of the questions addressed in this consensus statement, limitations existed in the quantity and quality of the evidence to develop specific recommendations for youth sports stakeholders.

It is important that these recommendations be evaluated in context and that they do not overshadow the considerable physical, cognitive, psychological, and social health benefits of regular physical activity in youth. The evidence supporting these benefits has been reviewed by several researchers.<sup>10-14</sup> For example, Eime et al<sup>11</sup> conducted a systematic review of studies that addressed the psychological and social health benefits associated with youth sports. The most common benefits reported by participants were improved self-esteem and social interactions and fewer depressive symptoms. In their review, participation in team sports appeared to be associated with more positive health outcomes than participation in individual sports. The American Academy of Pediatrics<sup>13</sup> also released a recent clinical report that addressed the benefits and risks associated with participation in organized sports for children and adolescents.

The US Department of Health and Human Services recently published the *2018 Physical Activity Guidelines Advisory Committee Scientific Report*<sup>14</sup> and a second edition of the *Physical Activity Guidelines for Americans*.<sup>4</sup> The advisory report provided updated physical guidelines and a detailed summary of the health-related benefits of physical activity for children and adolescents aged 3 to 17 years. The advisory committee used a rigorous systematic review process to evaluate the scientific literature, reporting evidence that suggested greater amounts of physical activity are associated with improved bone health, improved cardiorespiratory and muscular fitness, lower adiposity, and increased cognition, including improved executive function, attention, and academic achievement.<sup>14</sup> The sec-

ond edition of the physical activity guidelines recommended that school-aged children and adolescents perform 60 minutes or more of moderate to vigorous daily physical activity. This daily activity should include vigorous, muscle-strengthening, and bone-strengthening activities at least 3 times per week. The guidelines also recommended that adults provide opportunities for children and adolescents to engage in age-appropriate, enjoyable, and varied activities. Sports participation is specifically highlighted as a practical strategy to help children meet the guidelines for vigorous, muscle-strengthening, and bone-strengthening physical activity.<sup>4</sup>

The occurrence and consequences of SRCs among youth athletes are areas in which the evidence is rapidly accruing; however, many questions remain. The consensus panel was limited in its ability to make specific practice recommendations for many of the questions owing to the limited number of analytic outcome studies available. This is an important limitation, which will only be overcome by additional studies that use the most rigorous methods possible and address specific questions for athletes in this age group.

It is also important to carefully consider the current literature in view of the attitudes, knowledge, playing practices, equipment, and rules of each sport at the time of the athlete's exposure to the contact or collision sport. Many of these beliefs and policies have evolved, particularly in the last decade. Although data from previous long-term longitudinal cohort studies are important and useful, the findings from those studies may or may not be applicable to youth athletes who are currently playing sports. This is true because the way we define, diagnose, treat, and consider return-to-play decisions is different today than it was in past decades when those involved in the available studies of long-term effects were playing sports and incurring injuries. Thus, as stated, the findings may not be applicable to youth athletes playing sports today. Another limitation is that many studies were not prospective and may not have used validated surveillance methods, appropriate controls for confounding factors, and populations that were generalizable.

Because the evidence associated with these questions continues to evolve, it will be important that these conclusions and recommendations be periodically updated.

Researchers generally agree that substantial objective evidence exists to suggest that physical activity is necessary for the optimal health of children and adolescents and that it confers long-term cognitive, mental, and physical benefits across the lifespan. As high-quality evidence accumulates, these recommendations will provide more specific guidance regarding ways in which the goal of optimal physical activity can be achieved as safely as possible.

### ARTICLE INFORMATION

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National Basketball Association and the National Football League, a member of the Neurological Care Program of the National Hockey League Players' Association, and a member of the advisory committees of Major League Soccer, the National Basketball Association, and US Soccer outside the submitted work. Dr Herring reported receiving stock options from VICIS, personal fees for serving as a team physician for the Seattle Seahawks and the Seattle Mariners, and volunteering for the National Collegiate Athletic Association outside the submitted work. Dr Labella reported receiving personal fees and reimbursement of travel expenses from the American Academy of Pediatrics, Pop Warner Football, USA Gymnastics, the Illinois High School Association, the American Medical Society for Sports Medicine, the Canadian Academy of Sport and Exercise Medicine, Northwestern University, the American College of Sports Medicine, and the National Federation of State High School Associations outside the submitted work, and serving on the medical advisory board of US Soccer and as a team physician for Northside Youth Football outside the submitted work. Dr Valovich McLeod reported receiving grants from the A. T. Still University Warner Grant Fund and the National Athletic Training Association Ethnic Diversity Enhancement Grant Advisory Committee and serving as a trustee of the United States Brain Injury Alliance outside the submitted work. Dr Meehan reported receiving a grant from the National Football League, philanthropic support from the National Hockey League Alumni Association, and personal fees from ABC-CLIO, Springer International, and Wolters Kluwer during the conduct of the study. No other disclosures were reported.

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