

Running head: GUARDIAN CAPS: WHAT'S THE IMPACT?

Published in "*JTRM in Kinesiology*" an online peer-reviewed research and practice journal,
July 1st 2017

Guardian Caps: What's the Impact?

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Abstract

Reported sport-related concussion rates have dramatically increased recently. In response, the Guardian company has emerged as a leading manufacturer of soft-shell helmet covers. The “Guardian Cap” is a foam padded covering that fits over a helmet that aims to reduce the impact of collisions and lessen the chance of a concussion. The purpose of this study was to determine the perceived effectiveness of using Guardian Caps in preventing concussions in youth and high school football players. In addition, this study also examined reported coaching strategies used in the attempt to reduce concussions with these athletes. United States high school and youth football stakeholders (e.g., coaches, athletic directors, youth football presidents, etc.) completed an online survey containing Likert-based and open response questions focusing on the main research goals. On average, participants reported a 40.5% decrease in concussions per year after transitioning to using Guardian Caps with their youth or high school football players.

However, 16.2% of participants would not recommend the use of Guardian Caps, citing concerns such as helmet warranty worries, helmet bulkiness, product malfunctions, and expense. Moreover, several additional methods participants’ used in an effort to keep players safe from concussions are also discussed. Findings may assist youth and high school football coaches and athletic directors in making informed equipment and coaching decisions regarding player safety focusing on reducing concussions with their players.

Keywords: *concussion, football, CTE, tackling, head injury, SIS*

Introduction

Recently, popular media has focused on the potential long-term negative effects of concussions that some American football players have incurred. Released in 2015 starring movie star Will Smith, the motion picture entitled “Concussion” (Columbia Pictures, Culver City, CA) shed light on the occurrence of traumatic brain injuries within professional American football. Other media followed suit which focused on chronic injuries and fatalities attributed to football concussions (e.g., Herbst, 2015; Reed, 2015).

A concussion is defined as a type of mild traumatic brain injury caused by a blow to the head (Gavett, Stern, & Mckee, 2011). Many concussions occur without loss of consciousness, as only one in six are diagnosed (Concussion Legacy Foundation, 2016). Symptoms of concussions may consist of imbalance, headache, confusion, memory loss, loss of consciousness, vision change, hearing impairment, mood change, fatigue, and malaise (Gavett et al., 2013). Long-term, concussions can cause dementia, Alzheimer’s, depression, and chronic traumatic encephalopathy (CTE) (Mayo Clinic, 2016). CTE is a progressive degenerative disease of the brain and is associated with repeated head traumas, including symptomatic concussions and asymptomatic sub-concussive blows to the head (Mckee et al., 2009). Ninety of ninety-four former National Football League (NFL) players have been diagnosed with CTE (Concussion Legacy Foundation, 2016).

Concussions account for 6% of all collegiate and 4% of all interscholastic sport injuries, with football topping the list for highest concussion incidence rates across all sports (American College of Sports Medicine [ACSM], 2015). In addition to football having the highest interscholastic sport concussion rates, high school players are nearly twice as likely to suffer a concussion compared to collegians as college football players average 6.3 concussions per 10,000 athletic exposures, while high school players average 11.2 for the same number of exposures (Graham, Rivara, Ford, & Spicer, 2014).

The two most common reasons for high school football players not reporting concussions are that the player’s desire to continue to participate (i.e., they did not want to be removed from play) or they did not feel their injury was serious enough to warrant medical attention (Register-Mihalik et al., 2013). However, reported concussion rates have increased recently possibly due to increased disclosure by athletes and/or improved diagnostic strategies (ACSM, 2015). In 2012 it was estimated that there were 3.8 million sports-related concussions in the United States, doubling

the amount reported in 2002 (Prevacus, 2016). In addition, high school football-related concussions account for 47% of all interscholastic sport concussions (Graham et al., 2014). These alarming rates have spurred state governments to adopt laws concerning sports-related concussion protocols. In 2009, Washington state and Oregon passed laws centered on sport concussion protocols called the Zackery Lystedt Law and Max's Law, respectively (Centers for Disease Control and Prevention [CDC], 2013). Within 3 years, 43 other states and the District of Columbia passed similar laws on concussion protocols in youth and high school sports coined "Return to Play Laws."

These laws also aim to reduce incidences of Second Impact Syndrome (SIS). SIS involves post-concussive symptoms following a head injury and, within weeks, if the individual sustains a second head injury, diffuse cerebral swelling, brain herniation, and in rare cases death can occur within a few minutes – even in apparent healthy, young athletes (Bey & Ostick, 2009). Other side-effects of SIS are physical paralysis, mental disabilities, and epilepsy. Therefore, coaches and administrators are taking steps to try and reduce concussion incidences.

Football Skill Coaching and Other Safety Considerations

When injuries or concussions occur in football, there may be a breakdown in the education of key skill fundamentals. For instance, teaching safe tackling techniques and wearing proper fitting equipment aligns with the Society for Health and Physical Educators (SHAPE) America (2014) national physical education standards one and two, which states that the physically literate individual demonstrates competencies in motor skills (e.g., tackling) and has knowledge of concepts related to movement. USA Football (USAF, 2010a) is the national governing body for youth and high school football in the United States. USAF develops programs and products for players, coaches, and administrators with an emphasis on coaching education, football certifications, and player safety. USAF (2010a) notes:

USA Football evolves and grows the sport through innovative standards and best practices to advance coach and player development, participation and safety within the fun of the game and its inherent values. As the sport's national governing body and member of the U.S. Olympic Committee, USA Football partners with leaders in medicine, child advocacy

and athletics to support positive football experiences for youth, high school and other amateur players. (para. 1).

Heads Ups Football. USAF's flagship safety program, called "Heads Up Football", focusses on concussion awareness, proper tackling and blocking, equipment fitting, and other strategies to make the game safer (USA Football, 2010b). See Table 1 for a review of USAF's safe tackling technique. In addition to offering programs in equipment fitting, heat illness, and cardiac arrest training, USA Football promotes a holistic approach to preventing injuries and concussions by promoting communication that fosters feedback from all stakeholders (i.e., players, parents, medical community, coaches, etc.). Moreover, as an extension of the Heads Up Football program, USAF also has a "Player Safety Coach" (PSC) training certification.

Table 1

USA Football "Heads Up" Safe Tackling Technique

Step	Technique	Description
One	Breakdown Position	Feet shoulder-width apart (foundation starting point of movements and drills)
Two	Buzzing Feet	Heel-to-toe strides (coming to balance in breakdown position before contact)
Three	Hit Position	Head and eyes up, using front of shoulder pad as point of contact
Four	Shoot	Open hips to create power and perform ascending tackle
Five	Rip	With head to side away from contact, throw double arm uppercuts and grab back of uniform to secure tackle

Note. Adapted from USA Football (2010).

USAF Player Safety Coach. After completing a USAF training clinic and successfully passing an exit exam, a USAF PSC is responsible for overseeing the organization's implementation of Heads Up Football (USA Football, 2010b). These components include coach education (i.e., Heads Up Blocking and Heads Up Tackling), proper equipment fitting, concussion recognition and response, and heat and hydration preparedness. A PSC can be any trained stakeholder linked to the football organization (e.g., trainer, parent, team physician, etc.), but it is not recommended that the stakeholder be a coach for the team as this may result in a conflict of interest which could carry serious legal ramifications for the PSC and the organization. For example, a coach focused on winning may be influenced for a concussed player to return to play sooner than is safe. However, USAF is not the only outlet for training regarding reducing concussions in football.

Other Techniques used to help Prevent Concussions in Football

Seattle Seahawks tackling method. Another common “safer” football tackling technique called “Seahawks Tackling” has been popularized by the Seattle Seahawks (2016). This new rugby style of tackling is led by the Seattle Seahawks’ Assistant Head Coach (Defense) Rocky Seto. According to the Seahawks, “the [tackling] philosophy takes the head out of the play and increases safety, all while maintaining the toughness and physicality that makes the game great” (Seattle Seahawks, 2016, para. 1). The style was developed so that defenders would target an offensive player’s hips and thighs and drive his shoulder into his opponent. In the past 3 years, 4 Seahawks defensive players have suffered a reported concussions – only 3 teams have had fewer, while the NFL has averaged 7.03 (Kapadia, 2016).

Rule changes. First, the NFL has made alterations to kick-off distances, increased visibility to penalties involving helmet-to-helmet contact and preventing “defenseless” players from taking shots above their shoulders, and standardized return to play concussion protocols all in an attempt to limit head injuries (National Football League, 2012). Recently, the youth football organization Pop Warner became the first national American football organization to eliminate kickoffs where hard player-to-player collisions often occur (Pop Warner National Staff, 2016). Another possible rule change which has yet to gain traction is to eliminate the three-point stance in favor of the two-point stance for offensive linemen, which may reduce helmet-to-helmet contacts (Nussbaum, 2015).

Ancillary helmet padding products. Developed in 1989, ProCap was a special hard-shell padded cover that was fitted onto a helmet, touted to reduce helmet-to-helmet impacts by 30 percent (Hyler, 2013). However, in 1996, NFL helmet manufacturer Riddell effectively signed ProCap’s death warrant when it stated that Riddell’s warranty would be negated if their helmets were modified with the use of the ProCap (Nussbaum, 2015).

Additionally, in 2011, the National Operating Committee on Standards for Athletic Equipment (NOCSAE, 2017) stated that add-on equipment will void standards and certification of the product. Nevertheless, in 2013 this stance was revised in that the NOCSAE recognized third-party certification where equipment add-on companies (i.e., ProCap’s helmet add-on) would be responsible for re-testing equipment with add-ons and then become solely responsible for the warranty of the equipment as well as any legal action resulting in injuries while using add-on equipment. The company Guardian (2015) emerged after this NOCSAE development.

Recently, Guardian (2015) has evolved into the new leading manufacturer of soft-shell helmet covers engineered for impact reduction called the “Guardian Cap”. Started in 2010, Guardian (2015) touts that this soft-shell layer attached to the outside of the decades old hard-shell football helmet reduces impact up to 33% compared to traditional helmets and is worn by over 50,000 football and lacrosse players nationwide. Still, an independent study found that, compared to helmets without add-ons, Guardian Caps reduced linear accelerations by approximately 11% and angular accelerations by only 2% (American Academy of Neurology, 2015). However, as Guardian (2015) warns on their website:

No helmet, practice apparatus, or helmet pad can prevent or eliminate the risk of concussions or other serious head injuries while playing sports. Researchers have not reached an agreement on how the results of impact absorption tests relate to concussions. No conclusions about a reduction of risk or severity of concussive injury should be drawn from impact absorption tests. (para. 1).

Thus, a gap in the literature exists investigating effective methods in reducing the chance of concussions, particularly in high school and youth football. This is despite the aforementioned evidence that concussions in youth and high school football are on a steady incline and twice as likely to occur compared to college football. Moreover, there are discrepancies in the research regarding the effectiveness of using Guardian Caps in preventing concussions, a product not used yet in professional football.

The aims of this study were to: 1) research the perceived effectiveness of Guardian Caps in reducing concussions in high school and youth football players, and 2) investigate high school and youth football coaching strategies used in the attempt to reduce concussions. The research questions guiding this study included:

1. Are Guardian Caps perceived to be effective in preventing concussions in youth and high school football players?
2. What coaching strategies are currently used in the attempt to reduce concussions with youth and high school football players?

Findings from this study may assist other coaches and athletic directors in making informed equipment and coaching decisions regarding player safety focusing on reducing concussions with their athletes.

Method

Institutional Review Board approval and participant consent were obtained prior to conducting the study. Utilizing the online survey software Qualtrics (Qualtrics Research Suite, Provo, UT), an 18 question survey was emailed to a convenience sample of 380 youth and high school football stakeholders attained from a nationwide customer listing provided to the researchers by Guardian Caps. A total of 56 participants began the survey, however only 37 completed the survey (10.3% response rate). The majority of participants were Caucasian (91.8%), male (91.8%), high school head or assistant football coaches (54.1%), holding a Bachelor's degree (48.6%), with a mean age of 47.1 years. Over three quarters of the participants had experience utilizing Guardian Caps with their team. More specific demographic characteristics are found in Table 2.

Table 2

Participant Demographics

Gender	Male	34
	Female	3
Age (SD)		47.1 (11.1)
Race/Ethnicity	African American	1
	American Indian or Alaska Native	1
	Asian or Pacific Islander	1
	Caucasian	34
United States Region	South	12
	Northeast	11
	Midwest	9
	West	5
Highest Degree Earned	Associate Degree	2
	Bachelor's Degree	18
	Master's Degree	13
	Professional Degree	3
	Doctorate Degree	1
Primary Football-related Position	HS Football Head or Assistant Coach	21
	Athletic Trainer / Team Physician	4
	Other (Parent or Team Safety Advocate)	4
	HS Athletic Director	3
	Youth Football Head or Assistant Coach	3

	Youth Football President	2
Avg. Number of Years in Current Primary Football-related Position (SD)		13.1 (11.5)
Has your football team(s) in the past, or does your team currently, use Guardian Caps?	Yes	30
	No	7
How many season have the Guardian Cap been used?	One Season	5
	Two Seasons	6
	Three Seasons	13
	Four Seasons	3
	Five Seasons	1
	No Answer	8
Including you, how many of the coaches on your staff are USA Football "Heads Up Football" certified?	None	15
	One Coach	3
	Three to Six Coaches	7
	Ten or More Coaches	5
	No Answer	7
How Many "Player Safety Coaches" regularly attend practices and games?	Zero	17
	One	12
	Two	1
	Five or More	2
	No Answer	6
Who diagnoses concussions for your football team?	Athletic Trainer	22
	Team Physician	7
	Other (EMT, Athletic Director, or Player's Personal Physician)	6
	Head Football Coach	1
	No Answer	1

Note. HS = high school.

In addition to 11 demographic questions listed in Table 2, the next 2 survey questions focused on how many concussions occurred during training or games each year before and then while using Guardian Caps for participants with experience using the product. Next, four open-ended survey questions targeted participants' perceptions of the effectiveness of Guardian Caps in preventing concussions in youth and high school football players (e.g., "How satisfied were you in the performance of the Guardian Caps?"; Would you recommend Guardian Caps to other coaches? Why or why not?", etc.). Finally, the concluding survey item was: "Please list any and all other methods you use to help keep your players safe from concussions."

Data Analysis

All quantitative analyses were conducted using IBM SPSS Statistics Version 21.0 (IBM, Armonk, NY). Qualitative data were analyzed by thematic constant comparison content analysis (Creswell, 2007). Microsoft Excel was used to assist with the organizing and categorizing of open-ended responses through open coding. The primary themes were classified as they naturally emerged and then axial coding occurred across related primary themes. The final themes then materialized through a selective coding process based upon the interrelationships of the major coded categories.

Results

Research Question One

Participants' reported an average of 5.04 ($SD = 4.62$; 131 total) concussions per year during football practice or games prior to using Guarding Caps with their youth or high school football players. Subsequently, this number reduced to an average of 2.04 ($SD = 1.37$; 53 total) concussions per year while using Guardian Caps – representing a 40.5% decrease. Of note, 70.3% ($n = 26$) of the participants responded to this item. Moreover, Table 3 provides the themes generated from the participant responses regarding whether or not they would recommend the use of Guardian Caps. Overall, 31 participants (83.7%) would recommend the use of Guardian Caps, 3 participants would not recommend Guardian Caps, and 3 more participants were undecided.

Table 3

Open-Response Themes: "Would you recommend Guardian Caps to other coaches? Why or why not?"

Theme	Number of Times Mentioned
Reasons Why Guardian Caps Were Recommended:	
Good for head-to-head (or head-to-ground) contact; thus reducing number of concussions	14
Good to use in practice	7
Only use with players that have had concussions in the past	4
Good for teaching younger players not to fear hard objects (increases confidence)	2
Guardian Cap colors help with distinguishing offense and defense	1
Reasons Why Guardian Caps Were Not Recommended:	
Warranty of helmet would be voided if Guardian Caps were used	2
Players do not like bulkiness of helmet while using Guardian Caps	2

Product malfunctions (snap attachment rips; comes off during play)	2
Expensive (approximately \$50 each)	1
Football league does not use them	1

Research Question Two

Table 4 presents the main themes generated regarding the participants' cited methods used to help reduce concussions with their football players. The top most commonly mentioned strategies were to limit contact during football practices, players utilizing proper technique, employing the Seattle Seahawk's (2016) tackling method, and the education of players and coaches. The ensuing section will now discuss these results, integrating sample participant quotes to help clarify these themes and findings.

Table 4

Open-Response Themes: Additional Methods Used to keep Players Safe from Concussions

Method	Description of Technique	Number of Times Mentioned
Limit Contact in Practice	Limiting full-speed, full-pads practice per week	16
Technique	Did not mention Seahawk's or USA Football	11
Seattle Seahawk's Tackling Method	Leading with shoulder pad while aiming for lower body	10
Education	Training of players and coaches	10
USA Football "Heads Up Tackling"	See Table 1	7
Strengthening Neck	Belief that a strong neck would give more control of the head while the helmet is on.	5
Tackling Dummies	Tackling dummies instead of real people	4
Proper Fitted Equipment	Having a trained staff issue helmets to students	4
The Shadow Man	A tackling dummy that can be put into motion	2

Discussion

Research Question One

First, this study sought to determine the perceived effectiveness of using Guardian Caps in preventing concussions in youth and high school football players. As estimated by the participants, a 40.5% decrease in yearly concussions were seen with the use of Guardian Caps. No past empirical research could be found to compare this figure, but as previously mentioned, Guardian (2015) claims that Guardian Caps reduce impact up to 33% while the American Academy of

Neurology (2015) found that linear accelerations were reduced by 11% and angular accelerations by 2% compared to traditional helmets. Regarding the present study, it is not clear whether the estimated 40.5% reductions in yearly concussions are solely due to Guardian Cap use or whether other methods (i.e., reduced contact during practices, safer tackling or blocking techniques, coach or player education, etc.) may have also impacted these results. In addition, the participant reported concussion figures were estimates and not actual recorded data so caution must be heeded when evaluating this finding. Moreover, the reduced concussion rate of 40.5% found in this study must also be carefully considered given this study's low response rate and differences in the duration of experience using Guardian Caps within the sample. Future research should include a larger sample and compare officially diagnosed and recorded concussion figures before and after Guardian Cap use.

Moreover, 83.7% ($n = 31$) of participants would recommend Guardian Caps to other youth and high school football coaches. The most common reason provided was that the majority of participants felt Guardian Caps were effective in reducing head-to-head (or head-to-ground) contact, thus decreasing the number of concussions experienced by players. For example, one youth football coach, who noted initial push-back due to NOCSAE helmet certification concerns, commented:

Guardian Caps have been a blessing to our program and the results speak for themselves. The Guardian Caps in some instances protect the athletes from themselves. To go from 12 concussions to 0 concussions are fantastic results. We wore them as a Pop Warner Association and were the only association to do so. At first we were met with some resistance from the officials as the Guardian Caps were not NOCSAE certified, but at the end of the season the parents were happy with the result.

Thus, it appears more education is needed for all stakeholders informing them that using add-on helmet produces does not void warranty as long as the add-on helmet company certifies their product through additional safety testing through a the third-party certification in line with NOCSAE (2013) requirements.

Moreover, discrepancies were evident amongst a minority of participant responses regarding under what circumstances the Guardian Caps should be utilized. Several participants felt Guardian Caps should only be used in practice and not games. For example, one participant noted: “[Guardian Caps should be used] for practices only. Most of our concussions occurred in

practices, and the frequency of these has dropped significantly since we began using the Guardian Caps.” However, teams practice more than they play games, so it is logical that more concussions would occur during practice. Moreover, some participants stated they wanted more empirical data on the effectiveness of using Guardian Caps in games. It appears more research is needed in game settings for more stakeholders to make the transition to using (or permitting the use of) helmet add-on products during game play.

In addition, a small minority of participants noted they only use Guardian Caps with players who had previously been concussed. “[We] only [use Guardian Caps] when forced to; after a first concussion will a player wear it,” one participant reported. It appears the major concern here is SIS, and is puzzling as to why a more proactive approach is not taken if it is thought Guardian Caps provide benefit after a concussion. It is possible other cited reasons such as those listed in Table 3 may facilitate this response such as product malfunctions (i.e., snap attachment rips, product comes off during play, etc.) or the monetary expense (approximately \$50 each) is too high. More research is needed in this area.

Research Question Two

The second aim of this study was to investigate what strategies are currently used in the attempt to reduce concussions with youth and high school football players. As seen in Table 4, the most commonly cited response was limiting contact in practice. Several participants noted that this comprised of limiting practicing full-speed with full pads each week. In 2014, the National Federation of State High School Associations (NFHS, 2014) conducted a concussion summit and the resulting report states:

The task force strongly recommends full-contact be allowed in no more than 2-3 practices per week. Consideration should also be given to limiting full-contact on consecutive days and limiting full-contact time to no more than 30 minutes per day and no more than 60-90 minutes per week. (p. 3).

Moreover, one participant noted that his team followed the Alabama High School Athletic Association’s (2016) guidelines for full-speed contact during football practices, which details a systematic progression ending with no more than 90 minutes of full-speed contact practice per week during the season. More youth and high school football associations should consider adopting similar protocols.

Technique was the next most mentioned strategy aimed at reducing concussions in youth and high school football players. Participant responses involved providing focused teaching on head placement with stationary and moving targets. Often, formally teaching (sometimes without pads) proper stances and coming to balance were discussed. These responses were provided in generalities, which may have been describing similar characteristics ascribed by the Seattle Seahawk's (2016) tackling method or USAF's (2010b) Head's Up Football Blocking and Tackling recommendations – the third and fifth most commonly cited methods respectively. All of these responses surrounded teaching players and coaches various football skills aimed at making the game safer. SHAPE America's (2006) national standards for sport coaches espouses that coaches must remain at the forefront of safety and injury prevention (domain two) as well as be up-to-date in the sport's skills and tactics (domain six). Coaching certifications (i.e., USAF) can assist with standardizing knowledge. However, more research is needed regarding the effectiveness of the Seattle Seahawk's tackling technique versus USAF Head's Up Tackling.

Moreover, another strategy which emerged was educating players and coaches. These responses surrounded the importance of professional development, attaining coaching and PSC certifications, and educating stakeholders on return-to-play policies and the dangers of concussions. Participants noted that certifications (like USAF) provide coaches with the current research on new technologies and trends on player safety, which also come with the added benefit of liability insurance. In addition to being a USAF PSC, coaches may also encourage stakeholders (i.e., parents) of youth and high school football players to attain free online "Heads Up to Youth Sport" training certificate provided by the CDC (2017) surrounding concussions and properly fitted equipment.

Incorporating player strength exercises for the neck was another strategy noted by participants with the aim of reducing concussions. It would seem logical that a stronger neck would help control the head during certain instances, which may help reduce impacts. However, while there is some literature to support this claim (e.g., Caswell, York, Ambegaonkar, Caswell, & Cortes, 2014), no large-scale empirical evidence could be found which maintains that a stronger neck will reduce concussions. More empirical research is needed before widespread recommendations should be given.

Lastly, participants mentioned using tackling dummies – including the mobile "Shadowman" (Shadowman Sports, 2017) – and ensuring properly fitted equipment. Similar to

reducing full-contact practices, tackling dummies reduce physical contact between players, and thus can minimize the chance of concussions. Also, players may still be able to more safely maintain full-speed while practicing tackling technique with the dummy equipment. Moreover, not permitting movement within the helmet (i.e., not using a helmet too large) and fully utilizing internal helmet padding may also reduce concussions. All of these strategies should be considered to be employed by youth and high school football stakeholders.

Limitations

Like all research, this study is not without its limitations. A larger sample would have assisted in further generalizing the results. In addition, the sample was attained through the assistance of Guardian Caps, introducing potential bias. However, as was reported, not all participants spoke favorably toward the use of Guardian Caps.

Conclusion

The majority of participant youth and high school football stakeholders in this study recommended the use of the add-on helmet product Guardian Caps in the attempt to reduce concussions. A representative quote from one participant included:

Guardian caps are essential at the youth level from the standpoint of the impact of the head hitting the ground during practice and games. While we can train the coaches there are still times when the athletes either do not listen or are not paying attention in a game. There is contact that happens. The Guardian Cap helps in all situations

Likewise, another participant commented: *“I believe the Guardian caps add an additional layer of protection. Nothing is ‘concussion proof’ but any extra protection gives a player an opportunity to play and not sit on the sidelines.”* However, several concerns of using Guardian Caps were also voiced (Table 3). In addition, the participants provided several strategies used in the attempt to keep players safe from concussions (Table 4). Key stakeholders of youth and high school football should consider the use of add-on helmet football products as well as attain appropriate coaching and safety certifications to keep abreast of the advances in coaching methods and equipment which may reduce concussions in this population.

Conflict of Interest Statement

No conflict of interest pertaining to this manuscript exists nor are there any relevant financial disclosures.

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