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Mouthguard BITES (Behavior, Impulsivity, Theory Evaluation Study): What Drives Mouthguard Use Among High School Basketball and Baseball/Softball Athletes

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Abstract

Although mouthguards are effective, inexpensive, easy to use, and readily available, this form of protective equipment has been underutilized. “Impulsive delay discounting” (an index of impulsive behavior) among high school athletes may help explain their decision making regarding use of protective equipment such as mouthguards. We investigated the relationship between high school baseball, softball, and basketball players’ mouthguard use, impulsive delay discounting, and the precaution adoption process model (a behavior change theory). A convenience sample of boys’ and girls’ basketball and baseball/softball players at 21 high schools in the Greater Columbus, Ohio, metro area completed a self-administered survey that captured their demographic information, knowledge, attitudes, and beliefs regarding mouthguard use, impulsive delay discounting, and precaution adoption process model stage. We surveyed a total of 1636 students (55.9 % male, 43.8 % female, 0.3 % unknown). Only 12.3 % reported using a mouthguard either

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Compliance With Ethical Standards

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every time or sometimes during practice or competition. The primary reasons reported for not wearing mouthguards were they were not required to (65.3 %) and that the athletes could not breathe or talk while wearing one (61.5 %). These reasons were consistent across sex and sport. Most athletes reported that their coaches (87.3 %) and parents (64.5 %) had never talked to them about wearing a mouthguard. Lower precaution adoption process model stage was significantly associated with higher impulsivity ($p < 0.001$) and higher delayed discounting ($p = 0.016$) after adjusting for school, sport, and sex. Voluntary mouthguard use among high school athletes playing basketball and baseball/softball remains low despite the risk of dental injury in these sports. Effective, evidence-based, targeted, and tailored interventions to improve adolescent athletes' use of mouthguards to prevent sports-related dental injuries should be based on the specific behavioral and social factors influencing each athlete's decision making regarding use of mouthguards.

Keywords

Youth; Sports; Protective equipment

Introduction

High school sports play an important role for millions of United States adolescents in the adoption and maintenance of a physically active lifestyle. However, individuals participating in certain sports are at risk of oral or dental injury (ADA Council on Access & ADA Council on Scientific Affairs, 2006; Knapik et al., 2007; Newsome, Tran, & Cooke, 2001). The US Surgeon General's report on oral health identified sports participation as one of the leading causes of oral and dental injuries (US Department of Health and Human Services, 2000), and previous studies have found that sporting activities account for up to one-third of all dental injuries (ADA Council on Access & ADA Council on Scientific Affairs, 2006; Borssen & Holm, 1997; Lephart & Fu, 1991; US Department of Health and Human Services, 2000). While the rate of dental injuries may be low compared to other common sports-related injuries like sprains and strains, dental injuries can have a long-term functional, social, psychological, and financial impact (ADA Council on Access & ADA Council on Scientific Affairs, 2006; Fakhruddin, Lawrence, Kenny, & Locker, 2008; Newsome et al., 2001).

Risk of oral or dental injuries is present not only in full-contact sports such as boxing, football, hockey, rugby, and lacrosse but also in other sports such as baseball and basketball (ADA Council on Access & ADA Council on Scientific Affairs, 2006; Newsome et al., 2001). One previous study found that, among nine high school sports (football, boys' and girls' soccer, girls' volleyball, boys' and girls' basketball, wrestling, baseball, and softball), boys' baseball and girls' basketball had the highest rates of dental injuries (3.22 and 1.12 dental injuries per 100,000 athlete exposures, defined as one athlete participating in one competition or one practice, respectively; Huffman, Yard, Fields, Collins, & Comstock, 2008).

Although mouthguards are effective, inexpensive, easy to use, and readily available, this form of protective equipment has been underutilized for decades (Beachy, 2004; Collins &

Comstock, 2008; Ferrari & Ferreria de Mederios, 2002; Finch, Braham, McIntosh, McCrory, & Wolfe, 2005; Kvitem, Hardie, Roettger, & Conry, 1998; Maestrello-deMoya & Primosch, 1989; Morton & Burton, 1979; Rodd & Chesham, 1997). Multiple behavioral and social factors play a role in adolescent athletes' decision to wear a mouthguard to prevent sports-related dental injuries. Although adolescent athletes have an intense desire to participate in their sport, when given a choice they often fail to utilize protective equipment which can prevent time loss injuries (Berg, Berkey, Tang, Altman, & Londeree, 1998; Nowjack-Raymer & Gift, 1996). Adolescent athletes tend to rationalize their failure to use protective equipment by arguing their low risk of injury, the ineffectiveness of protective equipment, a concern that protective equipment will inhibit performance, and discomfort. Thus, efforts to promote the use of optional protective equipment in this population have largely failed (Bourdin et al., 2006; Gardiner & Ranalli, 2000; Patrick, van Noort, & Found, 2005; Perunski, Lang, Pohl, & Filippi, 2005; von Arx, Flury, Tschan, Buerger, & Geiser, 2008). In fact, many high school athletes who use a mouthguard in sports when it is required as protective equipment (e.g., football, ice hockey, and lacrosse) fail to use the protective devices in sports when it is optional (e.g., basketball, soccer, baseball, and softball).

Basketball, baseball, and softball have been specifically identified as sports with low prevalence of mouthguard use, despite their relatively high risk of dental injury (ADA Council on Access & ADA Council on Scientific Affairs, 2006; Newsome et al., 2001). Research on how to improve high school basketball, baseball, and softball players' mouthguard use has largely failed to consider specific behavioral and social factors influencing each athlete's decision making, and to our knowledge no study to date has attempted to account for individual athletes' readiness to adopt the behavior or impulsive delay discounting (DD). Similar to other safety behaviors, the use of mouthguards consists of several different behaviors. The precaution adoption process model (PAPM), a behavior change theory, has been used to describe the adoption of health-related precautionary behavior as a developmental process through several distinct behavioral stages that culminates in the adoption and maintenance of the behavior (Weinstein, Lyon, Sandman, & Cuite, 1998; Weinstein & Sandman, 1992). Impulsivity, which has been identified as a risk factor for injury (Uslu, Uslu, Eksioglu, & Ozen, 2007), has been defined as intolerance of delays, the inability to sustain attention over time, or the inability to inhibit inappropriate or unwanted behaviors. "Delay discounting" (DD) is an index of impulsive behavior. Impulsive individuals are thought to be highly insensitive to delayed consequences (i.e., rewards or punishers) and, therefore, to exhibit greater preference for more immediate outcomes (Ainslie, 1975; Herrnstein, 1981; Logue, 1988; Rachlin & Green, 1972). An evaluation of impulsive DD among adolescent athletes may help explain their decision making regarding the use of protective equipment such as mouthguards, as more impulsive athletes would be expected to be highly insensitive to the delayed consequence (reward) associated with mouthguard use.

We conducted this study to describe high school basketball, baseball, and softball players' knowledge, attitudes, beliefs, and behaviors regarding mouthguard use and to investigate the relationship between mouthguard use, impulsive DD, and the PAPM.

Materials and Methods

During the 2009/10 academic year, we identified 48 high schools in the Greater Columbus, Ohio, metro area via an internet search, which we contacted by phone or email and asked to participate in the study. Ultimately, we enrolled a convenience sample of 21 high schools after the athletic director and coaches agreed to allow their athletes to participate in the study during a scheduled practice time. Enrolled schools included 14 large (defined as more than 1000 students in grades 9 through 12) and 7 small (defined as 1000 or fewer students in these grades) schools; 16 were public and 5 were private.

We surveyed boys' and girls' basketball players at all 21 study schools and baseball and softball players at 18 of the study schools. Study staff traveled to schools twice (once each during the winter and spring sports season) to administer surveys that included questions concerning student athletes' demographic information (age, sex, year in school, and self-reported height and weight), history of mouthguard use, knowledge, attitudes, and beliefs regarding mouthguard use (developed based on the results of a focus group which included 11 high school basketball, baseball and softball athletes), DD (using the 27 question Kirby Monetary-Choice Questionnaire), impulsivity (using the Barratt Impulsivity Scale-11 [BIS-11]), and PAPM stage. Each question on the Kirby Monetary-Choice Questionnaire offers a choice between two monetary rewards of varying amounts and asks respondents to choose which reward they would prefer; the smaller reward today or the larger in a specified number of days (Kirby & Herrnstein, 1995). The Kirby Monetary Choice Questionnaire has efficiently estimated discounting and is temporally stable (da Matta, Gonçalves, & Bizarro, 2012). The BIS-11, a 30-item self-reported questionnaire that also provides a total score has demonstrated validity and reliability (Stanford et al., 2009), measures impulsivity on six factors including motor impulsiveness, cognitive complexity, self-control, lack of delay, attention, and perseverance (Patton, Stanford, & Barratt, 1995). A higher total BIS-11 score indicates greater impulsivity.

All basketball, baseball, and softball athletes in the enrolled schools were invited to participate in the study. Athletes were gathered during practice where researchers explained the study and asked them to complete the brief survey, lasting no longer than 15 min. Researchers told the athletes that participation in the study was completely voluntary and that declining to take part in the study would not affect their participation in their sports team. This informed assent information was also included on the first page of the survey. By completing the survey, the athletes provided their consent to participate. Parental consent was not obtained. The survey was completely anonymous, and did not include any personal identifiers or questions of a sensitive nature. All athletes who were given the opportunity to participate agreed to complete the survey. The Nationwide Children's Institutional Review Board, Columbus, Ohio approved all study procedures, including forgoing parental consent.

Surveys were administered electronically via laptop computers whenever feasible. When not feasible (e.g., no power at field where athletes were surveyed, not enough laptops to survey the number of athletes present in the time the coach allotted), we administered a pen and paper survey with identical questions. Research staff provided additional instruction to athletes taking the pen and paper survey (e.g., to explain skip patterns) and at least two

research staff were present at every survey administration to answer questions and assist study participants as needed. Among the 1636 athletes surveyed, 59.0 % completed the survey on paper, and 41.0 % completed it electronically. Based on Chi-square tests for categorical variables and two-sample *t* tests for continuous variables, we found no significant differences between the two modes of survey administration.

We used the PAPM to determine how close athletes were to (or how far they were from) adopting the recommended safety practice, namely consistent mouthguard use during all practices and competitions. We grouped athletes into one of six PAPM stages for mouthguard use based on their survey responses (Fig. 1). At any point in time, an individual may be unaware of the risk (Stage 1). Once they first learn something about the issue, they are no longer unaware but they may not necessarily be engaged (Stage 2). Individuals in Stage 3, the decision-making stage, have become engaged by the issue and are considering their response. The decision-making process can result in either “no action” or adoption. If the decision is to take no action, the precaution adoption process ends (Stage 4), but for people who decide to adopt the precaution (Stage 5), the next step is to initiate and maintain the behavior (Stage 6).

We analyzed data using SPSS software, version 19.0. Statistical analyses included the Chi-square test with Yates' continuity correction which was designed to improve the Chi-square approximation. We calculated injury proportion ratios (IPR) using 95 % confidence intervals (CI) to assess statistical significance. For example, the calculation comparing the proportion of male athletes whose parents have never talked to them about wearing a mouthguard and the proportion of female athletes whose parents have never talked to them about wearing a mouthguard was:

$$\text{IPR} = \frac{\text{number of males whose parents never talked to them about wearing a mouthguard/number of male athlete}}{\text{number of females whose parents never talked to them about wearing a mouthguard/number of female athlete}}$$

We used ordinal logistic regression models to study the relationship between the PAPM stage, Kirby, and BIS scores (all continuous variables). We fitted Proportional odds models on athletes classified into PAPM stages one through six, and excluded those athletes without a Kirby score ($n = 196$) or BIS score ($n = 157$) from the analysis (athletes who did not answer all of the DD questions were not given a total score). We included sex, sport, and school as covariates. We conducted analyses using SAS version 9.2.

Results

We surveyed 1636 student athletes, of whom 55.9 % ($n = 914$) were male and 43.8 % ($n = 717$) were female (0.3 % of athletes did not report sex). Overall, the mean age of participating athletes was 15.9 years (range 14–19, $SD = 1.2$, see Table 1). A similar proportion of athletes played basketball (50.7 %, $n = 829$) and baseball/softball (49.3 %, $n = 807$). Basketball and baseball/softball players did not significantly differ by sex, age, or BMI. Of the 1636 participating athletes, 26.7 % of the athletes were from a private school, and 25.6 % were from a small school.

There were 1622 basketball and baseball/softball student athletes (99.1 %) who answered the question “Do you have a mouthguard?” (Fig. 1). Among these athletes, 22.6 % had not heard about the need to wear a mouthguard to prevent dental injuries during practice and competition and were grouped into PAPM Stage 1 (i.e., unaware of the hazard). Of the remaining athletes, 23.9 % were grouped into Stage 2 (i.e., aware, but not engaged), 11.1 % into Stage 3 (i.e., engaged, but undecided), 13.4 % into Stage 4 (i.e., decided, not planning), and 3.2 % into Stage 5 (i.e., decided, planning). Only 12.3 % of athletes reported using a mouthguard either every time or sometimes during practice or competition (i.e., Stage 6, acting). We were unable to place 11.0 % of athletes in any of the model’s stages as they had a mouthguard but reported they never wore it during practice or competition, and 3.5 % did not answer all of the staging questions. Individual survey item non-response ranged from none to 4.1 %.

Overall, the most frequent reasons athletes gave for not wearing mouthguards were that they were not required to do so (65.3 %) and they felt they could not breathe or talk while wearing one (61.5 %). Reasons for not wearing a mouthguard were consistent across sex and sport. Among athletes who had a mouthguard but never wore it ($n = 178$), their most commonly reported reasons, for both sexes, were “I am not required to wear a mouthguard” (65.7 %), “I cannot breathe or talk when I wear a mouthguard” (54.5 %), “My coach does not tell me to wear a mouthguard” (47.8 %), and “No one else on my team wears a mouthguard” (33.7 %; see Table 2). A greater proportion of athletes who did not have a mouthguard and decided not to wear one gave the reason “I cannot breathe or talk when I wear a mouthguard” (67.3 %) compared to athletes who had a mouthguard but never wore it (54.5 %, IPR 1.24, 95 % CI 1.05–1.45). Among both athletes who had a mouthguard but never wore it and athletes who did not have one and decided not to wear it, the most common reasons why they did not were similar by sport (see Table 3).

The majority of athletes reported that their coach had never talked to them about wearing a mouthguard (87.3 %), which was similar by sex and sport (see Tables 4 and 5). Overall, 64.5 % of athletes reported their parents had never talked to them about wearing a mouthguard, while 30.6 % reported their parents told them they should wear one. A greater proportion of male (72.5 %) than female (54.3 %) athletes reported that their parents had never talked to them about wearing a mouthguard (IPR 1.34, 95 % CI 1.24–1.45, Table 4). A greater proportion of baseball and softball players reported their parents had never talked to them about wearing a mouthguard (70.4 %) compared to basketball players (58.7 %) (IPR 1.20, 95 % CI 1.11–1.29, Table 5).

Adolescent athletes’ PAPM stage was associated with their level of impulsive DD. Lower PAPM stage (i.e., the athlete was less likely to wear a mouthguard) was associated with higher impulsivity and delayed discounting after adjusting for the effect of school, sport, and sex. A 0.02 increase in the expected log odds to be in a lower PAPM Stage ($p = 0.0004$) matched every one point increase in BIS, and a 0.08 increase in the expected log odds to be in a lower PAPM stage ($p = 0.0156$; see Table 6) matched every unit increase in the log Kirby score.

Discussion

Despite the evidence of the risk of dental injury associated with sports activity (ADA Council on Access & ADA Council on Scientific Affairs, 2006; Knapik et al., 2007; Newsome et al., 2001) and the clearly demonstrated potential of mouthguards to prevent oral-facial injury (Ferrari & Ferreria de Medeiros, 2002; Maestrello-deMoya & Primosch, 1989; Morton & Burton, 1979), we found that the prevalence of mouthguard use among high school basketball, baseball and softball players continues to be low (12.3 %). Although few athletes reported actually using a mouthguard, the majority were widely distributed across PAPM stages of use. This distribution demonstrates that adolescent athletes' knowledge, attitudes, beliefs, and behaviors vary with regard to mouthguard use.

We also found an association between DD and PAPM stage. High school aged adolescents often behave in ways inconsistent with their long-term best interests. This includes risk taking and failing to adopt known preventive measures to promote long-term health. Their behaviors are often based on avoiding immediate effort, cost, time burden, or physical or social discomfort and discounting delayed or uncertain consequences. Understanding athletes' PAPM stage and their DD level should drive the development of targeted and tailored interventions to increase the use of effective protective equipment such as mouthguards.

Several previously published studies have investigated barriers to mouthguard use, identifying a multitude of potential issues including construction (e.g., durability, cost, fit, comfort, and availability; DeYoung, Robinson, & Godwin, 1994; Gardiner & Ranalli, 2000), players' perceptions of mouthguards (e.g., factors such as a lack of knowledge of injury risk or mouthguard effectiveness and concerns over decreased comfort, ability to communicate, and athletic performance; Berry, Miller, & Leow, 2005; DeYoung et al., 1994; Gardiner & Ranalli, 2000; Hawn, Visser, & Sexton, 2002; Maestrello-deMoya & Primosch, 1989; Morton & Burton, 1979), peer pressure, and the attitudes, knowledge, and beliefs of parents (Diab & Mourino, 1997; Gardiner & Ranalli, 2000; Pribble, Maio, & Freed, 2004; Walker, Jakobsen, & Brown, 2002), coaches (Berg et al., 1998; Gardiner & Ranalli, 2000; Hawn et al., 2002; Ranalli & Lancaster, 1995), and referees/officials (Gardiner & Ranalli, 2000; Hawn et al., 2002; Lancaster & Ranalli, 1993). Similar to previous studies, we found that overall, among both athletes who have a mouthguard but never wear it and athletes who do not have one and have made a decision not to wear one, the main reasons for not doing so were similar; that is, they were not *required* to wear one (65.3 %) and they felt they could not breathe or talk while wearing one (61.5 %). The main reasons for not wearing a mouthguard were consistent across sex and sport. Although previous studies have found similar results, to date no one has been able to successfully utilize such information to create and implement effective interventions to increase voluntary mouthguard use among adolescent athletes.

The vast majority of athletes reported their coaches (87.3 %) and parents (64.5 %) have never talked to them about wearing a mouthguard while playing basketball, baseball, or softball. However, female athletes reported being told more frequently than males that their parents or coaches said they must or should wear mouthguards. Compared to only 0.2 % of

male athletes, 2.8 % of female athletes responded that coaches told them they must wear a mouthguard; similarly, coaches told 13.0 % of females that they should wear mouthguards compared to 8.0 % of males. Parental suggestions were parallel: 44.9 % of females were told they must or should wear a mouthguard compared to 25.7 % of males. Given the absence of significant sex differences in this study except in this category, the mandate or suggestion from coaches and parents to females to wear mouthguards in greater proportions than males suggests a heightened concern for female athletes perhaps because of their safety or appearance (American Academy of Pediatrics, 2012; Morrongiello & Hogg, 2004).

Previous research concerning this topic has most commonly resulted in broadly focused (i.e., population based) educational interventions aimed at increasing the prevalence of mouthguard use. The consistently low prevalence of use reported in this study constitutes evidence that these efforts have been largely unsuccessful. To date, the only uniformly successful intervention among this population has been regulatory—in sports which have rules requiring the use of a mouthguard (e.g., football, ice hockey, and lacrosse), athletes wear them during competitions because they are otherwise not allowed to participate. While external influences on individuals are important, an additional piece missing from traditional sports injury prevention research conducted to date has been the study of intrinsic behavioral factors that influence decision making regarding protective equipment use, including DD. We found that as an athlete's DD increased, there was a significant increase in the likelihood that they would be in a lower stage of the precaution adoption process. Research on DD and other intrinsic factors may lead to the development of individually targeted and tailored interventions that could be expected to be more effective than "one size fits all" interventions such as hanging an educational poster in the locker room or training room, having a dentist talk to athletes and parents at a team meeting, or providing all athletes on a team a free mouthguard. The combination of intrinsic individual factors combined with a wide range of familial, social, and cultural factors undoubtedly influence adolescent athletes' decisions regarding voluntary use of protective equipment.

Finally, we combined both athletes who wore a mouthguard "every time" and athletes who wore a mouthguard "sometimes" into Stage 6 (i.e., Acting). Unlike athletes in other stages, athletes who wore a mouthguard at least sometimes have demonstrated a conscious decision to wear it even though the rules of the sport did not require it. More research is needed to determine why there was inconsistent use of mouthguards among this group of athletes.

This study had several limitations. Because we utilized a convenience sample of schools located in the Greater Columbus, Ohio, metro area, our results may not be generalizable to high schools in other areas. However, we enrolled a variety of schools, both large and small, as well as public and private, which improves our confidence in the external validity of our findings. Additionally, we believe that athletes from this area, who had low prevalence of mouthguard use similar to that reported in prior studies, are unlikely to differ from adolescent athletes in other geographic areas. We also recognize that our sample size was relatively small, which may limit the generalizability of our results. However, this study, which is the first to consider the cumulative effect of specific behavioral and social factors influencing athletes' decision making and their DD, had sufficient power to demonstrate statistically significant results.

Conclusions

Wearing a protective mouthguard while participating in sports can prevent severe injuries to athletes' faces and mouths, thereby reducing medical costs associated with sports-related oral and dental injuries. However, as shown in this as well as in previous studies, voluntary mouthguard use among high school athletes playing sports such as basketball, baseball, and softball remains low despite the risk of dental injury in these sports. This study also demonstrated why previous "one size fits all" interventions may have been unsuccessful in increasing adolescent athletes' use of mouthguards. Effective, evidence-based, targeted interventions to improve adolescent athletes' use of mouthguards to prevent dental injuries should be based on the specific behavioral and social factors influencing athletes' decision making regarding the use of mouthguards. Specifically, such interventions should account for each individual's knowledge, attitudes, beliefs, and behaviors regarding mouthguard use while also accounting for their level of impulsivity and delayed discounting.

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Fig. 1.
Behavioral profile^a and PAPM staging algorithm: Mouthguard BITES (Behavior, Impulsivity, Theory Evaluation Study)

Table 1

Demographic characteristic of athletes by sex: Mouthguard BITES (Behavior, Impulsivity, Theory Evaluation Study)

	Basketball			Baseball and Softball			Overall		
	Male	Female	Total ^a	Male	Female	Total ^b	Male	Female	Total
<i>Year in school</i>									
8th	0 (0.0 %)	1 (0.3 %)	1 (0.1 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	0 (0.0 %)	1 (0.1 %)	1 (0.1 %)
9th	130 (28.5 %)	129 (34.9 %)	259 (31.2 %)	127 (27.7 %)	116 (33.4 %)	243 (30.1 %)	257 (28.1 %)	245 (34.2 %)	502 (30.7 %)
10th	129 (28.3 %)	97 (26.2 %)	227 (27.4 %)	123 (26.9 %)	108 (31.1 %)	232 (28.7 %)	252 (27.6 %)	205 (28.6 %)	459 (28.1 %)
11th	103 (22.6 %)	81 (21.9 %)	185 (22.3 %)	114 (24.9 %)	84 (24.2 %)	198 (24.5 %)	217 (23.7 %)	165 (23.0 %)	383 (23.4 %)
12th	94 (20.6 %)	61 (16.5 %)	155 (18.7 %)	88 (19.2 %)	38 (11.0 %)	126 (15.6 %)	182 (19.9 %)	99 (13.8 %)	281 (17.2 %)
Unknown	0 (0.00 %)	1 (0.3 %)	2 (0.2 %)	6 (1.3 %)	1 (0.3 %)	8 (1.0 %)	6 (0.7 %)	2 (0.3 %)	10 (0.6 %)
Total	456 (100.0 %)	370 (100.1 %) ^c	829 (99.9 %) ^c	458 (100.0 %)	347 (100.0 %)	807 (99.9 %) ^c	914 (100.0 %)	717 (100.0 %)	1636 (100.1 %) ^c
<i>Age (years)</i>									
Minimum	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
Maximum	19.0	18.0	19.0	19.0	19.0	19.0	19.0	19.0	19.0
Mean (<i>SD</i>)	16.0 (1.2)	15.6 (1.2)	15.8 (1.2)	16.1 (1.2)	15.8 (1.2)	16.0 (1.2)	16.1 (1.2)	15.7 (1.2)	15.9 (1.2)
<i>BMI</i>									
Minimum	15.8	12.1	–	13.6	15.2	–	13.6	12.1	–
Maximum	41.2	38.1	–	35.9	35.4	–	41.2	38.1	–
Mean (<i>SD</i>)	22.7 (3.0)	21.8 (3.0)	–	23.4 (3.6)	22.5 (3.3)	–	23.1 (3.3)	22.2 (3.2)	–

^aSex was not reported for three basketball players^bSex was not reported for two baseball/softball players^cTotal does not sum to 100.0 % due to rounding

Table 2

Athletes' self-reported reasons for not wearing a mouthguard by sex: Mouthguard BITES (Behavior, Impulsivity, Theory Evaluation Study)

	Male <i>n</i> = 91	Female <i>n</i> = 87	Total <i>n</i> = 178
<i>Among athletes who have a mouthguard but never wear it^a</i>			
I am not at risk for dental injuries	17 (18.7 %)	11 (12.6 %)	28 (15.7 %)
I do not think mouthguards work	3 (3.3 %)	1 (1.1 %)	4 (2.2 %)
I am not required to wear a mouthguard	61 (67.0 %)	56 (64.4 %)	117 (65.7 %)
My coach does not tell me to wear a mouthguard	40 (44.0 %)	45 (51.7 %)	85 (47.8 %)
No one else on my team wears mouthguards	30 (33.0 %)	30 (34.5 %)	60 (33.7 %)
I cannot breathe or talk when I wear a mouthguard (i.e., inhibits performance, uncomfortable)	45 (49.5 %)	52 (59.8 %)	97 (54.5 %)
I did not get a mouthguard when my equipment was handed out	8 (8.8 %)	13 (14.9 %)	21 (11.8 %)
Other	17 (18.7 %)	21 (24.1 %)	38 (21.4 %)
	<i>n</i> = 105	<i>n</i> = 112	<i>n</i> = 217
<i>Among athletes who do not have a mouthguard and decided not to wear one^a</i>			
I am not at risk for dental injuries	18 (17.1 %)	11 (9.8 %)	29 (13.4 %)
I do not think mouthguards work	5 (4.8 %)	8 (7.1 %)	13 (6.0 %)
I am not required to wear a mouthguard	63 (60.0 %)	78 (69.6 %)	141 (65.0 %)
My coach does not tell me to wear a mouthguard	43 (41.0 %)	58 (51.8 %)	101 (46.5 %)
No one else on my team wears mouthguards	28 (26.7 %)	32 (28.6 %)	60 (27.7 %)
I cannot breathe or talk when I wear a mouthguard (i.e., inhibits performance, uncomfortable)	69 (65.7 %)	77 (68.8 %)	146 (67.3 %)
I did not get a mouthguard when my equipment was handed out	13 (12.4 %)	19 (17.0 %)	32 (14.8 %)
Other	10 (9.5 %)	22 (19.6 %)	32 (14.8 %)

^a Athletes were allowed to select multiple responses (responses do not sum to 100.0 %)

Table 3

Athletes' self-reported reasons for not wearing a mouthguard by sport: Mouthguard BITES (Behavior, Impulsivity, Theory Evaluation Study)

	Basketball <i>n</i> = 94	Baseball/Softball <i>n</i> = 84	Total <i>n</i> = 178
<i>Among athletes who have a mouthguard but never wear it^a</i>			
I am not at risk for dental injuries	12 (12.8 %)	16 (19.0 %)	28 (15.7 %)
I do not think mouthguards work	2 (2.1 %)	2 (2.4 %)	4 (2.3 %)
I am not required to wear a mouthguard	56 (59.6 %)	61 (72.6 %)	117 (65.7 %)
My coach does not tell me to wear a mouthguard	43 (45.7 %)	42 (50.0 %)	85 (47.8 %)
No one else on my team wears a mouthguard	28 (29.8 %)	32 (38.1 %)	60 (33.7 %)
I cannot breathe or talk when I wear a mouthguard (i.e., inhibits performance, uncomfortable)	57 (60.6 %)	40 (47.6 %)	97 (54.5 %)
I did not get a mouthguard when my equipment was handed out	10 (10.6 %)	11 (13.1 %)	21 (11.8 %)
Other	17 (18.1 %)	21 (25.0 %)	38 (21.4 %)
	<i>n</i> = 132	<i>n</i> = 85	<i>n</i> = 217
<i>Among athletes who do not have a mouthguard and decided not to wear one^a</i>			
I am not at risk for dental injuries	15 (11.4 %)	14 (16.5 %)	29 (13.4 %)
I do not think mouthguards work	7 (5.3 %)	6 (7.1 %)	13 (6.0 %)
I am not required to wear a mouthguard	87 (65.9 %)	54 (63.5 %)	141 (65.0 %)
My coach does not tell me to wear a mouthguard	61 (46.2 %)	40 (47.1 %)	101 (46.5 %)
No one else on my team wears a mouthguard	35 (26.5 %)	25 (29.4 %)	60 (27.7 %)
I cannot breathe or talk when I wear a mouthguard (i.e., inhibits performance, uncomfortable)	96 (72.7 %)	50 (58.8 %)	146 (67.3 %)
I did not get a mouthguard when my equipment was handed out	24 (18.2 %)	8 (9.4 %)	32 (14.8 %)
Other	18 (13.6 %)	14 (16.5 %)	32 (14.8 %)

^a Athletes were allowed to select multiple responses (responses do not sum to 100.0 %)

Table 4

Athletes' self-report of what their coach and parents told them about wearing a mouthguard by sex:
Mouthguard BITES (Behavior, Impulsivity, Theory Evaluation Study)

	Male	Female	Unknown	Total
<i>What does your coach tell you about wearing a mouthguard?</i>				
I have to wear a mouthguard	2 (0.2 %)	20 (2.8 %)	0 (0.0 %)	22 (1.3 %)
I should wear a mouthguard	73 (8.0 %)	93 (13.0 %)	1 (20.0 %)	167 (10.2 %)
My coach has never talked to me about wearing a mouthguard	821 (89.8 %)	603 (84.1 %)	4 (80.0 %)	1428 (87.3 %)
I should not wear a mouthguard	9 (1.0 %)	0 (0.0 %)	0 (0.0 %)	9 (0.6 %)
I cannot wear a mouthguard	4 (0.4 %)	0 (0.0 %)	0 (0.0 %)	4 (0.2 %)
Not reported	5 (0.5 %)	1 (0.1 %)	0 (0.0 %)	6 (0.4 %)
Total	914 (99.9 %) ^a	717 (100.0 %)	5 (100.0 %)	1636 (100.0 %)
<i>What do your parents tell you about wearing a mouthguard?</i>				
I have to wear a mouthguard	22 (2.4 %)	35 (4.9 %)	1 (20.0 %)	58 (3.5 %)
I should wear a mouthguard	213 (23.3 %)	287 (40.0 %)	0 (0.0 %)	500 (30.6 %)
My parents have never talked to me about wearing a mouthguard	663 (72.5 %)	389 (54.3 %)	3 (60.0 %)	1055 (64.5 %)
I should not wear a mouthguard	8 (0.9 %)	4 (0.6 %)	0 (0.0 %)	12 (0.7 %)
I cannot wear a mouthguard	3 (0.3 %)	2 (0.3 %)	0 (0.0 %)	5 (0.3 %)
Not reported	5 (0.5 %)	0 (0.0 %)	1 (20.0 %)	6 (0.4 %)
Total	914 (99.9 %) ^a	717 (100.1 %) ^a	5 (100.0 %)	1636 (100.0 %)

^aTotal does not sum to 100.0 % due to rounding

Table 5

Athletes' self-report of what their coach and parents told them about wearing a mouthguard by sport:
Mouthguard BITES (Behavior, Impulsivity, Theory Evaluation Study)

	Basketball	Baseball/Softball	Total
<i>What does your coach tell you about wearing a mouthguard?</i>			
I have to wear a mouthguard	2 (0.2 %)	20 (2.5 %)	22 (1.3 %)
I should wear a mouthguard	112 (13.5 %)	55 (6.8 %)	167 (10.2 %)
My coach has never talked to me about wearing a mouthguard	703 (84.8 %)	725 (89.8 %)	1428 (87.3 %)
I should not wear a mouthguard	6 (0.7 %)	3 (0.4 %)	9 (0.6 %)
I cannot wear a mouthguard	4 (0.5 %)	0 (0.0 %)	4 (0.2 %)
Not reported	2 (0.2 %)	4 (0.5 %)	6 (0.4 %)
Total	829 (99.9 %) ^a	807 (100.0 %)	1636 (100.0 %)
<i>What do your parents tell you about wearing a mouthguard?</i>			
I have to wear a mouthguard	33 (4.0 %)	25 (3.1 %)	58 (3.5 %)
I should wear a mouthguard	297 (35.8 %)	203 (25.2 %)	500 (30.6 %)
My parents have never talked to me about wearing a mouthguard	487 (58.7 %)	568 (70.4 %)	1055 (64.5 %)
I should not wear a mouthguard	6 (0.7 %)	6 (0.7 %)	12 (0.7 %)
I cannot wear a mouthguard	5 (0.6 %)	0 (0.0 %)	5 (0.3 %)
Not reported	1 (0.1 %)	5 (0.6 %)	6 (0.4 %)
Total	829 (99.9 %) ^a	807 (100.0 %)	1636 (100.0 %)

^aTotal does not sum to 100.0 % due to rounding

Table 6

Estimated parameters from proportional odds models with various covariates: Mouthguard BITES (Behavior, Impulsivity, Theory Evaluation Study)

Covariates	Kirby score		BIS score	
	β	<i>p</i> value	β	<i>p</i> value
None	0.0738	0.0191	0.0175	0.0009
Sex only	0.0598	0.0013	0.0176	0.0008
Sport only	0.0805	0.0109	0.0184	0.0005
School only	0.0839	0.0088	0.0184	0.0006
Main effect only of sport, sex, school	0.0785	0.0156	0.0192	0.0004
All two-way interactions of sport, sex, school	0.0799	0.0174	0.0189	0.0007

BIS Barratt Impulsivity Scale-11 [BIS-11]