The Effect of Lace-up Ankle Braces on Injury Rates in High School Basketball Players

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The Effect of Lace-up Ankle Braces on Injury Rates in High School Basketball Players

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Investigation performed at the University of Wisconsin, Madison, Wisconsin

Abstract

Background—Ankle injuries are the most common injury in basketball players. However, no prospective studies have been performed to determine if wearing lace-up ankle braces will reduce the incidence of ankle injuries in high school athletes.

Purpose—This trial was undertaken to determine if lace-up ankle braces reduce the incidence and severity of acute first-time and recurrent ankle injuries sustained by high school basketball players.

Design—Randomized controlled trial; Level of evidence, 1.

Methods—A total of 1460 male and female basketball players from 46 high schools were randomly assigned to a braced or control group. The braced group players wore lace-up ankle braces during the 2009–2010 basketball season. Athletic trainers recorded brace compliance, athlete exposures, and injuries. Cox proportional hazards models (adjusted for demographic covariates), accounting for intracluster correlation, were utilized to compare time to first acute ankle injury between groups. Injury severity (days lost) was tested with the Wilcoxon rank-sum test.

Results—The rate of acute ankle injury (per 1000 exposures) was 0.47 in the braced group and 1.41 in the control group (Cox hazard ratio [HR] 0.32; 95% confidence interval [CI] 0.20, 0.52; P <.001). The median severity of acute ankle injuries was similar (P = .23) in the braced (6 days) and control group (7 days). For players with a previous ankle injury, the incidence of acute ankle injury was 0.83 in the braced group and 1.79 in the control group (Cox HR 0.39; 95% CI 0.17, 0.90; P = .028). For players who did not report a previous ankle injury, the incidence of acute ankle injury was 0.40 in the braced group and 1.35 in the control group (Cox HR 0.30; 95% CI 0.17, 0.52, P <.001).

Conclusion—Use of lace-up ankle braces reduced the incidence but not the severity of acute ankle injuries in male and female high school basketball athletes both with and without a previous history of an ankle injury.

Keywords

ankle injury; knee injury; ankle brace; basketball

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Basketball is one of the most popular sports in the United States, with an estimated 1 million high school interscholastic participants.[19] Ankle injuries are the most common musculoskeletal injury sustained in sports such as basketball that require sudden stops and cutting movements,[3,18,20,21,32] and these injuries impose severe monetary consequences on the US health care system.[12,27] Ankle injuries can affect athletes long after they are finished playing competitive high school sports, with the development of chronic ankle instability,[9] increased likelihood for the onset of osteoarthritis,[13,28] decreased levels of physical activity, and lower quality of life.[1,8]

Despite the morbidity and financial burden that ankle injuries impose, there is still a need for research investigating ankle injury prevention strategies in young athletes.[11,30] Prospective research studies[2,7,16,17,23,24,26] that have reported on the effectiveness of ankle braces in preventing or reducing ankle injury in adult or college athletes utilized a semirigid (hard-plastic shell) brace or enrolled participants with a previous history of ankle injury. To date, no studies have been reported to evaluate the effect of using lace-up ankle braces either prophylactically to prevent a first-time ankle injury or following an ankle sprain to prevent recurrent injury in adolescent basketball players.

The primary objectives of this study were (1) to determine whether using lace-up ankle braces reduces the number and severity of acute first-time and recurrent ankle injuries sustained by high school basketball players and (2) to determine whether using lace-up ankle braces affects the incidence of other lower extremity injuries.

METHODS

Design

This was a randomized controlled trial that utilized stratified cluster (school) randomization. Schools were assigned to be in the braced (use ankle braces) or control (no ankle braces provided) group. This study was approved by the University of Wisconsin-Madison Health Sciences Minimal Risk Institutional Review Board. Data were collected for 1 basketball season (November 2009 through March 2010).

Sample Size

The base sample size was calculated for the primary outcome to compare the incidence rates of acute ankle injuries by ankle brace versus no brace. On the basis of previous research[20,21,32] and our own experience working with this population, we assumed an injury rate of 12% in controls and 6% in braced subjects. The alpha level was set at .05 with 80% power to detect a difference in injury rates. It was assumed that the within-cluster variation[6] would be small (0.001) across schools because each high school was required to conform to Wisconsin Interscholastic Athletic Association regulations regarding the first day of practice, season length, and maximum number of competitions and practices allowed. Previously, we found that approximately one-third of the eligible players (n = 60 to 70) at any given school will agree to serve as a research study participant.[15]

As a result of these factors, it was estimated that we would need a base sample size of 720 participants from 36 schools (360 players from 18 schools in each group). The sample size was increased to enroll more players in the control group (9 additional schools) to account for the players in control schools who would be predisposed to wear ankle braces. Also, an additional 6 schools (3 braced and 3 controls) were added as a precaution for possible school dropout and/or noncompliance. The final estimated number of schools and subjects was 21 braced schools (420 participants) and 30 control schools (600 participants).

School Recruitment and Randomization

Each of the 277 Wisconsin high schools with licensed/certified athletic trainer (AT) services was contacted by letter and e-mail to determine if they were interested in participating in the study. To be eligible, each school's administrator and coaches were required to give their permission to enroll their student athletes as research study participants and each school AT was required to complete an online research training tutorial.

A total of 51 eligible schools agreed to participate and were stratified based on their pupil enrollment into 3 groups (small, medium, and large). Schools were randomized (7 braced and 10 control) within each stratification level. Five schools were randomized but did not collect any data. A complete description of the school recruitment and randomization is found in Figure 1.

Participants

Potential participants included all male and female basketball players (grades 9–12). Players were made aware of the study through the use of flyers and recruited by the research staff and school ATs during preseason meetings. To be included in the study, each candidate had to be a member of the freshman, subvarsity, or varsity interscholastic basketball teams and be able to fully participate (no disabling injuries) on the first day of practice. All participants (and their parents if the participants were <18 years of age) signed the research study participant consent form. Following the school's official tryout, any potential participants who did not make the team were dropped from the study.

Ankle Brace

The lace-up ankle brace selected for the study was the McDavid Ultralight 195 (McDavid Inc, Woodridge, Illinois), which is used by many collegiate and high school players in the United States (Figure 2). The brace can fit the right or left foot and is constructed of synthetic fabric. It is worn over a single pair of socks while laced in the front like a shoe. Two straps wrap around the ankle and are secured with Velcro while another elastic band wraps around the top of the ankle. The research staff and school ATs provided each player in the braced group with a pair of braces. Participants were instructed on the proper application and fitting of their braces and told to wear them for each team-organized conditioning session, practice, or competition until the season was completed.

Data Collection

Before participation, athletes completed a self-report questionnaire to collect information, including sex, grade level, dominant leg, level of competition (freshman, subvarsity, or varsity), history of lower extremity injury within the last 12 months, surgical history, previous use of ankle tape or braces, the type of shoe they elected to wear (mid-top or low-top), and the Foot and Ankle Ability Measure (FAAM)–Sport, which is a self-report measure of ankle function validated for use in athlete populations.[14]

During the season, ATs at each school maintained a daily exposure calendar, recorded the onset of injuries, days lost due to injury, and the daily use of external ankle support (brace and/or athletic tape) throughout the entire season. An athlete-exposure was defined as any coach-directed competition, practice, or conditioning session[3,20] and they were monitored with the assistance of the basketball coaching staff. An injury was an event that occurred during a basketball exposure that forced the athlete to stop participation and prevented the athlete from participating in basketball activities the following day.[3,20,21] Athletic trainers evaluated each injury by obtaining an injury history from the athlete, determining the injury mechanism, and performing a physical examination. When warranted, injured athletes were referred to their primary care physician for complete diagnosis and treatment. Control group players who injured an ankle were provided with the same ankle brace as the braced subjects when they returned to competition.

Injury severity was determined by the number of days that an athlete was prohibited from participating in basketball because of the injury.[3,21] An injured player was allowed to return to practice or competition under the direction of his or her AT. To return, each injured player was required to be able to perform functional activities (running, jumping, hopping, and cutting drills) similar to the demands of basketball. If players sustained an injury that kept them out until after the season would have ended, the length of time the player would have been unable to participate was estimated by the AT and the physician who treated the injury.

Ankle brace compliance and the use of other external support by control participants (lace-up brace, hard-shell brace, adhesive tape) were monitored by the on-site AT. Players in both groups were encouraged to be compliant with their original group assignment. Players who elected to be noncompliant had their change in compliance status recorded in the exposures calendars so that the number of exposures with and without ankle braces could be determined. All the injury and exposure data for the participants who dropped out (quit, or were dropped for athletic code violations) were included in the analyses through the last day they were a member of their team. Players were allowed to wear their own style of court shoe, which was classified as being low-top or mid-top height.

Statistical Analyses

All analyses were done based on the intent-to-treat principle. Descriptive statistics were used to characterize the individual participants in each group and clusters in each group. Acute injury rates and corresponding 95% confidence intervals (CIs) were calculated by cluster-adjusted Poisson regression with generalized estimating equations and number of exposures as an offset. All injury rates are reported per 1000 exposures with corresponding 95% CIs.

The time to first event was compared between the braced and control groups using a univariate, cluster-accounted-for Cox proportional hazards (Cox PH) model. A multivariate, cluster-accounted-for Cox PH model was utilized to examine the relationship between treatment groups and acute ankle injury survival while controlling for several independent variables (sex, grade, level of competition, body mass index, and previous injury). Injury severity was determined by comparing the median days lost because of injury for participants in the control and braced groups with the Wilcoxon rank-sum test. All analyses were carried out using R software for analysis, version 2.10.1.[22]

RESULTS

A total of 1468 players initially enrolled in the study. Before the start of the regular season, 8 (3 female and 5 male) players quit or were cut from their team's roster, leaving a total of 1460 players (720 control group and 740 braced group) as study participants. The players participated in a total of 112 439 basketball exposures (24% in competition and 76% in practice) from November 2009 through March 2010. The number of exposures categorized by players' external support was as follows: wore braces alone, 66 397 (59.1%); braces plus ankle tape, 288 (0.3%); tape alone, 212 (0.02%); and no support, 45 542 (40.5%). All players wore the same type of mid-top court shoes throughout the season. The demographic characteristics of both the control and braced groups were similar (Table 1).

Two hundred forty-six players (16.6%) sustained a total of 265 injuries of any type (Table 2). Ninety-two percent of the injuries were acute rather than gradual in onset. Forty percent (n = 107) were located at the ankle, followed by the head with 13.2% (n = 35); knee with

12.5% (n = 33); and the hand, wrist, and fingers with 9.1% (n = 24). Approximately 50% (n = 132) of the injuries consisted of ligament sprains, followed by muscle strains (12.4%, n =33) and concussions (12%, n = 32). Half of the injuries required a referral to a physician or emergency department for further evaluation and treatment, while 5% required surgical intervention. The median number of days lost because of injury was 6 (range, 1–180), but the majority (55%) were classified as being mild (1–7 days lost). The overall injury rate (per 1000 exposures) was 2.68 (95% CI: 2.13, 3.37) for control participants and 2.05 (95% CI: 1.46, 2.86) for braced participants.

Acute Ankle Injuries

A total of 78 acute ankle injuries (lateral, medial, syndesmotic sprains, and fractures) were sustained by players in the control group, while 27 acute ankle injuries were sustained by players in the braced group. As shown in the Kaplan-Meier curves in Figure 3, the control group had lower survival rates for acute ankle injuries beginning with the first exposure. The overall incidence of acute ankle injury was lower in the braced group (0.47; 95% CI: 0.30, 0.74) than in the control group (1.41; 95% CI: 1.05, 1.89) (Figure 4).

There were 75 first-event acute ankle injuries, occurring at a median of 24 exposures, in the control group, compared with 26 first-event acute ankle injuries, occurring at a median of 49.5 exposures, in the braced group (Cox hazard ratio [HR] 0.32; 95% CI: 0.20, 0.52; $P < .001$). First-event acute ankle injuries occurred 68% less often in braced athletes compared with controls. The lower rate of first-event acute ankle injuries in the braced group did not change significantly after adjusting for sex, previous ankle injury, grade level, competition level, and body mass index (Cox HR 0.32; 95% CI: 0.19, 0.51; $P < .001$). These results are summarized in Table 3. The number needed to treat (NNT) to prevent a first-event acute ankle injury was 14.5 (95% CI: 10.4, 24.0).

The reduced rate of first-event acute ankle injuries in the braced group was similar for both players with and without a history of an ankle injury (interaction: $P = .59$). For players who reported a previous ankle injury, the incidence of first-event acute ankle injury was lower in the braced group (0.83; 95% CI: 0.37, 1.84) than in the control group (1.79; 95% CI: 0.98, 3.27); first-event acute ankle injuries occurred about 60% less often in braced athletes than in controls (Cox HR 0.39; CI: 0.17, 0.90, $P = .028$) (Table 4).

For players who did not report a previous ankle injury, the incidence of a first-event acute ankle injury was lower in the braced group (0.40; 95% CI: 0.23, 0.70) than in the control group (1.35; 95% CI: 1.00, 1.81); first-event acute ankle injuries occurred 70% less often in braced athletes than in controls (Cox HR 0.30; 95% CI: 0.17, 0.52; $P <.001$).

Injury severity was classified by the number of days lost. The severity of the first-event acute ankle injuries was similar between the braced and control groups ($P = .23$). The median (range, interquartile [25th, 75th] range [IQR]) days lost in the braced group was 5.0 days (range, 1.0–38.0; IQR 3.0, 8.5) compared with 6.0 days (range, 1.0–60.0; IQR 4.0, 10.5) in the control group.

Acute Knee Injuries

There were 28 acute knee injuries recorded. Injuries in the braced group (n = 15) included 5 anterior cruciate ligament (ACL) tears, 5 medial collateral ligament (MCL) sprains, 2 hyperextension injuries, 2 meniscal tears, and 1 other injury. Injuries in the control group (n = 13) included 5 ACL tears, 2 MCL sprains, 3 patellar instability injuries, 2 other injuries, and 1 hyperextension injury. No subject sustained multiple acute knee injuries. The incidence of acute knee injury was similar between the braced (0.26; 95% CI: 0.12, 0.58) and control (0.20; 95% CI: 0.11, 0.37) groups (Cox HR 1.31; 95% CI 0.60, 2.89; $P = .51$).

The HR did not change significantly when adjusted for other participant covariates (Table 3). The severity of acute knee injuries was similar between the braced and control groups (*P* = .85). The median days lost in the braced group was 60 days (range, 2.0–180.0; IQR 16.5, 180.0) compared with 61 days (range, 5–180.0; IQR 14.0, 180.0) in the control group.

Other Lower Extremity Injuries

There were 53 other lower extremity injuries (n = 35, braced group; n = 18, control group), which included ligament sprains, muscle strains, stress fractures, and tendinitis. Fifty-one of the 53 were first-time events. The incidence of other lower extremity injury was 0.61 (95% CI: 0.32, 1.19) in the braced group and 0.33 (95% CI: 0.20, 0.53) in the control group, while the rate of first-time events was 78% higher in the braced group (Cox HR 1.78; 95% CI 0.92, 3.44; *P* = .08). The HR did not change significantly when adjusted for other participant covariates (Table 3). The severity of other lower extremity injuries was similar between the braced and control groups (*P* = .49). The median days lost in the braced group was 5.0 days (range, 1.0–80.0; IQR 3.0, 14.5) compared with 5.0 days (range, 1.0–89.0; IQR 3.0, 7.0) in the control group.

DISCUSSION

This is the first large-scale study to examine the effectiveness of a lace-up ankle brace in preventing acute ankle injuries in adolescent athletes. The primary finding is that using a lace-up ankle brace reduced the incidence of acute ankle injuries by over 3 times in high school basketball players, regardless of their sex, age, level of competition, or body mass index. In addition, this injury reduction was similar for braced players both with and without a previous ankle injury. The reduction in the incidence of ankle injury is similar to the results of previous prospective studies that looked at the effectiveness of rigid (hard-shell) braces.[23,24]

The overall ankle injury rate was slightly higher than the previous reported rate of 0.77/1000 by Nelson et al[20] in high school basketball players but similar to the distribution of injuries reported by Powell and Barber-Foss.[21] The proportion of ankle injuries (40%) and proportion of athletes injured (16.8%) was similar to findings from previous studies.[3,23]

Sitler et al[23] reported that an Air-Stirrup orthosis (DJO Global, Vista, California) primarily reduced the incidence of ankle sprains in military cadets participating in intramural basketball. Surve et al[24] reported that the risk of sustaining an ankle sprain was reduced by 69% in adult male soccer players with a previous injury while no reduction in injury risk was noted for players who did not have a previous injury. Unlike those previous studies, however, we found that lace-up braces reduced the incidence of injury in athletes both with and without a history of ankle injury. The difference in our results may be explained in part by the fact that our study participants were adolescent rather than adult athletes and that the sample size, number of exposures, and injury incidence in our study was substantially larger than Surve's study. Our results are also in contrast to the retrospective study of North Carolina high school athletes by Yang et al,[31] who reported higher ankle injury rates in players using ankle braces who had no history of ankle injury. This may be due to the fact that the Yang study identified ankle brace use through athlete self-report rather than direct observation by ATs, such as in our study, and that numerous sports (other than basketball) were included in their analysis.

Acute Knee Injuries

Previous authors[25,29] have postulated through laboratory studies that limiting motion through external support at the ankle would influence the transfer of force up through the kinetic chain, leading to more acute knee injuries such as ACL tears. Venesky et al[29] reported that these force transfers did indeed take place with the use of a hard-shell brace. However, our results reveal that the incidence and severity of knee injuries were not affected by the use of the lace-up braces. This may be attributable in part to the fact that lace-up braces offer less support than hard-shell braces, thereby minimizing the transfer of forces up to the knee. This finding is supported by laboratory studies by Cordova et al,[4] who found that hard-shell braces restricted ankle motion more than lace-up braces. In addition, DiStefano et al[5] reported that while a lace-up brace limited sagittal plane motion, it did not cause changes in lower extremity kinematics that may lead to acute knee injuries. It is noteworthy to report that the number and severity of acute knee injuries were similar in the braced and control groups. However, we must acknowledge that this study may not have adequate sample size and statistical power to detect a statistically significant difference.

Other Lower Extremity Injuries

There was a nonsignificant trend toward an 85% higher rate of other lower extremity injuries in the braced group compared with the control group. Approximately half (51%) of these injuries consisted of acute muscle or tendon strains and occurred in the lower leg (gastrocnemius, peroneals, and Achilles), upper leg (quadriceps, hip flexor, and hamstring), or hip/pelvis area (adductors, gluteals). The remaining injuries consisted of acute injuries to the foot (sprains, metatarsal fractures) and 1 case each of an upper leg avulsion fracture, lower leg fracture, and foot stress fracture.

We have not found previous research that indicates there is a relationship between ankle bracing and other lower extremity injuries. Unlike acute ankle and knee injuries, the incidence of the specific types of injuries was so low that analysis between the 2 groups was not possible. In addition, the previously cited laboratory studies seem to indicate that there should not be an increased risk for acute injuries like muscle strains or gradual onset injuries such as a stress fracture while wearing ankle braces. However, in the future, researchers may want to examine the relationship that limited ankle motion plays in upper leg, hip, or low back kinematics.

Effect of Other Ankle Support

We are aware that other factors such as the use of a specific shoe style (high-top vs low-top)[2] or use of ankle taping[16] have been examined in previous research on preventing ankle injuries. While we did not collect data on specific shoe brands, each player wore essentially the same shoe design, specifically a mid-top court shoe. As such, we did not include shoe height as a variable in our analysis.

On the other hand, we were concerned that the use of ankle tape (alone or in conjunction with a lace-up brace) would confound our results. Even though all players were constantly encouraged to be compliant with their group assignment, players were allowed to use ankle tape if they desired. To control for this phenomenon, we had each AT record all of the instances in which ankle tape was used. In many cases, ankle tape was used by a player in conjunction with the ankle brace immediately after an ankle injury or alone if they forgot their braces for a specific practice or game. While analyzing the results, however, we found that the influence of ankle tape was negligible as it was used in less than 0.05% of the exposures and only 2 acute ankle injuries were sustained (1 in the braced group and 1 in the control group) by participants using ankle tape.

Other Injury Prevention Strategies

Verhagen and Bay[30] published an extensive review on the optimal strategies to prevent lateral ankle sprain. Neuromuscular programs were found to reduce relative risk of ankle sprain rates per 1000 exposures of a similar magnitude as bracing (from 0.2 to 0.5), primarily for recurrent ankle sprain. Therefore, they argue that the preferred injury prevention method could be determined by athlete preference. This may be of particular importance in the adolescent population, who may be more compliant with consistently wearing a brace rather than consistently participating in a neuromuscular program.

However, there is good evidence that neuromuscular programs are also effective at preventing or reducing other types of injuries such as ACL tears.[10] We would support their conclusion that the most effective injury prevention strategy is the combination of both bracing and a neuromuscular training program for prevention of both first-time and recurrent ankle sprains as well as other lower extremity injuries.

Effect of Cluster Randomization

As pointed out by Emery,[6] careful consideration in both sample size calculation and in analysis of the data needs to be taken into account when conducting a cluster randomized designed study. We took cluster randomization into account in both the (a priori) sample size calculation and in the final analysis of the data. Emery further states that for large clusters, like schools, the intracluster correlation can be 0.01 or less. We chose to use 0.001, and post hoc analysis showed that the intracluster correlation of the rate of acute ankle injuries was 0.005. Even though the intracluster correlation was very small, it was appropriately accounted for in the estimation of the standard error of the rate of first-event injuries. Without accounting for the intracluster correlation, the *P* values would have been biased to smaller *P* values than they truly are.

Limitations

First, like numerous high schools across the United States, not all schools in Wisconsin have athletic training services for their athletes. As such, approximately 38% were not eligible for inclusion in the study. Second, we only classified shoes as being 1 of 2 styles, low-top or mid-top, and acknowledge that a specific brand or model of shoe may have played a role in the results. Third, there could have been selection bias for players who enrolled in the study. Most Wisconsin high schools require that potential study participants be made aware of any interventions or lack of interventions before study enrollment. Therefore, it is feasible that potential players from control schools did not elect to participate because they would not receive ankle braces before the start of the season. It is also possible that players in the braced group did not elect to participate because they did not want to wear ankle braces during the season. Finally, as with similar injury intervention studies, players and the ATs collecting the data were not blinded as to their allocation into the control or braced groups.

CONCLUSION

The use of a lace-up ankle brace reduced the incidence but not the severity of acute ankle injuries in male and female high school basketball athletes. This protective effect was observed in adolescent athletes both with and without a previous ankle injury. Use of the brace did not significantly increase the incidence or severity of acute knee injuries. However, use of the brace was associated with a trend toward a higher incidence of minor other lower extremity injuries.

Wearing lace-up ankle braces may be a cost-effective injury prevention strategy in adolescent basketball players. Future research is warranted on the effect of lace-up ankle braces on all lower extremity injuries when used in conjunction with a comprehensive neuromuscular training program.

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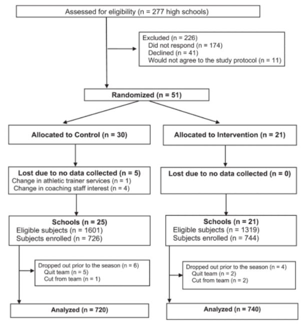

Figure 1.
School selection and randomization.

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Figure 2.
Lace-up ankle brace.

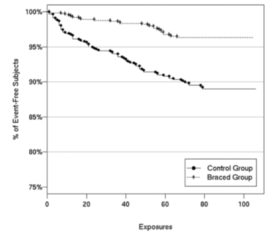

Figure 3.
Percentage of acute ankle injury–free participants over time. Dots (controls) and crosses (braced) show times (number of exposures) of first injury.

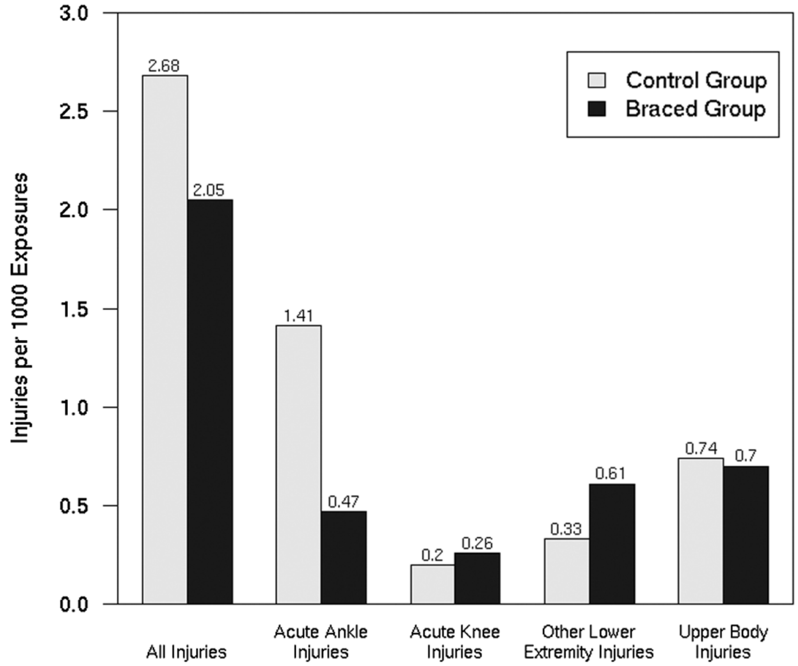

Figure 4.
Injury rates (per 1000 exposures), total and by site of injury, for participants in braced and control groups.

TABLE 1

Demographic Summaries of Braced and Control Groups by Individual Participant and by Cluster

	Individual Participant		Cluster[a]		
Variable	**Controls (n = 720) No. (%)**	**Braced (n = 740) No. (%)**	**Controls (n = 25) No. (%)**	**Braced (n = 21) No. (%)**	***P* Value[b]**
Gender					.532
Female	380 (52.8)	356 (48.2)	54.0 ± 18.7	50.5 ± 18.7	
Male	340 (47.2)	384 (51.8)	46.0 ± 18.7	49.5 ± 18.7	
Age, y (mean ± standard deviation)	16.0 ± 1.1	16.0 ± 1.1	16.1 ± 0.4	16.1 ± 0.2	.819
Body mass index, kg/m^2 (mean ± standard deviation)	21.7 ± 2.8	21.9 ± 2.7	21.7 ± 0.8	21.9 ± 0.6	.320
Grade					.901
Freshman (9th)	235 (32.6)	225 (30.4)	27.7 ± 17.3	29.0 ± 15.5	
Sophomore (10th)	230 (31.9)	233 (31.4)	33.0 ± 10.9	31.7 ± 16.2	
Junior (11th)	142 (19.7)	164 (22.1)	21.3 ± 10.0	22.8 ± 8.7	
Senior (12th)	113 (15.6)	118 (15.5)	18.0 ± 8.8	16.6 ± 6.0	
Level of competition					.668
Freshman	155 (21.5)	156 (21.1)	16.1 ± 15.6	19.2 ± 14.3	
Subvarsity	246 (34.2)	259 (35.0)	34.7 ± 12.5	34.2 ± 16.0	
Varsity	319 (44.3)	325 (43.9)	49.3 ± 17.9	46.6 ± 16.5	
Previous ankle injury					
Yes	102 (14.2)	121 (16.4)	15.8 ± 9.1	15.5 ± 9.8	.907
Leg dominance					
Right	660 (91.7)	677 (91.5)	91.5 ± 5.0	91.1 ± 5.3	.820
Previous use of ankle tape					
Yes	54 (7.5)	79 (10.7)	9.7 ± 8.7	10.7 ± 8.9	.695
Previous use of ankle braces					
Yes	283 (39.3)	308 (41.6)	40.7 ± 13.8	41.8 ± 16.7	.827
FAAM–Sport Scale[c] (mean ± standard deviation)					
Left	95.7 ± 8.5	95.2 ± 8.9	95.5 ± 2.3	95.2 ± 2.1	.686
Right	95.4 ± 9.6	94.7 ± 10.0	94.9 ± 3.6	94.7 ± 2.4	.861
Basketball exposures					
Competition	18.4 ± 6.0	19.1 ± 5.3	529 ± 311	673 ± 229	.079

Variable	Individual Participant		Cluster[a]		P Value[b]
	Controls (n = 720) No. (%)	Braced (n = 740) No. (%)	Controls (n = 25) No. (%)	Braced (n = 21) No. (%)	
Practice	58.4 ± 12.1	58.1 ± 11.7	1683 ± 880	2047 ± 631	.111

[a] Reported as mean average percentage (categorical) or average value (continuous) within each cluster.

[b] *t* test *P* value for comparison of cluster averages between groups.

[c] FAAM, Foot and Ankle Ability Measure.

TABLE 2

Injury Characteristics in Braced and Control Groups

Variable	Control Group (n = 148 Injuries), No. (%)	Braced Group (n = 117 Injuries), No. (%)
Team session		
Practice	93 (62.8)	55 (53.0)
Competition	55 (37.2)	62 (47.0)
Injury onset		
Acute	141 (95.3)	104 (88.9)
Gradual	7 (4.7)	13 (11.1)
Body area		
Foot	6 (4.1)	3 (2.6)
Ankle	80 (54.1)	27 (23.1)
Lower leg	1 (0.1)	7 (6.0)
Knee	13 (8.8)	20 (17.9)
Upper leg	5 (3.4)	12 (10.3)
Hip/pelvis	2 (1.4)	8 (6.8)
Trunk/back	3 (2.0)	4 (3.4)
Shoulder	4 (2.7)	4 (3.4)
Arm/elbow	3 (2.0)	3 (2.6)
Hand/wrist/fingers	13 (8.8)	11 (9.4)
Face	0 (0)	1 (0.9)
Head	18 (12.2)	17 (14.5)
Type of injury		
Ligament sprain	86 (58.1)	46 (39.3)
Muscle strain	12 (8.1)	21 (17.9)
Contusion	4 (2.7)	7 (6.0)
Fracture	7 (4.7)	8 (6.8)
Concussion	17 (11.5)	15 (12.8)
Other	22 (14.9)	20 (17.9)
MD or emergency dept. referral		
Yes	69 (46.6)	59 (50.4)
Required surgery		
Yes	7 (4.7)	7 (6.0)
Injury severity (days lost)		
Mild (1–7 days)	82 (55.4)	64 (54.7)
Moderate (8–21 days)	40 (27.0)	29 (24.8)
Severe (>21 days)	26 (17.6)	24 (20.5)
Days lost, median (range)	7.0 (1.0–180.0)	6.0 (1.0–180.0)

TABLE 3

Cluster-Adjusted Cox Proportional Hazards Rates Comparing Injury Events in the Braced Group With Injury Events in the Control Group[a]

	Unadjusted Analysis		Adjusted Analysis[b]	
Treatment	**HR (95% CI)**	***P* Value**	**HR (95% CI)**	***P* Value**
Acute ankle injury				
Control	Reference		Reference	
Braced	0.32 (0.20, 0.52)	<.001	0.32 (0.19, 0.51)	<.001
Acute knee injury				
Control	Reference		Reference	
Braced	1.31 (0.59, 2.89)	.507	1.33 (0.61, 2.90)	.479
Other lower extremity injury				
Control	Reference		Reference	
Braced	1.78 (0.93, 3.44)	.084	1.85 (0.97, 3.52)	.062

[a]HR, hazard ratio; CI, confidence interval.

[b]Analysis adjusted for sex, previous ankle injury, grade level, competition level, and body mass index.

TABLE 4

Cluster-Adjusted Cox Proportional Hazards Rates Comparing Acute Ankle Injuries in Braced Group With Acute Ankle Injuries in Control Group by Previous Ankle Injury Status[a]

		Unadjusted Analysis		Adjusted Analysis[c]	
Previous Ankle Injury	Injury Rate[b]	HR (95% CI)	*P* Value	HR (95% CI)	*P* Value
No					
Control	1.35	Reference		Reference	
Braced	0.40	0.30 (0.17, 0.53)	<.001	0.30 (0.17, 0.52)	<.001
Yes					
Control	1.79	Reference		Reference	
Braced	0.83	0.39 (0.17, 0.89)	.024	0.39 (0.17, 0.90)	.028

[a]HR, hazard ratio; CI, confidence interval.

[b]Injury rate per 1000 exposures.

[c]Analysis adjusted for sex, grade level, competition level, and body mass index.