Prior Injury, Health-Related Quality of Life, Disablement, and Physical Activity in Former Women’s Soccer Players

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Context: Former collegiate athletes may be at risk for negative health outcomes like lower health-related quality of life (HRQoL), higher disablement, and lower lifetime physical activity (PA) participation. A history of severe sports injury may play a role in these outcomes.

Objective: To assess the role prior sports injury plays in self-reported HRQoL, levels of disablement, and PA behaviors of former Division I women’s soccer players.

Design: Cross-sectional study.

Setting: Online Survey.

Participants: Former NCAA Division I women’s soccer players (n = 382, Mage = 36.41 ± 7.76) completed demographics, injury history, the Patient-Reported Outcomes Measurement Information System (PROMIS; HRQoL), the Disablement for the Physically Active Scale (DPA; disablement), and the Godin Leisure Time Physical Activity Questionnaire (PA).

Main Outcome Measures: The dependent variables were physical and mental component summary scores for HRQoL and disablement, and frequency of moderate-to-vigorous PA. Means, standard deviations, and correlations among the main outcome variables were examined for those who reported a severe injury (n = 261) and those who did not (n = 121). To address the primary aim of the study, multiple regression analyses were used to predict PA, disablement, and HRQoL based on history of severe injury, accounting for age.

Results: Having a severe injury was significantly predictive of having worse physical disablement and worse physical HRQoL, with severe injury predicting a greater than 5-point
increase and 2-point decrease on the respective scales. Injury status was not predictive of mental disablement, mental HRQoL, or PA.

**Conclusions:** The majority of participants reported suffering a prior severe soccer-related injury, which may have a negative long-term impact on health outcomes for former women’s soccer players. Athletic trainers should be aware of risk for decreased HRQoL and increased disablement with injury and encourage continued monitoring of relevant patient-reported outcomes (PROs).

**Keywords:** retired athletes, physical health, mental health, exercise

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**Key Points:**

- Over two thirds (68.3%) of participants reported suffering a severe injury during their soccer playing career, with knee and ankle injuries being the most commonly reported severe injuries.
- Suffering a prior severe soccer-related injury was predictive of worse physical HRQoL and physical disablement scores.
- Athletic trainers should consider the value of using population relevant PROs and develop population specific normative values to determine clinically relevant deficits in HRQoL and disablement in former athletes.
Though collegiate athletes are often viewed as the quintessential picture of health, there is growing evidence that former athletes are at risk of developing negative health outcomes.\(^1\)\(^-\)\(^7\) For example, declines in physical activity (PA) and fitness\(^3\)\(^-\)\(^5\) and decreased health-related quality of life (HRQoL)\(^1\)\(^,\)\(^2\)\(^,\)\(^5\)\(^,\)\(^6\) have been found in former collegiate athletes. Prior sport-related injury may play a key role in the development of these negative health outcomes. Specifically, disablement (i.e., the inability to perform activities that are important to the individual\(^8\)) as a result of prior injury suffered while participating in sport is likely a contributing factor.\(^9\) Researchers studying diverse cohorts of former college athletes have documented a relationship between prior injury and lower HRQoL scores.\(^1\)\(^-\)\(^3\)\(^,\)\(^6\)\(^,\)\(^10\)

HRQoL is a measure of health domains that usually incorporates physical, mental and social components and is uniquely personal to the individual.\(^11\)\(^,\)\(^12\) The disablement process incorporates this uniqueness by describing the interrelated factors that result in disability, including how the functioning of the body systems are affected and the resulting physical and mental consequences.\(^8\) Disability, or level of disablement, is characterized by the inability to perform physical activities or social responsibilities that are of importance to the individual due to a health or physical problem.\(^8\) Additionally, HRQoL has been found to be highly connected to PA, as HRQoL is enhanced by regular PA participation.\(^13\) Sports injury can have short and long-term consequences that usually include impairments like physical pain and stiffness, but also functional limitations like impaired activities of daily living and fitness-related PA.\(^12\) The disablement model offers a useful framework for understanding how injury can have lasting impact on former athletes’ PA levels and, subsequently, additional HRQoL deficits.\(^9\)

Current collegiate athletes have reported declines in HRQoL following injury, which often remain lower even after returning to full sport participation.\(^14\)\(^-\)\(^16\) Consequently, HRQoL
appears to then continue to decline into retirement from sport, with a history of sports injury linked to decreased HRQoL scores and difficulty performing activities of daily living.\textsuperscript{1-3,10} In particular, a history of ankle and knee injury and surgery has been linked to dramatically high rates of osteoarthritis (OA) and/or subsequent decreases in HRQoL.\textsuperscript{15,17}

As demonstrated by previous research, negative health outcomes in former college athletes appear to be linked to their prior sport experiences that include a history of injury. However, every sport has unique experiences and injury risks. Soccer is one of the most popular sports in the US and also has one of the highest rates of injury at the collegiate level.\textsuperscript{18,19} Women’s soccer had the highest injury rate in competition for women’s sports, and the second highest injury rate overall, in the NCAA from 2009-2014.\textsuperscript{18} Injuries to the hip/thigh/upper leg, knee, ankle, and head/face are the most common injuries in women’s college soccer.\textsuperscript{19} These injuries are also linked to declines in HRQoL in collegiate athletes even after returning to full participation.\textsuperscript{14-16} Anterior cruciate ligament (ACL) injuries are especially concerning for former female soccer athletes: 82\% report OA within 12 years of suffering an ACL injury and 75\% report challenges to knee-related quality of life.\textsuperscript{17} Prien and colleagues\textsuperscript{20} identified health concerns specific to former elite women’s soccer players and found they are related to knee, ankle, and head injuries. However, Prien and colleagues\textsuperscript{20} studied former German professional women’s players, not players from the American collegiate system. This is an important distinction because the American system essentially peaks at the NCAA Division I level with only a small fraction of women’s players continuing on to the American professional league.\textsuperscript{21,22} Therefore, the most equivalent comparison group for American soccer athletes to the European professional is the Division I collegiate player.
Given most US soccer athletes reach the pinnacle of their careers in college, it is important to understand how elite sport participation and potentially high rates of injury impact their future long-term health, especially when prior research has indicated a strong likelihood of detriments to HRQoL and activities of daily living following severe sport-related injury.\textsuperscript{1-3, 6,9,10,14-16,17} Despite women’s soccer experiencing particularly high rates of participation and injury, most of the research on former collegiate athletes’ health has included mixed sport cohorts that consisted largely of male athletes and/or sample sizes not allowing for comparisons across individual sports.\textsuperscript{1-5} In research by Simon & colleagues\textsuperscript{3,5} around 30\% of the sample was comprised of former football players whose injury experiences and potential consequences in a male-dominated collision sport may not be comparable to those of female athletes participating in contact sports like soccer. Additionally, most soccer-specific research has been done with male players,\textsuperscript{23-26} whereas female former athletes have been underrepresented. More sport- and gender-specific research is needed to identify long-term impacts of injury in the context of women’s soccer. Therefore, the purpose of this study was to assess the current perceived health of former Division I collegiate women’s soccer players, and specifically to examine the role prior sports injury plays in the health and PA behaviors of these former athletes. By determining the relationships among prior sport injury, current disablement, PA, and HRQoL of former women’s college soccer players, athletic trainers can gain a better understanding of the long-term consequences of severe injury in former athletes. Increasing the knowledge of HRQoL, disablement, and PA behaviors in former athletes can aid athletic trainers in promoting lifespan wellness and PA, as well as inform strategies for enhancing health outcomes in former athletes and those transitioning into athletic retirement.

\textbf{METHODS}
Study Design

This research study used a cross-sectional design focusing on former NCAA Division I women’s soccer players. Participants completed an online survey that included measures of injury history, HRQoL, disablement, and physical activity.

Participants

Participants (n = 382; M\text{age} = 36.41 ± 7.76) were drawn from a convenience and snowball sample of former NCAA Division I women’s soccer players. To be eligible for the study, participants must have played NCAA Division I women’s soccer and no longer be playing elite competitive soccer (e.g., collegiately, semi-professionally, professionally). The participants played on average 3.87 years of Division I soccer. Most (n = 308; 80.6%) reported that they were starters during the best season of their collegiate career. The breakdown by primary position played was forward (n = 69; 18.1%), midfield (n = 132; 34.6%), defender (n = 117; 30.6%), and goalkeeper (n = 64; 16.8%). Participants were between the ages of 22 and 59, with the majority (n = 298; 78.0%) being 10 or more years (M = 14.6, SD = 7.76) removed from their NCAA playing career. Many participants were still involved in the game of soccer, with most citing recreational play (n = 138, 36.1%) or coaching (n = 140, 36.6%). However, over a third of the sample (n = 135; 35.3%) was no longer involved in soccer in any capacity. Reasons for terminating their soccer careers included graduating college (n = 27; 7.1%), injury-related reasons (n = 92; 24.1%), lack of opportunity/no monetary compensation (n = 51; 13.4%), work or career not related to soccer (n = 78; 20.4%), and change in desire/burnout (n = 47; 12.3%).

Procedures

Participants completed an online survey through Qualtrics. The university’s institutional review board approved the study prior to data collection and all participants provided informed consent before completing the survey.
consent electronically. We recruited participants through email and social media (e.g., Facebook, Instagram, Twitter). Current Division I college coaches were also asked to send study information to their alumni through email or social media alumni groups. Participants were also asked to forward the electronic survey link to former teammates. The online survey was accessed a total of 487 times in a three-month study window. A total of 382 participants were included for data analysis, including 372 who completed the full survey (completion rate = 79.6%) and an additional 10 participants who completed at least one main outcome measure.

**Demographic Questionnaire.** Participants provided information about their age, playing position, the number of years they played NCAA Division I, the number of years removed from playing collegiate soccer, and current involvement with the sport (see Appendix).

**Injury History.** Participants were asked to provide a detailed background of their injury history, including the number of severe injuries experienced throughout their entire soccer career, specific body part(s) affected, and whether surgery was required. In line with similar studies, severe injury was defined as any injury that kept an athlete out of participation 21 or more days.\(^{10,14}\)

**Global Health Patient Reported Outcome Information System.** The Adult Global Health version 1.2 of the Patient Reported Outcome Measurement Information System (PROMIS) was used to measure HRQoL. The PROMIS is a 10-item measure with Physical and Mental Function domain scores that has been validated for use in diverse clinical and research populations.\(^ {27}\) The physical component score (PCS) and mental component score (MCS) are comprised of four items each.\(^ {27}\) The remaining two questions (i.e. “In general, would you say your health is . . .” and “In general, please rate how well you carry out your usual social activities and roles.”) are not combined in the domain scores and reported separately.\(^ {27}\) Raw
mental and physical domain scores were converted to a T-score through a standardized table. The standardized T-scores allow for comparison with the general population with a mean score of 50 and a standard deviation (SD) of 10. A score higher than 50 equates to a higher than average level of health. When the PROMIS global health summary scores were developed with a general US population sample the mental scores demonstrated an internal consistency of 0.86 for MCS and 0.81 for PCS. In the current study, the reliability for MCS was acceptable ($\alpha = 0.80$). PCS was lower ($\alpha = 0.63$), but all four items correlated and contributed to the total reliability.

**Disablement of the Physically Active.** The Disablement of the Physically Active Scale (DPA) is a reliable and valid tool designed to measure level of disablement in physically active populations. The DPA is a 16-item survey with 12 items assessing physical health (e.g., impairment, activity limitations) and four items assessing mental health (e.g., psychosocial and emotional well-being) based on how much of a problem the athlete has had within the past 24 hours. Physical component scores (PCS) and mental component scores (MCS) are calculated with higher scores indicating higher levels of disablement. High test-retest reliabilities (ICC = 0.94) were reported for the DPA. The reliability for the current study was high for both the Physical Score ($\alpha = 0.95$) and Mental Score ($\alpha = 0.83$). Similar reliabilities were reported in a previous study using the DPA with current athletes for both physical ($\alpha = 0.94$) and mental scores ($\alpha = 0.88$).

**Godin Leisure Time Physical Activity Questionnaire.** The Godin Leisure Time Physical Activity Questionnaire (Godin) was used to measure participants’ weekly moderate-to-vigorous physical activity (MVPA). The Godin assesses frequency of participation in strenuous (e.g., running, vigorous swimming), moderate (e.g., fast walking, biking), and light (e.g., yoga,
easy walking) activities for more than 15-minute periods. A metabolic equivalent (MET) unit is then created from these values through a standard equation. Because a summary score of only strenuous and moderate activities has been suggested as a better indicator of health contribution\textsuperscript{31} weekly PA levels were computed using the equation: (frequency of strenuous activity/week X 9) + (frequency of moderate activity/week X 5). Higher total scores represent greater participation in PA, with scores ≥ 24 considered active with substantial health benefits.\textsuperscript{31}

**Exploratory Questions.** We asked participants to rate on a 4-point scale (0 = Never, 3 = Almost Always) how much their injury history impacted their current ability to participate in sports and PA. We also asked whether the participants had any concerns regarding the health of various body systems (e.g., joint, skin, mental, cardiovascular health).

**Statistical Analysis**

Upon completion of data collection through Qualtrics, we downloaded the data into SPSS for data reduction, scoring, and analysis. Scores that were reported in minutes of PA rather than frequency of PA were removed from analysis (n = 5). Descriptive analysis was completed for all demographics, playing history, injury history, and exploratory questions. Means, standard deviations, and correlations among the main outcome variables were examined separately for those who reported a severe injury and those who did not (See Table 1). To address the primary aim of the study, separate multiple regression analyses were used to predict PA, disablement, and HRQoL based on history of severe injury (dummy coded with no prior severe injury as the reference group), controlling for age. While group sizes were uneven, the assumption of homogeneity of variance was not violated based on examination of residual plots. The distributions of the dependent variables resulted in a violation of the residual normality assumption of ordinary least squares regression. Therefore, nonparametric bootstrapping
procedures were performed with 5,000 replications; significance was determined based on 99% bias-corrected confidence intervals. Further, semi-partial correlations were calculated to estimate the variance in outcomes uniquely accounted for by injury history given that age was included as a control variable. Effect sizes were interpreted as small (0.1), moderate (0.3), and large (0.5). 

RESULTS

Over two thirds (68.3%) of participants reported suffering a severe injury during their playing career. Knee and ankle injuries were the most commonly reported severe injuries. Most of the former athletes who reported a knee injury also had at least one surgery (see Table 2).

Results of the separate regression analyses (see Table 3) indicated that having a severe injury was significantly predictive of worse physical disablement (DPA-PCS; sr = .22) and worse physical HRQoL (PROMIS-PCS; sr = -.15). Injury status was not predictive of mental disablement (DPA-MCS), mental HRQoL (PROMIS-MCS), or PA.

Most of the sample (n = 314; 82.2%) rated their current health as “very good” or “excellent” overall; however, many (n = 231; 60.5%) listed at least one area of concern, with concerns related to joint health (n = 149; 39%) and mental health (n = 69; 18.1%) cited most often. When participants in the severe injury group (n = 261) were asked to what extent they felt their prior injury experience currently limited or hindered their ability to participate in recreational activities, sports, or physical activity, 28.4% (n = 74) reported Often or Almost Always, 44.4% (n = 116) stated Rarely, and 25.7% (n = 67) reported Never.

DISCUSSION

The primary goal of our study was to examine the role prior severe sports injury plays in the perceived levels of disablement, HRQoL, and self-reported PA behaviors of former Division I women’s soccer players. We found that former soccer players in this sample reported high rates
of severe sport-related injury overall. Knee injuries were most frequently reported, with the
majority of participants requiring surgery for their knee injury. A 10-year study on the
epidemiology of athletic knee injuries found that 79.35% of internal knee trauma injuries
resulted in surgery.\textsuperscript{33} With female soccer players having 3 to 5 times higher risk of this injury
than men,\textsuperscript{34} the high rate of surgery reported in the current sample is not unexpected.

Overall, those with a history of severe injury were more likely to report worse physical
HRQoL and greater physical disablement. In particular, a small to moderate effect was observed
for physical disablement, suggesting that having a severe injury was predictive of a greater than
5-point increase in the DPA-PCS. However, more research is needed to evaluate the clinically
meaningful influence of injury on the DPA summary components.\textsuperscript{30}

These results are consistent with previous research indicating that former collegiate
athletes may suffer from health consequences,\textsuperscript{15} with a history of sports injury being related to
decreased health outcomes.\textsuperscript{1-3,6,10} Prior research has also indicated that former elite women’s
soccer players should be concerned about the long-term impact of knee, ankle, and head
injuries.\textsuperscript{20} Participants in the current sample reported high rates of injuries at those same
locations and cited joint and mental health being their areas of greatest concern. These findings
also align with the disablement theory model that HRQoL has many interrelated factors that
contribute to a person’s perceived level of health.\textsuperscript{8,9,12} While not all previously injured athletes
will suffer extreme disablement or health deficits, prior sports injury that has lingering physical,
emotional, social, and mental health consequences can play a role in current HRQoL.

The DPA scores reported in this study are similar to a recent study with former Division
II athletes.\textsuperscript{35} While the DPA has not been used much to date with former athletes, Russell, et al.\textsuperscript{9}
suggested the DPA scale provides a more nuanced understanding of the physical activity-related
barriers former athletes may experience when compared to generic HRQoL scales that have been found to have floor-to-ceiling effects. In addition, the DPA measures constructs that are more relevant to a physically active population.\textsuperscript{29} With a high Cronbach’s alpha for both the physical ($\alpha = 0.95$) and mental ($\alpha = 0.83$) scores for the DPA, this study supports DPA as a reliable tool to use with former athletes and highlights the limitations in global physical functioning former athletes may suffer due to prior sport-related injury.

It is worth noting that most participants in this sample rated their current health as very good or excellent in general, and mean scores for the PROMIS in the prior severe injury group ($M = 52.91$) were still above the general population norm of $M = 50$,\textsuperscript{27} even though the severe injury group reported lower physical HRQoL compared to their uninjured peers. The findings of our study are consistent with other researchers who have found that former athletes were not much different from the general population regardless of the HRQoL survey used.\textsuperscript{6} Additionally, it has been reported that athletes may still rate their health high even when injured because they tend to function at a higher level of health.\textsuperscript{36} Therefore, it is important for clinicians to be mindful that deficits or declines in HRQoL in athletes and former athletes may be population-specific and only recognized when compared with uninjured peers, not necessarily against the general population.\textsuperscript{36,37} Additionally, the amount of PA reported in this cohort of former women’s soccer players regardless of prior injury history was well above the minimum amount for health benefits.\textsuperscript{31} However, this may be considerably less PA than what these athletes participated in college as student-athletes. Interestingly, in a recent follow-up study by Simon, et al.,\textsuperscript{5} former collegiate athletes reported less PA than their non-athlete peers and showed significant declines in HRQoL compared to 5 years prior. Reported HRQoL was also lower than both their non-varsity athlete peers in the study and the general population average. However,
that study’s former athlete sample was approximately 20 years older on average than our sample and included former athletes from a variety of sports, with a large representation of former football players (31%), suggesting that it may be important for researchers to consider the specific sport played, gender, and current age of former athletes when drawing comparisons.

Moreover, Valier and Lam\(^{36}\) recommend that when determining a minimal clinically important difference (MCID), values derived from a population as close as possible to the one of interest should be used.

Previous research has been limited by not addressing impact of injury on health-related quality of life within specific sports.\(^{1,3,5,10}\) Simon and colleagues compared former athletes based on level of contact (collision, contact, limited-contact) to age-matched general US population norms and found that former athletes from collision sports had lower HRQoL than contact and limited contact sports and the general population.\(^2\) Contact and limited-contact former athletes did not deviate from the general population values;\(^2\) however, it has been suggested that athlete populations require their own set of normative values\(^{37,38}\) as being similar to the general population may actually still reflect a decline in HRQoL within that specific athlete population. Therefore, to provide an accurate frame of reference to base clinical decisions on it is important to use not only an appropriately relevant patient reported outcome measure but also normative values for that distinct patient population.\(^{38}\) Additional research is needed to establish population-specific normative values with comparisons of injured and non-injured athletes within sport- and gender-specific samples to determine a clinically meaningful change in HRQoL and disablement resulting from prior sport-related injury.

Wiese-Bjornstal\(^{39}\) described injury as a far-reaching adverse event and suggested that the long-term effects of injury are more significant for athletes than those suffered by non-athletes.
because of the role PA participation plays in an athlete’s life and well-being. It has already been noted that former collegiate athletes may experience declines in lifespan PA\textsuperscript{3-5} and face challenges in maintaining a physically active lifestyle.\textsuperscript{40} While severe injury status was not predictive of PA, PA demonstrated small to moderate correlations with many of the main outcome measures, particularly for the group of former athletes who did not report a severe injury, indicating that worse HRQoL and disablement is associated with less PA. Some evidence of the potential impact of injury and disablement on PA was also apparent in the severe injury group with more than a quarter of those respondents noting that their injury history limited them in recreation, sports and PA \textit{Often} or \textit{Almost Always}. Weise-Bjornstal\textsuperscript{39} noted the benefits on mood, motivation, and return-to-health that alternative forms of PA have on physically active populations like athletes. For former athletes who may be struggling with the inability to perform desired forms of PA due to disablement or prior injury history, finding alternative forms of PA they enjoy would likely be beneficial. Thus, athletic trainers can support athletes with a history of sport-related injuries as they transition out of sport by recommending activity modification and providing education on the psycho-social factors surrounding the importance of PA for mental, physical, and social health.

\textbf{Limitations and Recommendations}

Findings from this study should be interpreted within the limitations of the study design. The cross-sectional nature of the study precludes causal inferences; future studies should incorporate longitudinal approaches with more complex analysis to provide added insight. While other studies have used self-reported recall,\textsuperscript{10,14} there is always the possibility of inaccurate reporting of injuries. Additionally, the age of this sample is relatively young, and not necessarily generalizable to an older group of former athletes. Finally, the injury-related care received
before, during, and after college likely varied across the sample; gathering more information related to this would be beneficial for promoting the care of future athletes.

Given the long-term consequences of sports injury, an emphasis should be placed on prevention efforts. The importance of strength training, injury prevention programs, and adequate rest/not overtraining as preventative measures to decrease the risk of injury should be highlighted. When an injury does occur the importance of a quality rehabilitation program should also be emphasized. Coaches, sports medicine staff, and players should evaluate the appropriate timeline for when the athlete should return to play after an injury. Current players at all levels of competition should also be educated on potential long-term consequences of sport-related injury. Former athletes who have suffered an injury should be educated on these potential consequences to their health and encouraged to receive follow-up medical care following retirement from sport.

Future research should explore the number and types of injury that may have the greatest negative health implications. Specific interventions to help manage the long-term physical and psychological consequences of prior sports injury are needed and should be implemented and evaluated to determine if they can improve HRQoL and other health outcomes of former athletes. This might include pain management tools, PA modification, and relaxation and/or mindfulness techniques to assist in promoting mental health and wellbeing.

**Conclusion**

Based on the reported rates of previous injury, Division I women’s soccer players suffer high rates of severe injury, which is subsequently predictive of physical health consequences in some athletes. Evidence is increasing that athletes may sacrifice future HRQoL and fitness as a result of sport-related injury suffered during participation in collegiate athletics. Athletic trainers should be aware of the risk of decreased HRQoL and increased disablement with injury.
and use this knowledge to practice patient-centered care to determine appropriate return to participation after injury. Understanding these possible outcomes will allow clinicians to better serve the patients while also encouraging continued monitoring of these patient reported outcomes long-term after both return to play and retirement from sport.
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APPENDIX

Demographic Questions

How many years did you play NCAA Division I Soccer?
   I never played*  
   1  
   2  
   3  
   4  
   5 – Medical redshirt  
   5 – Other redshirt  
   6 – Medical hardship & redshirt

* Note: Choosing this answer removed the participant from the survey as the inclusion criteria was having played Division I women’s soccer

How many years removed are you from playing collegiate soccer? _______

How are you still involved in the game of soccer? (choose all that apply)
   Still play competitively (college, semi-pro or pro)**  
   Still play recreationally (coed, pick-up, indoor)  
   Coaching  
   Refereeing  
   Team Administrator  
   Other ________________  
   Not involved anymore

** Note: Choosing this answer removed the participant from the survey as the inclusion criteria was no longer playing competitive soccer

Why did you stop playing soccer competitively (i.e. college, semi-pro, pro)? _______

What was your primary playing position?
   Forward  
   Midfield  
   Defender  
   Goalkeeper

During the best season of your collegiate playing career, how would you classify the playing time you received/status on your team?
   Starter/First team/played majority of the minutes  
   Regular sub/Second team  
   Rarely participated in games/Third team  
   Participated in practice but did not compete in games

Age ______

Age ______
Table 1. Descriptive statistics for main outcome measures\textsuperscript{a}

| Variable | No Severe Injury Group | Severe Injury Group | Correlations |
|----------|------------------------|---------------------|--------------|
| 1. PA    | Mean (SD)              | Mean (SD)           | 1 2 3 4 5    |
|          | 40.49 (23.54)          | 38.08 (21.66)       | .44 .29 -.30 -.19 |
| 2. PROMIS-PCS\textsuperscript{b} | 54.82 (6.54)          | 52.91 (6.54)        | .24 .60 -.61 -.52 |
| 3. PROMIS-MCS\textsuperscript{b} | 54.70 (7.89)          | 54.17 (7.35)        | .15 .56 -.28 -.69 |
| 4. DPA-PCS\textsuperscript{c}     | 8.86 (10.69)          | 13.77 (11.60)       | -.07 -.63 -.33 .37 |
| 5. DPA-MCS\textsuperscript{c}     | 2.94 (3.26)           | 2.95 (3.41)         | -.14 -.48 -.65 .43 |

Abbreviations: PA = physical activity; PROMIS = Patient Reported Outcome Measurement Information System; DPA = Disablement of the Physically Active Scale; PCS = physical component score; MCS = mental component score.

\textsuperscript{a} Correlations below the diagonal are for the severe injury group, correlations for the no severe injury group are above the diagonal. Significant values (bold) based on bootstrapped 99% bias-corrected confidence intervals.

\textsuperscript{b} Higher scores indicate better health.

\textsuperscript{c} Higher scores indicate poorer health.
Table 2. Frequency of Severe Injury and Surgery

| Injury Location           | Participants with at least 1 Severe Injury | %   | Participants Requiring at least 1 Surgery | %   |
|--------------------------|-------------------------------------------|-----|------------------------------------------|-----|
| Knee                     | 164                                       | 42.9%| 131                                      | 79.8%|
| Ankle                    | 88                                        | 23.0%| 29                                       | 32.9%|
| Soft tissue              | 61                                        | 15.9%| 5                                        | 8.2% |
| Lower leg                | 47                                        | 12.3%| 22                                       | 46.8%|
| Head/concussion          | 45                                        | 11.7%| ---                                      | ---  |
| Upper body               | 44                                        | 11.5%| 23                                       | 52.3%|
| Spine (neck/back)        | 22                                        | 5.7% | 4                                        | 18.1%|
| Hip                      | 19                                        | 4.9% | 8                                        | 42.1%|
| Other                    | 16                                        | 4.2% | 8                                        | 50.0%|
Table 3. Prediction of Perceived Health-Related Quality of Life, Disablement, and Self-Reported Physical Activity by History of Severe Injury

| Model         | Adj. $R^2$ | Predictor | $B$  | $SE$  | Bootstrapped Bias-Corrected 99% confidence interval |
|---------------|------------|-----------|------|-------|---------------------------------------------------|
|               |            |           |      |       | Lower                      | Upper                      |
| PROMIS-PCS    | .02        | Intercept | 54.91| .59   | 53.37                     | 56.42                     |
|               |            | Age       | -.07 | .04   | -1.8                      | .04                       |
|               |            | Severe Injury | -2.05 | .72   | **-3.81**                  | -.16                     |
| PROMIS-MCS    | .01        | Intercept | 54.57| .71   | 52.70                     | 56.36                     |
|               |            | Age       | .09  | .05   | -.02                      | .21                       |
|               |            | Severe Injury | -.35  | .85   | -2.57                     | 1.84                      |
| DPA-PCS       | .07        | Intercept | 8.48 | .94   | 6.17                      | 11.00                     |
|               |            | Age       | .27  | .07   | **.08**                   | .46                       |
|               |            | Severe Injury | 5.44  | 1.19  | **2.32**                  | 8.54                      |
| DPA-MCS       | .01        | Intercept | 3.02 | .30   | 2.27                      | 3.85                      |
|               |            | Age       | -.06 | .02   | -.11                      | -.01                      |
|               |            | Severe Injury | -.10  | .37   | -1.09                     | .84                       |
| PA            | .00        | Intercept | 40.72| 2.21  | 35.09                     | 46.43                     |
|               |            | Age       | -.16 | .15   | -.54                      | .24                       |
|               |            | Severe Injury | 2.73  | 2.65  | -9.79                     | 3.94                      |

Abbreviations: PA = physical activity; PROMIS = Patient Reported Outcome Measurement Information System; DPA = Disablement of the Physically Active Scale; PCS = physical component score; MCS = mental component score.

*Age variable is mean-centered so that the intercept is the expected value of the dependent variable when participants have no severe injury and are of average age. Unstandardized estimates are reported. Significant values (bold) based on bootstrapped 99% bias-corrected confidence intervals.