

# Physical and Mental Well-Being in Former Collegiate Soccer Athletes

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**Objectives:** Collegiate soccer may carry a high risk of injury during one's career. Although the long-term health outcomes of injuries in professional athletes have been well documented, less is known about the short- to mid-term health and physical activity levels of former collegiate soccer players. This study aimed to evaluate the activity levels as well as the physical and mental well-being of these athletes, with a secondary focus on the impact that injury status has on these outcomes.

**Methods:** We conducted a retrospective survey-based study involving former male and female collegiate soccer athletes who competed between 2011 and 2021. Participants completed a general survey assessing demographics, injury history, current physical activity levels using the Tegner Activity Scale (TAS), and self-reported health outcomes using the Patient-Reported Outcomes Measurement Information System (PROMIS) scale. A follow-up survey was administered to participants who reported injuries, focusing on joint-specific outcomes.

**Results:** Thirty-nine participants completed the initial survey with 86 injuries reported. Among reported injuries were foot/ankle (22), knee (20), hip (12), back (6), upper extremity (5), and other (21). The average physical activity quantity and TAS scores were 5.08 and 4.84, respectively. Average raw mental and physical PROMIS scores were  $15.5 \pm 1.7$  and  $15.6 \pm 1.7$ , respectively. Single Assessment Numeric Evaluation (SANE) scores averaged 76.7 in the affected limb and 89.1 in the unaffected limb. Physical PROMIS scores showed a positive correlation with affected and unaffected limb SANE scores ( $P = 0.02$  and  $P = 0.04$ , respectively), and affected limb SANE scores showed a positive correlation with physical activity quantity ( $P = 0.04$ ). Of the injury-specific outcomes, the only significant correlation with activity levels was the Lysholm Knee Scoring Scale score with the TAS score ( $P = 0.03$ ).

**Conclusions:** Although physical activity decreases in former collegiate soccer players, their overall mental and physical health remains stable. Future research should focus on larger cohorts to further explore the impact of specific injuries on long-term health outcomes in this population.

**Key Words:** injury outcomes, mental well-being, physical activity, PROMIS, soccer athletes

(*South Med J* 2025;118:394–399)

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A.M.M. has received compensation from Arthrex, CONMED Linvatec, Miach Orthopaedics, and Reparel and is a board member of *Arthroscopy*. The remaining authors did not report any financial relationships or conflicts of interest.

Accepted January 2, 2025.

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ISSN: 1541-8243

DOI: 10.14423/SMJ.0000000000001849

Collegiate soccer is considered a limited-contact sport; however, with injury rates as high as 18.6/1000 athlete exposures and concussion rates similar to American football, playing soccer can result in significant injuries with long-term implications.<sup>1</sup> The results of injuries sustained during an athlete's career have been well studied in former National Football League athletes showing that lower extremity injuries carry higher rates of osteoarthritis, total hip and knee arthroplasty, and increased cardiovascular risk factors.<sup>2,3</sup> Although physical limitations from musculoskeletal injuries are obvious, mental health and overall well-being are reduced following injury as well.<sup>4,5</sup>

College athletes who performed at moderate activity levels for their sport have a reduced risk of long-term illness; however, vigorous activity during collegiate sports, such as soccer, may not be as protective.<sup>6</sup> Former collegiate athletes have shown to be less likely to meet recommended exercise guidelines when compared with the general US adult population (38% vs 49%) and possess higher body fat percentages.<sup>6,7</sup> This is reflected by lower health-related quality of life in former collegiate athletes, especially those with an injury history and contact sports participation.<sup>8,9</sup>

The impact of participating in athletics has become an increasingly discussed topic because it affects an athlete's longevity, quality of life, and health after sport.<sup>10–13</sup> There is, however, limited investigation of short- to mid-term health, specifically physical activity, of collegiate athletes following their athletic careers. The present study aimed to evaluate the activity levels as well as physical and mental well-being of former collegiate soccer players with a secondary aim to examine the role that injury status has on these outcomes. We hypothesize that former collegiate soccer athletes will remain active and demonstrate high physical and mental well-being scores in spite of a previous injury history.

## Key Points

- This study analyzes the physical activity and well-being of former collegiate soccer athletes through a retrospective survey.
- Injuries during collegiate careers negatively affected physical activity levels, although overall mental and physical well-being remained stable.
- Single Assessment Numeric Evaluation scores for injured limbs correlated with reduced physical function, highlighting the long-term impacts of injuries on activity levels.
- The findings indicate a need for targeted interventions to support former athletes in maintaining higher physical activity levels postcollege.

## METHODS

Following institutional review board approval (IRB no. 300007895), we conducted a retrospective survey-based study. Inclusion criteria encompassed female and male soccer athletes who competed within the 2011–2021 competition seasons and resigned their eligibility before the Fall 2023 competition season. Exclusion criteria were athletes who competed collegiately in a sport that was not soccer.

### Recruitment

Division I athletic departments across the southeastern United States were contacted to identify eligible student-athletes. Athletic departments provided a list of alumni to the investigators or sent study information to former athletes on behalf of the research team. Athletes were contacted via e-mail and telephone for recruitment purposes.

### Survey 1

Participants were sent a general introductory survey (survey 1) via online links sent to their telephone or e-mail. The survey served as eligibility confirmation and gathered collegiate and postcollegiate information, including demographics, collegiate injury and surgical history, current activity quantity and level, and self-reported health estimates. Participants assessed physical activity quantity by using the scale in Figure 1, and physical activity level by using the validated Tegner Activity Scale (TAS).<sup>14</sup> Survey 1 also included a general Patient-Reported Outcomes Measurement Information System (PROMIS) scale for mental and physical well-being as well as a general health survey.<sup>15,16</sup>

### Survey 2

If an injury was reported in survey 1, then the athlete was sent a follow-up survey (survey 2). Injuries, in this study, are defined as any musculoskeletal event (eg, fracture, sprain, tear, strain) requiring a minimum 3-week break from playing time.

Every survey 2 included the Single Assessment Numeric Evaluation (SANE), a validated self-reported functional rating, identifying the percentage of normal in the affected or injured extremity compared with the unaffected or noninjured extremity.<sup>17</sup> Participants who reported knee injuries were administered survey 2 containing the Knee Injury and Osteoarthritis Outcome Score, the International Knee Documentation Committee (IKDC) Subjective Knee Form, and the Lysholm Knee Scoring Scale.<sup>14,18,19</sup> Participants who reported ankle injuries were administered the Foot and Ankle Disability Index and the Foot and Ankle Outcome Score.<sup>20,21</sup> Participants who

Physical Activity Quantity*: Choose the number that reflects the best estimate of your current active/intentional physical activity schedule			
	Training Description	Training Frequency	Training Time per Week
0	No exercise	n/a	n/a
1	Occasional, light activity	Fewer than once a week	Less than 15 minutes
2		Once a week	15-30 minutes
3	Regular activity	2-3 days per week	Approximately 30 minutes
4		2-3 days per week	Approximately 45 minutes
5		2-3 days per week	45 minutes to 1 hour
6		2-3 days per week	1 to 3 hours
7	Daily activity	3-5 days per week	3 to 7 hours
8		5-6 days per week	7 to 11 hours
9		7 days per week	11 to 15 hours
10		7 days per week	More than 15 hours

\*adapted from fitness tracker classifications

FIG. 1. The scale used for physical activity quantity.

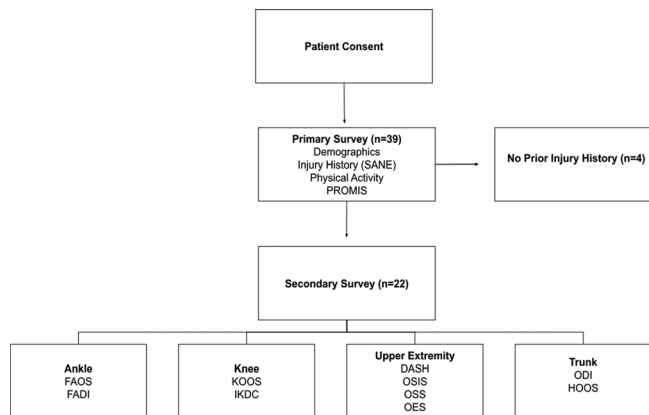


FIG. 2. Roadmap of injury and survey requirements. DASH, Disabilities of the Arm, Shoulder, and Hand; FADI, Foot and Ankle Disability Index; FAOS, Foot and Ankle Outcome Score; HOOS, Hip Disability and Osteoarthritis Outcome Score; IKDC, International Knee Documentation Committee Subjective Knee Form; ODI, Oswestry Disability Index; OSIS, Oxford Shoulder Instability Score; OSS, Oxford Shoulder Score; OES, Oxford Elbow Score; PROMIS, Patient-Reported Outcomes Measurement Information System; SANE, Single Assessment Numeric Evaluation.

reported trunk injuries were administered the Hip Disability and Osteoarthritis Outcome Score and the Oswestry Disability Index.<sup>22,23</sup> Participants who reported upper extremity injuries were administered the Disabilities of the Arm, Shoulder, and Hand questionnaire, the Oxford Shoulder Instability Score, the Oxford Elbow Score, and the Oxford Shoulder Score.<sup>24-27</sup>

If multiple ipsilateral injuries of the same joint were reported, then the athlete completed one survey concerning that joint. If multiple contralateral injuries of the same joint were reported, then the athlete completed one survey for each laterality. If injuries occurred to multiple joints, then the athlete was sent a survey for each joint. Figure 2 shows the algorithm for injuries and subsequent surveys.

### Statistical Analysis

Following completion of the general introductory (survey 1) and the injury-specific surveys (survey 2), we coded all of the responses to calculate scores for each validated subscale. The statistical analysis for qualitative and quantitative metrics included descriptive and correlative measures, mean comparisons, and  $\chi^2$  evaluation.

## RESULTS

The survey was sent out to nine Division I schools. Thirty-nine participants completed survey 1 and met the inclusion criteria. Four participants reported no injury and thus were not sent survey 2. Survey 2 was sent to 35 participants with a 62.9% (22 participants) completion rate. The demographic data of participants who completed surveys 1 and 2 are shown in Table 1.

### Screening and General Health Survey (Survey 1)

#### Injury Characteristics

Table 2 describes the injury characteristics in detail. Eighty-six injuries were reported from the 35 participants who reported injuries. Of the 86 injuries, 37.2% (32) required surgery. Athletes reported experiencing one (25.6%), two (28.2%), three (15.4%), four (10.3%), or five (10.3%) injuries. Following each injury, the return-to-play rate was 74.4%.

**TABLE 1.** Demographic information of each survey

	Survey 1 (n = 39)	Survey 2 (n = 22)
Sex		
Female	31	22
Male	8	4
Race		
African American or Black	8	6
White	21	12
Hispanic or Latinx	1	1
Mixed ethnicity	7	5
Other	2	2
Age, y (range)	26.7 (22–34)	26.5 (22–33)
Years from play (range)	4.5 (0–11)	4.4 (0–11)
Years of active roster	4.2 (1–6)	4.2 (1–6)
Positions (most played position)		
Forward	12	7
Midfielder	6	2
Defender	16	12
Goalkeeper	5	1
Foot dominance		
Left	7	6
Right	24	14
Ambidextrous	8	6

**Physical Activity**

Of the 39 physical activity scales completed in survey 1, the mean physical activity quantity and TAS score were 5.08 and 4.84, respectively. Females were found to have a significantly greater quantity of physical activity than males (5.32 vs 4.13,  $P = 0.02$ ). Commitments to work and school were the most common deterrents to physical activity, followed by previous or continued injury. Better self-reported health ratings were associated with greater quantities of physical activity ( $P < 0.001$ ) but not with higher TAS scores; however, TAS physical activity levels did show a positive correlation ( $r = 0.34$ ,  $P = 0.04$ ) with the number of years an athlete competed collegiately. Neither quantity nor TAS score was significantly associated with years from retirement, injury status (ie, injury vs no injury), or the number of injuries and surgeries.

**Health Outcome Scores**

Overall health was self-reported as “excellent” (10.3%), “very good” (38.5%), “good” (28.2%), “fair” (23.1%), or “poor” (0%). Average raw PROMIS mental and physical scores were  $15.5 \pm 1.7$  and  $15.6 \pm 1.7$ , respectively. Table 3 displays the average raw PROMIS scores respective to the joint affected. PROMIS mental and physical scores positively correlated with each other for ankle injuries ( $r = 0.83$ ,  $P = 0.02$ ) and knee injuries ( $r = 0.87$ ,  $P = 0.03$ ) but did not correlate with hip or back injuries.

**TABLE 2.** Injury types and outcomes

	Prevalence in survey 1 (n = 86 injuries)	Prevalence in survey 2 (n = 49 injuries)	Average SANE (survey 2, n = 49)		Average injury-specific survey
			Affected joint	Unaffected joint	
Joint affected					
Ankle/foot	22	13	$88.0 \pm 15.2$	$92.0 \pm 14.5$	FAOS: 92.7 FADI: 97.6
Knee	20	12	$53.0 \pm 34.1$	$89.0 \pm 21.8$	IKDC: 68.1 KOOS: 79.0 Lysholm: 80.1
Upper extremity	5	3	$87.0 \pm 7.64$	$97.0 \pm 2.89$	—
Hip	12	5	$87.0 \pm 10$	$99.0 \pm 2$	HOOS: 85.6
Back	6	3	$68 \pm 23.1$	$87 \pm 15.3$	ODI: 5.00
Other (eg, head, shin, thigh, neck)	21	13	—	—	—
Laterality affected					
Left	25	15	$83.0 \pm 16.9$	$93.0 \pm 15.2$	—
Right	44	24	$73 \pm 31.0$	$93 \pm 13.3$	—
Not described	17	10	$81 \pm 25.8$	$95 \pm 15.7$	—
Surgery	32	20	—	—	—
Injury type					
Connective tissue	49	27	—	—	—
Muscular	16	13	—	—	—
RTP	64	35	—	—	—

FADI, Foot Ankle Disability Index; FAOS, Foot Ankle Outcome Score; HOOS, Hip Disability and Osteoarthritis Outcome Score; IKDC, International Knee Documentation Committee Subjective Knee Form; KOOS, Knee Injury and Osteoarthritis Outcome Score; ODI Oswestry Disability Index; RTP, return to play; SANE, Single Assessment Numeric Evaluation.

**TABLE 3.** Average raw PROMIS scores of respondents by joint injured

Joint injured	PROMIS scores (everyone, n = 86 injuries)		PROMIS scores (completed survey 2, n = 49 injuries)	
	Physical	Mental	Physical	Mental
Foot/ankle	15.0 ± 1.63	15.9 ± 1.96	14.7 ± 1.38	15.6 ± 1.90
Knee	14.4 ± 1.51	14.8 ± 1.39	14.3 ± 1.63	14.7 ± 1.51
Hip	16.3 ± 2.31	17.0 ± 1.00	16.3 ± 2.31	17 ± 1.00
Back	15.0 ± 0	14.5 ± 0.71	15.0 <sup>a</sup>	15.0 <sup>a</sup>
Upper extremity	15.0 ± 0	17.0 ± 1.41	15.0 ± 0	17.0 ± 1.41

PROMIS, Patient-Reported Outcomes Measurement Information System.

<sup>a</sup>Only one respondent.

### Injury Outcomes Survey (Survey 2)

Twenty-two participants completed survey 2. Table 2 provides full data on the outcomes recorded.

### SANE Scores

SANE scores averaged 76.7 in the injured limb versus 89.1 in the noninjured limb and were positively correlated with one another ( $r = 0.53, P < 0.001$ ). SANE scores of the affected limb positively correlated with PROMIS Physical Function ( $r = 0.48, P = 0.02$ ) and physical activity quantity scores ( $r = 0.23, P = 0.04$ ). Unaffected limb SANE scores were seen to be positively correlated only with the PROMIS physical score ( $r = 0.42, P = 0.04$ ).

### Ankle Injuries

Of the 13 ankle injuries, five underwent surgical fixation and eight did not with a statistically significant difference between the Foot Ankle Disability Index scores of the two groups (92.5, 98.6;  $P < 0.001$ ). Ankle-specific scores did not correlate with either physical activity quantity or TAS score.

### Knee Injuries

Of the 12 knee injuries, eight underwent surgery with no statistically significant associations with the knee-specific scales. The IKDC Subjective Knee Form, however, positively correlated with the number of years an athlete competed ( $r = 0.86, P = 0.001$ ). The Lysholm Knee Scoring Scale only positively correlated with the TAS score ( $r = 0.69, P = 0.03$ ).

### Hip and Back Injuries

Of the five hip and three back injuries, only one hip and one back underwent surgery. No injury-specific score correlated with whether the participant had undergone surgery. Hip- and back-specific scores were not correlated with physical activity quantity or TAS score.

### Upper Extremity Injuries

Statistical analysis was not completed in upper extremity injuries due to the low sample size ( $n = 3$ ).

## DISCUSSION

The most important finding of this study is that although former collegiate soccer players experience decreased total

physical activity and reduced level of activity at an average follow-up of 4.5 years after their career, their overall mental and physical health remains stable.

Former collegiate soccer players had an average physical activity quantity score of 5.08 (Fig. 1). This score indicates regular exercise and training two to three times per week for a total of 45 minutes to 1 hour. This is less than the Centers for Disease Control and Prevention’s recommendation of 150 minutes of moderate-intensity exercise per week.<sup>28</sup> In addition, participants reported an average TAS score of 4.84, indicating competitive participation in noncontact sports and recreational participation in low-impact activities such as jogging. Briggs et al<sup>29</sup> reported an average TAS score of 6.5 in a group of healthy 18- to 30-year-olds, which includes participation in contact sports recreationally and competitively. Not only did former collegiate soccer athletes report lower TAS scores in relation to this age-matched cohort but they also showed a large shift from their previous level of activity when they were competing in collegiate athletics. More than 90% of respondents in our study reported injuries, likely explaining the difference in activity levels when compared to healthy controls; however, psychosocial aspects are important to consider as well. The sustained high-intensity lifestyle of college athletes subsequently reduces their desire for physical activity when no longer in sport.<sup>6</sup> In addition, former athletes lose structured exercise regimens and dedicated training time. In our cohort, the most common deterrent to exercise was a commitment to work or school; therefore, learning to voluntarily incorporate exercise into daily schedules serves as a barrier to exercise. As college athletes retire from sports, they undergo a developmentally challenging period of emerging adulthood, which can lead to poor behavioral adaptations surrounding lifestyle habits such as exercise.<sup>30</sup>

Participants reported a total of 86 injuries among 35 respondents and had an average SANE score of 76.7 in the affected limb and 89.1 in the unaffected limb. SANE scores did show a significantly positive correlation with physical activity quantity, highlighting the disability these athletes faced in the wake of their injuries. Even though the function of the affected joint was below 80% of normal function, the function of the contralateral joint also reduced to less than 90%. As such, the effects of injuries are not just localized but also are experienced contralaterally by mechanisms such as compensation.<sup>31,32</sup> Participants also reported 32 surgeries; however, we found no association between whether an athlete had surgery and their current activity quantity or TAS score. This speaks to the

advances in sports medicine surgical techniques, technology, and postoperative rehabilitation.<sup>33–38</sup> Of the joint-specific outcome scores, only Lysholm Knee Scoring Scale scores correlated with physical activity quantity or level, which is expected. IKDC Subjective Knee Form, ankle, hip, and back scores did not show any correlation; however, this is likely due to the small sample sizes of participants reporting these injuries, and conclusions should not be drawn regarding the validity of these tests using our study.

The mental and physical PROMIS scores of participants averaged  $15.5 \pm 1.7$  and  $15.6 \pm 1.7$ , respectively. This validated assessment places former collegiate soccer players around the average for mental and physical wellness with *t* scores of 52.1 and 49.6.<sup>36–40</sup> This is in contrast to Simon and Docherty,<sup>41</sup> who reported that former Division I athletes reported significantly worse PROMIS scales for physical function, depression, fatigue, sleep disturbance, and pain interference when compared to noncollegiate athletes. This difference in outcomes is likely due to their cohort, including former American football players who sustain more injuries per practice and game than any other collegiate athlete.<sup>1</sup> At an average age of 53.6 years, their participants also were more likely to suffer from chronic degenerative joint diseases, such as arthritis, when compared with our cohort of athletes with an average age of 26 years. Nevertheless, SANE scores show that although injuries faced by participants in our study are still life-altering and disabling, 77% of our cohort rated their overall health as “good,” “very good,” or “excellent.” In the face of such disability, the maintenance of self-reported health and overall average PROMIS scores speaks to the resilience of former collegiate soccer players.

This study is not without limitations. The primary limitation of this study was the small sample size of respondents. This small sample size leads to confounding variables and an inability to control for specific injuries. This limited our ability to draw conclusions surrounding whether injuring a specific joint led to decreased activity levels and worse generalized outcome scores (PROMIS) because 74.4% of participants reported injury to multiple locations. Other limitations are inherent to survey studies and include response and nonresponse bias, inflexibility, recall bias, and self-reported data. Despite these limitations, our study offers valuable insight into the quality of life of former collegiate soccer players. Future studies should include larger sample sizes and aim to elucidate the effects that individual injuries have on physical activity levels in addition to overall mental and physical well-being.

## CONCLUSIONS

Despite reduced physical activity quantity and level, former collegiate soccer players maintain average outcome scores for mental and physical well-being. Future studies with larger sample sizes are needed to elucidate the effect that specific injuries have on former athletes' mental and physical wellness.

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