

# A History of Previous Severe Injury and Health-Related Quality of Life Among Former Collegiate Athletes

Katlyn Cowee, MS, AT; Janet E. Simon, PhD, ATC

Ohio University, Athens

**Context:** Empirical evidence supports the idea that previous severe injuries in former collegiate athletes may adversely affect their ability to participate in daily activities later in life, which may then decrease their health-related quality of life (HRQOL).

**Objective:** To assess the influences of previous severe injuries on the HRQOL of former National Collegiate Athletic Association (NCAA) athletes.

**Design:** Cross-sectional study.

**Setting:** Online survey.

**Patients or Other Participants:** A total of 171 former NCAA collegiate athletes (69 men, 102 women; age =  $29.7 \pm 3.9$  years, height =  $171.5 \pm 10.4$  cm, mass =  $76.4 \pm 12.9$  kg) participated. All individuals completed a demographics questionnaire and the Short Form-36 version 2 (SF-36v2) Health Survey via Qualtrics.

**Main Outcome Measure(s):** The dependent variables were the physical composite and mental composite summary scores and the 8 subscales of the SF-36v2. The independent variable was the presence of previous severe injury (history of a severe injury or no history of a severe injury during collegiate athletics).

Two multivariate analyses of variance were conducted. The first multivariate analysis of variance was conducted for the 8 SF-36v2 subscales and the second for the 2 summary scores.

**Results:** For the summary scores and all 8 SF-36v2 subscales, the responses were worse for the 103 former collegiate athletes who sustained a previous severe injury compared with the 68 who did not sustain a severe injury. The largest difference between groups was for the physical composite score, with a mean difference of 15.8 points (1.5 standard deviations worse than the US population); the physical functioning subscale demonstrated a mean difference of 12.9 points (1.3 standard deviations worse than the US population).

**Conclusions:** A majority of the athletes in our sample had experienced a severe injury. Based on these data, previous severe injuries had a negative influence on the HRQOL of former NCAA collegiate athletes.

**Key Words:** NCAA, retired athletes, mental health, physical health

## Key Points

- Regardless of National Collegiate Athletic Association (NCAA) Division participation, 60% of former collegiate athletes sustained a severe injury during college.
- Former NCAA athletes who sustained a severe injury during college had worse physical functioning and bodily pain scores on the Short Form-36 version 2.
- Former NCAA athletes who sustained a severe injury during college did not score worse on any of the mental scales of the Short Form-36 version 2.

Collegiate athletes compete at elite levels and train at very high intensities, increasing their susceptibility to sport-related injuries.<sup>1,2</sup> An estimated 67% of former National Collegiate Athletic Association (NCAA) Division I athletes reported that they sustained a major injury during their athletic career, and 50% reported chronic injuries.<sup>3</sup> Former athletes experienced increased degenerative changes in their joints and spine compared with nonathletes.<sup>3</sup> Injuries sustained during collegiate competitive years may contribute to degenerative changes in joints and other health problems that can interfere with performing tasks of daily living.<sup>1,3,4</sup> Prior researchers<sup>1–7</sup> have alluded to chronic illness or injury as reducing individuals' health-related quality of life (HRQOL).

*Health-related quality of life* is often thought of as an individual's contentment with life and general feeling of personal wellbeing.<sup>6</sup> Health-related quality of life includes several health components<sup>6</sup>: the physical, psychosocial, and social aspects that are affected by the individual's

experiences, expectations, beliefs, and perceptions.<sup>6</sup> As can be seen from these components, HRQOL is patient oriented. A patient-centered approach to care requires collecting and accounting for patient input at every step of the patient care process.<sup>6</sup> This approach is necessary because it accounts for the patient's perspectives and experiences, which helps in determining the overall well-being of the patient. However, measurement of HRQOL in sport-rehabilitation-related clinical practice and research is not yet routinely incorporated.<sup>6</sup> Clinicians tend to examine the HRQOL in athletes only during their athletic careers but rarely follow up with them after they have returned to activity or after the athletic career is over. This is because HRQOL and its importance are still not fully understood by those working in sport rehabilitation, which results in a continuing lack of awareness.<sup>6</sup> Understanding a patient's HRQOL will help clinicians to communicate and make knowledgeable health care decisions when returning the patient to activity from a severe injury.

Severe injuries can have a major effect on an athlete's overall HRQOL. A common definition for *severe injury* is any injury that resulted in a loss of more than 21 days of sport participation.<sup>8</sup> The 2 most common severe injury diagnoses are fractures and ligament sprains.<sup>8</sup> Severe injuries can also involve third-degree joint or tissue damage with gross instability and concussions.<sup>7</sup> The HRQOL was worse in former Division I collegiate athletes than in noncollegiate athletes.<sup>3</sup> Athletes have reported physical limitations in activities of daily living or exercise.<sup>3</sup> This finding could be due in part to severe injuries sustained during their athletic careers.<sup>3</sup>

Many athletes experience moderate to severe sport-related injuries during their careers that could compromise and reduce their future HRQOL. The assessment of HRQOL can help assist clinicians in enhancing an individual's overall quality of life. However, few authors have specifically explored former collegiate athletes and their HRQOL. The lack of knowledge about HRQOL in former collegiate athletes hinders clinicians from fully understanding the effects of severe injuries on athletes' overall HRQOL after their athletic careers are over. Therefore, the purpose of our study was to assess the influences of previous severe injuries on the HRQOL of former collegiate athletes.

## METHODS

### Study Design

This research study involved a cross-sectional design focusing on former NCAA Division I, II, and III collegiate athletes. Former collegiate athletes completed a demographic questionnaire and the Short Form-36 version 2 (SF-36v2) Health Survey questionnaire.

### Participants

Participants consisted of a convenience sample of former NCAA Division I, II, and III athletes from existing databases. A total of 720 former collegiate athletes were originally contacted, and 202 individuals started the survey. Of these, 171 former collegiate athletes (69 men, 102 women; age =  $29.7 \pm 3.9$  years, height =  $171.5 \pm 10.4$  cm, mass =  $76.4 \pm 12.9$  kg; Division I n = 83, Division II n = 32, and Division III n = 56) completed all aspects of the survey (response rate = 23.7%) and their data were used for analyses. The breakdown of participants' collegiate sports is shown in Table 1. To be eligible for participation, alumni must have competed in NCAA Division I, II, or III intercollegiate varsity athletics (baseball, basketball, bowling, boxing, cross-country, fencing, field hockey, football, golf, gymnastics, ice hockey, lacrosse, rifle, rowing, skiing, soccer, softball, swimming and diving, tennis, track and field, volleyball, water polo, or wrestling). Former athletes were excluded if they indicated participating only in organized club or intramural sports during their collegiate years or failed to complete the surveys. No other inclusion or exclusion criteria were established for participation in this study. Before the study, the university's institutional review board approved it, and each participant read and electronically signed an informed consent form.

**Table 1. Frequencies of Sports of all Respondents**

Sport	Frequency (%)
Baseball	13 (7.6)
Basketball	29 (17.0)
Cross-country	22 (12.9)
Field hockey	1 (0.6)
Football	9 (5.3)
Golf	5 (2.9)
Gymnastics	4 (2.3)
Ice hockey	2 (1.2)
Lacrosse	2 (1.2)
Rowing	7 (4.1)
Skiing	2 (1.2)
Soccer	21 (12.3)
Softball	8 (4.7)
Swimming and diving	14 (8.2)
Tennis	3 (1.8)
Track and field	19 (11.1)
Volleyball	6 (3.5)
Water polo	3 (1.8)
Wrestling	1 (0.6)

## Procedures

Participants completed the demographic and SF-36v2 questionnaires via Qualtrics (Provo, UT).

**Demographic Questionnaire.** The demographic questionnaire documented participants' demographic data (age, sex, diseases, height, weight) and information regarding the NCAA Division (I, II, or III) in which they competed, the sport(s) they played, and any severe injuries they sustained during their athletic careers. Although a consensus definition of severe injury has not been clearly presented within the current literature, we defined a *severe injury* as one that resulted in a loss of participation for more than 21 days.<sup>8</sup> This definition was explained to the participants in the questionnaire.

**Short Form-36v2 Health Survey.** The SF-36v2 is a widely used 36-item HRQOL questionnaire that measures an individual's perception of his or her overall health status and physical functioning.<sup>6</sup> Participants answered questions on 8 subscales: physical functioning, role limitations due to physical health problems, bodily pain, general health perceptions, vitality, social functioning, role limitations due to emotional problems, and mental health.<sup>9</sup> Two composite scores were also calculated: the physical composite score (PCS) and mental composite score (MCS).<sup>9</sup> A normative score of 50 with a standard deviation of 10 was the standard score for each subscale and composite score.<sup>10,11</sup> A score below 50 indicates below-average health status.<sup>10,11</sup> The SF-36v2 has been shown to provide valid and reliable data in the adult population; thus, the SF-36v2 was appropriate for use by the population in this study.<sup>6</sup>

## Statistical Analysis

Descriptive statistics were calculated for each dependent variable. The dependent variables were the 8 subscales and the PCS and MCS of the SF-36v2. The independent variable was the presence of a previous severe injury (history of a severe injury or no history of severe injury during collegiate athletics). Other potential confounding variables of interest were NCAA division (I, II, or III), sex

**Table 2. Descriptive Statistics for the 8 Short Form-36 Version 2 Subscales by Severity Group**

Characteristic	No Severe Injury	Severe Injury
Sex (%)	32 men, 57 women	37 men, 45 women
	Mean ± SD	
Years since National Collegiate Athletic Association participation	7.4 ± 2.8	6.9 ± 3.1
Physical functioning	57.3 ± 4.8	44.3 ± 6.9 <sup>a</sup>
Role physical	55.4 ± 5.5	46.2 ± 7.6 <sup>a</sup>
Bodily pain	53.2 ± 3.8	43.6 ± 5.2 <sup>a</sup>
General health	55.9 ± 5.5	46.9 ± 5.1 <sup>a</sup>
Vitality	55.8 ± 4.6	53.5 ± 4.5
Social functioning	57.2 ± 2.0	54.1 ± 3.6
Role emotional	54.6 ± 5.6	53.3 ± 5.3
Mental	56.1 ± 4.3	53.6 ± 3.2

<sup>a</sup> Difference between groups ( $P < .05$ ).

(male or female), and years since NCAA sport participation (1–5, 6–10, 11–15, or >15 years). These confounding variables (NCAA division, sex, and years since participation) were initially evaluated for statistical significance between groups (history of a severe injury and no history of severe injury during collegiate athletics) for each dependent variable. Confounding variables that resulted in significance were included in the multivariate analyses of variance (ANOVAs). Two separate multivariate ANOVAs were conducted based on which confounding variables were initially significant. The first multivariate ANOVA was conducted for the 8 SF-36v2 subscales. The second multivariate ANOVA was for the 2 summary scores. The  $\alpha$  level was set at .05 for all analyses.

## RESULTS

A total of 103 individuals sustained a severe injury and 68 did not sustain a severe injury during their collegiate career. Initial results for potential confounders indicated that NCAA division, sex, and number of years since NCAA sport participation were not significant ( $P > .05$ ) between groups for any dependent variables; thus, the levels were collapsed for the multivariate ANOVAs and not included as covariates. The first multivariate ANOVA was significant for the presence of previous severe injury ( $F = 4.83$ ,  $P = .003$ ) for the 8 SF-36v2 subscales. Follow-up 1-way ANOVAs indicated physical functioning ( $F = 5.391$ ,  $P = .02$ ,  $1 - \beta = 0.65$ ), role physical ( $F = 4.410$ ,  $P = .03$ ,  $1 - \beta = 0.55$ ), bodily pain ( $F = 5.73$ ,  $P = .01$ ,  $1 - \beta = 0.66$ ), and general health ( $F = 3.947$ ,  $P = .03$ ,  $1 - \beta = 0.51$ ) were significant, but vitality, social functioning, role emotional, and mental health were not significant (all  $P$  values  $> .05$ ). Based on Table 2, those who sustained a severe injury while participating in collegiate athletics had worse SF-36v2 subscale scores than those who did not sustain a severe injury. Of the 8 subscales, physical functioning had the largest mean difference at 12.9 points (1.2 standard deviations worse than the US population). The role physical score had a mean difference of 9.2 points (0.9 standard deviations worse than the US population), bodily pain score had a mean difference of 9.5 points (0.9 standard deviations worse than the US population), and general health score had a mean difference of 8.9 points (0.8 standard deviations worse than the US population). The second multivariate ANOVA was significant for the presence of a previous severe injury ( $F = 3.603$ ,  $P = .007$ ) for the dependent

variables PCS and MCS. Follow-up 1-way ANOVAs indicated PCS was significant ( $F = 4.431$ ,  $P = .01$ ,  $1 - \beta = 0.756$ ) but MCS was not. Based on Table 3, those who sustained a severe injury while participating in collegiate athletics had worse PCS scores with a mean difference of 15.8 points (1.5 standard deviations worse than the US population).

## DISCUSSION

The primary aim of our study was to assess the influence of previous severe injury on the HRQOL of former collegiate athletes. Athletes who endure a severe injury are often thought to experience physical and psychological effects on their health.<sup>3,5,6,8</sup> These adverse effects could potentially decrease the athletes' HRQOL postathletic retirement.<sup>1–6,8,12–14</sup> Our findings, which were based on a diverse population of 171 former collegiate athletes that included both men and women, 19 sports, and 3 NCAA divisions, demonstrated that those who sustained a severe injury while participating in collegiate athletics had worse SF-36v2 subscale scores than those who did not sustain a severe injury. Of the 8 SF-36v2 subscales, physical functioning, role physical, bodily pain, and general health were different between groups. Also, former collegiate athletes who sustained a severe injury had worse PCS scores. Conversely, vitality, social functioning, role emotional, and MCS were not different between groups. It is possible that previous severe injuries decreased former collegiate athletes' HRQOL and may have had a greater effect on their physical health compared with their mental health. Additionally, those who sustained a severe injury in college displayed worse HRQOL than the general US population with regard to SF-36v2 scores (mean of 50).

The SF-36v2 questionnaire was used by Simon and Docherty<sup>5</sup> when looking at the current HRQOL in former NCAA Division I collision athletes compared with contact and limited-contact athletes. Simon and Docherty<sup>5</sup> found the SF-36v2 to be a beneficial tool in assessing the HRQOL of these athletes. Researchers have implemented different

**Table 3. Descriptive Statistics for the Short Form-36 Version 2 Summary Scores by Severity Group, Mean ± SD**

Score	No Severe Injury	Severe Injury
Physical composite	55.8 ± 4.1	40.1 ± 5.5 <sup>a</sup>
Mental composite	54.2 ± 6.6	50.5 ± 5.7

<sup>a</sup> Difference between groups ( $P < .05$ ).

types of questionnaires to evaluate an individual's HRQOL,<sup>2,3,12</sup> such as Lam et al.<sup>2</sup> who used the SF-12 questionnaire to examine HRQOL in collegiate athletes. For our study, the SF-36v2 was the most appropriate tool because it has provided valid and reliable data in the adult population, and we were not concerned about the increased time to complete the instrument.<sup>9</sup> Also, Simon and Docherty<sup>5</sup> enrolled former Division I collegiate athletes 40 to 65 years old, whereas our study was open to all divisions of the NCAA and had a much younger sample.

In recent years, interest in examining HRQOL and outcomes after collegiate athletic participation has increased.<sup>2,3,5,12,15</sup> However, these authors have examined the HRQOL of only former NCAA Division I collegiate athletes (representing 36% of all NCAA athletes).<sup>16</sup> In particular, Simon and Docherty<sup>3</sup> evaluated former collegiate athletes and nonathletes from a large midwestern NCAA Division I university and found that their current HRQOL was worse compared with nonathletes. More specifically, former Division I athletes scored worse on the physical function, depression, fatigue, sleep disturbance, and pain interference Patient-Reported Outcomes Measurement Information System scales than did nonathletes.<sup>3</sup> We included former collegiate athletes from NCAA Division I, II, and III universities and found results similar to those of Simon and Docherty<sup>3</sup> and others.<sup>1,3-6,12,15,17</sup> The difference was that we did not find deficits for the mental component of HRQOL, unlike previous investigators.<sup>1,3-6,12,15,17</sup> This could be attributed to the younger age range of individuals surveyed in this study. Our participants were between 23 and 40 years old, whereas Simon et al.<sup>3</sup> examined individuals between 40 and 65 years old. Our younger age group of former collegiate athletes may not have experienced negative psychological effects on their health because they continued to be physically active and live healthy lifestyles after retirement, similar to the individuals in the Simon and Docherty<sup>3</sup> study. Researchers<sup>5,18</sup> have reported that current athletes displayed better HRQOL than their nonathlete counterparts, reflecting the benefits of physical activity on an individual's HRQOL. Current authors<sup>3,5,17,18</sup> have suggested that retired athletes who continued physical activity and exercise postretirement were likely to have a better HRQOL than those who did not. Sorenson et al.<sup>17</sup> stated that healthy lifestyle and exercise behaviors after athletic retirement must be emphasized. An older age group of former collegiate athletes may not be able to perform day-to-day activities and carry out physical activity and exercise as they age due to the development of joint and musculoskeletal disorders.<sup>1,3-5</sup> Former NCAA Division I athletes were at a higher risk for joint health concerns later in life due to their athletic participation.<sup>3,17</sup> Specifically, 40% of former Division I athletes indicated being diagnosed with osteoarthritis after college, compared with 24% of nonathletes.<sup>3</sup> This could be a contributing factor to the limitations of physical activity that former athletes may experience<sup>3</sup> and the reason for the decrease in the older age group's physical and mental health.

In a similar investigation,<sup>5</sup> the current HRQOL in former NCAA Division I collision athletes was compared with that of contact and limited-contact athletes. For all of the HRQOL scales, former collision athletes had worse HRQOL scores than limited-contact athletes.<sup>5</sup> Thus,

compared with contact and limited-contact athletes, former Division I collision athletes may sacrifice their future HRQOL.<sup>5</sup> The data from this study support our finding that previous severe injuries may contribute to the decrease in HRQOL postretirement. As we know, athletes at the collegiate level undertake training schedules that subject them to continued stress, which can increase their vulnerability to injuries.<sup>3</sup> Athletes who play with pain and injuries while competing may not experience changes in HRQOL until later in life, after their careers have ended.<sup>3,5,12</sup> This idea is supported by our findings as well as those of previous investigators<sup>3,5</sup> who demonstrated that former athletes, more specifically former collision athletes, scored worse than the normative data on the HRQOL scales. To our knowledge, only 1 group<sup>2</sup> has studied the effect of injury history on HRQOL in collegiate athletes. Lam et al.<sup>2</sup> examined collegiate athletes who had experienced knee injuries during their athletic careers. Individuals with a history of severe knee injury tended to report more emotional concerns than athletes with a history of mild or no knee injury.<sup>2</sup> Unlike us, Lam et al.<sup>2</sup> evaluated the effects of a specific joint injury on the HRQOL of current collegiate athletes. This is likely a reason why they found more of an effect on individuals' mental health. Other authors<sup>15</sup> have found a strong effect of 0.85 for the PCS and a weak effect of 0.15 for the MCS. This information can help us to validate the lack of significance for the MCS in our study.

This research has several clinical implications. A majority of our sample (60%) sustained a severe injury during collegiate athletics. The number of severe injuries sustained and associated worse HRQOL emphasize the need for access to health care resources for former high-level athletes after their collegiate careers. A large emphasis of research and the media has been on the postretirement health of professional athletes or Division I athletes only.<sup>19,20</sup> However, our findings warrant paying attention to the health of former collegiate athletes, particularly given that a majority of collegiate athletes never play professionally and that they play at all levels of the NCAA and not only Division I.<sup>21</sup> Clinicians should consider using HRQOL measures during preparticipation examinations to capture deficits to help optimize patient-centered care and establish baseline measurements for use in care after injury. Developing our understanding of the effect of injury is important for several reasons. First, these severe injuries result from sport participation, which may lead to dropout from physical activity and subsequently to a variety of negative long-term health consequences (eg, cardiovascular disease, heart disease, cancer, obesity, adult-onset diabetes). Second, poorly managed musculoskeletal injuries sustained during collegiate athletics may lead to disabling long-term health problems that have become a national health care concern, such as osteoarthritis. Efforts should be undertaken to evaluate the effect of sport-related injury on HRQOL in this vulnerable population.

Our study had several limitations. Our population consisted only of retired NCAA Division I, II, and III collegiate athletes and did not include other elite competitive athletes (eg, professional and Olympic sports) or former competitive adolescent athletes (eg, high school and premier-level sports). Thus, our findings may not be generalizable to other populations of former athletes in

the United States. In addition, the age range of our participants was younger than in previous studies. Also, the sample size was insufficient to evaluate sport-specific results. The sample size was restricted to former NCAA Division I, II, and III collegiate athletes between 23 and 40 years old. Further study limitations pertained to the questionnaires that were used. Evidence suggests that people are reliable reporters of medical diagnosis and other medical information. It would be ideal to follow up with all participants to confirm what they reported.<sup>22–24</sup> The demographic and SF-36v2 self-reported questionnaires are subject to recall bias and response misclassification (eg, overreporting or underreporting). Selection bias may have been a factor if former athletes who were more interested in health and pain limitations took part in our study, which could have skewed the results. We did not adjust for confounding variables such as years of athletic participation, number of injuries, current occupation, or treatment of severe injuries. These variables should be considered by future authors who focus on former athletes. Finally, sex bias may have been a factor, as more women than men participated. Despite these limitations, our study provides insight into the influences of previous severe injury on the HRQOL of former collegiate athletes.

To our knowledge, this is one of the first studies to examine the influences of previous severe injury on the HRQOL of former NCAA Division I, II, and III collegiate athletes. Future investigators should continue to focus on retired collegiate athletes. Previous researchers<sup>3,5,12,19,25–27</sup> have focused heavily on retired professional football players and former NCAA Division I athletes. (A small percentage of Division I collegiate athletes continue their athletic careers at the professional level, which is another reason it is important to examine the HRQOL of those who played collegiate athletics.) Thus, further attention to the transition from collegiate athlete to nonathlete is needed. Moreover, the specific types of severe injuries that may affect HRQOL in retired athletes should be considered. Also, implementing intervention studies that incorporate a fitness and exercise, nutrition, pain-management, or relaxation program for retired collegiate athletes could allow us to determine the effects of such programs on retired athletes' HRQOL.

## CONCLUSIONS

Many athletes experience severe sport-related injuries that may compromise their health and wellbeing later in life. We examined the influences of previous severe injury on the HRQOL of former collegiate athletes. Our main finding was worse HRQOL in former collegiate athletes who sustained a severe injury during their collegiate career. Understanding the influences that severe injuries have on former collegiate athletes may help clinicians practice better patient-centered care and encourage the evaluation of HRQOL throughout the spectrum of care. Also, this information can aid clinical decisions, such as ensuring that the athlete returns to play at the appropriate time and not too soon due to outside pressures. Returning an athlete who has sustained a severe injury before being fully recovered can lead to long-term health concerns, potentially decreasing the athlete's longevity and overall HRQOL.

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Address correspondence to Janet E. Simon, PhD, ATC, Ohio University, E150 Grover Center, Athens, OH 45701. Address e-mail to [simonjl@ohio.edu](mailto:simonjl@ohio.edu).