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A Longitudinal Pilot Study of Depressive Symptoms in Concussed and Injured/Nonconcussed National Collegiate Athletic Association Division I Student-Athletes

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Context: Depression, which affects millions of Americans each year, among them collegiate student-athletes, can be caused by a wide range of circumstances, including sport-related injuries.

Objective: To longitudinally examine the extent to which National Collegiate Athletic Association Division I student-athletes demonstrated postinjury depressive symptoms.

Design: Descriptive epidemiologic study.

Setting: National Collegiate Athletic Association Division I collegiate athletics.

Patients or Other Participants: Concussed, injured/nonconcussed, and healthy Division I collegiate student-athletes (aged 18–22 years) competing in men's basketball, football, and wrestling and women's basketball, soccer, and volleyball.

Main Outcome Measure(s): Participants completed the Center for Epidemiologic Studies Depression Scale at baseline and at 1 week, 1 month, and 3 months postinjury. We measured differences in depressive scores among concussed, injured/nonconcussed, and healthy participants. Longitudinal changes in postconcussion depressive symptoms were also examined.

Results: No differences in baseline depressive symptoms among subgroups were noted. After an increase between baseline and 1 week (4.3, 95% confidence interval [CI] = 0.41, 8.16, $P = .02$), depressive symptoms in the concussion group decreased between 1 week and 1 month (–2.7, 95% CI = –4.96, –0.47, $P = .01$) and between 1 week and 3 months (–4.0, 95% CI = –6.50, –1.49, $P = .004$). The injured/nonconcussed group showed differences between baseline and 1 week (4.6, 95% CI = 1.08, 8.17, $P = .009$) and between baseline and 1 month (3.2, 95% CI = –0.05, 6.30, $P = .03$). No significant differences were present in depressive symptoms between concussed participants and injured/nonconcussed participants at any of the postinjury time points.

Conclusions: Depression may present as a postinjury sequela in Division I collegiate athletes. Athletes who sustain a concussion or other injury resulting in time lost from practice or competition need to be observed carefully for signs and symptoms that may indicate depression. Tools such as the Center for Epidemiologic Studies Depression Scale can be valuable in helping clinicians to recognize and manage depressive symptoms in these individuals.

Key Words: psychology, Center for Epidemiologic Studies Depression Scale, athletic injuries

Key Points

- Postinjury depressive symptoms in concussed and injured/nonconcussed patients were higher than at baseline.
- No differences in depressive symptoms between concussed and injured/nonconcussed participants were noted at any of the assessment points.

Depression affects 121 million people worldwide and 14.8 million American adults aged 18 years and older.[1] The prevalence of depression in college students may be as high as 22%.[1,2] Collegiate student-athletes constitute a subset of the student population and demonstrate lower levels of depression.[3] Despite the psychosocial benefits of sport participation, collegiate student-athletes represent a population with its own unique set of depression-linked stressors, including coach and peer pressure, societal pressure, self-induced pressure, professional sport aspirations, and sport-related injuries.[1,4,5] The link between depression and sport-related injury is significant, given that 40% to 50% of collegiate athletes sustain at least 1 athletic injury resulting in 1 or more episodes of time loss during their college years.[1,6]

Depressive symptoms and emotional disturbances appear to be present regardless of the nature of the injury. Richmond et al[7] found that 18% of patients displayed major depression, depression not otherwise specified, or dysthymia a year after a minor injury. Additional authors[1,5,8,9] have reported increased incidences of depression and emotional disturbances after both chronic and serious injuries. These findings appear to be consistent regardless of whether the injury is musculoskeletal or concussion related.[10–12]

Depressive symptoms after head injuries are a major public health concern. Depression, commonly reported after traumatic brain injuries (TBIs) of various severities, including concussions, is the most prevalent psychological disturbance after a concussion.[13–15] These effects appear to be long term, with increased depressive symptoms being

reported in some patients from 3 months to 9 years postconcussion.[7,13,16–19]

Researchers[20,21] have also linked perceived stress with depressive symptoms after TBI, noting that the unsuccessful use of coping strategies or a lack of coping resources can exacerbate depressive symptoms. This can lead to additional psychological stress, which may negatively affect the individual's perception of his or her health-related quality of life (HRQOL).[10–12,15,22] Investigators[23–25] have elucidated the importance of HRQOL, including in concussed patients, drawing attention to its multifaceted, complex nature and relative importance as a health indicator as compared with impairments.

Despite the body of literature supporting the psychological consequences related to sports injury, few authors have specifically studied the onset of postinjury depression, especially in patients with concussions. Furthermore, data describing differences in the onset and extent of depression based on injury type, particularly in a longitudinal manner, are limited. Therefore, the purpose of our pilot study was twofold: to longitudinally examine the extent to which National Collegiate Athletic Association (NCAA) Division I student-athletes demonstrated postconcussion depressive symptoms and to identify differences in depressive symptoms among concussed, injured/nonconcussed, and healthy Division I student-athletes.

METHODS

Participants

Participants in this investigation were male and female student-athletes in the sports of men's basketball, football, and wrestling and women's basketball, soccer, and volleyball between the ages of 18 and 22 years from an NCAA Division I university. Student-athletes on these teams (n = 106) completed the Center for Epidemiologic Studies Depression Scale (CES-D) during their initial preseason team meeting. From this initial pool of candidates, a final participant pool (n = 21) with 3 groups emerged: (1) participants who sustained physician-diagnosed concussions while active in their respective sports (concussion group, n = 7), (2) participants who sustained an injury other than concussion as defined by the NCAA Injury Surveillance Program[26] and which resulted in 1 or more days of time lost from their respective sports (injured/nonconcussed group, n = 7), and (3) sport-matched healthy controls (n = 7). The concussion group included all athletes who sustained concussions on each of the targeted teams. Participants with a history of depression, anxiety, or any other psychological disorder or who had sustained any other type of injury as defined by the NCAA[26] that also resulted in 1 or more days of time lost within the previous 3 months were excluded from this study.

Instrumentation

Depressive symptoms were measured using the CES-D, which was developed and validated by Radloff[27] and McCauley et al[28] for use in the general population. The CES-D has been widely used in college-aged samples of both athletes and nonathletes; it demonstrated strong reliability (0.82–0.93) and did not overreport symptoms.[3,29–32] Scores from the CES-D were significantly associated with functional disability and symptom severity in patients with musculoskeletal injuries[33]; moreover, research indicates that the CES-D is an appropriate depression-screening instrument for patients with TBI.[28]

The CES-D is a self-report instrument that asks patients to identify how often they have felt or behaved in a particular way over the past week. It consists of 20 statements (eg, "I felt lonely," "I talked less than usual") scored on a 4-point Likert scale ranging from 0 (*rarely or none of the time—less than 1 day*) to 3 (*most or all of the time—5 to 7 days*).[27,28] Scores for the CES-D range from 0 to 60; higher scores represent a greater frequency of depressive symptoms. Patients who score 16 or more on the CES-D are considered at risk for developing clinical depression, warranting a more thorough evaluation by appropriately trained personnel.[31,32]

Procedures

We collected data over a 6-month period during the 2012–2013 academic year. After institutional review board approval to conduct the research was obtained, all members of the varsity men's basketball, football, and wrestling and women's basketball, soccer, and volleyball teams were apprised of the nature of the study during their teams' first preseason meeting. Student-athletes who agreed to participate signed informed consent forms and then completed the CES-D as a baseline measure. To maintain confidentiality, each participant was provided an identification number when he or she was recruited. Student-athletes who subsequently sustained an injury meeting the inclusion criteria (concussion or injury/nonconcussion) then completed the CES-D at 3 additional points in time: 1 week postinjury, 1 month postinjury, and 3 months postinjury. We selected these time points to address specific concerns. Research[10–12] indicates that emotional disturbance tends to be greatest within 4 days to 2 weeks postinjury. Furthermore, although injury-recovery times can vary widely, recovery tends to be most rapid during the first month postinjury.[34] Prior findings[7,13,22] of postinjury depression lasting 3 months or longer led us to select the final assessment point.

Throughout each team's sport season, participants were monitored by the sports medicine staff for injuries that met the study's inclusion criteria. Once a student-athlete sustained an injury meeting these criteria, the athletic trainer assigned to that participant's sport forwarded his or her name to the primary researcher. The primary researcher then contacted the participant to verify continued consent and complete a demographic information sheet. At 1 week postinjury, the participant completed the CES-D and placed the completed questionnaire in 1 of 2 locked boxes located in the campus sports medicine facilities; the primary researcher maintained sole possession of the keys for these boxes. This same procedure was followed at 1 and 3 months postinjury. Throughout the data-collection process, the primary researcher was the only individual who had access to participant information.

Data Analysis

The CES-D was administered to all participants at baseline and additionally to injured participants at 1 week, 1 month, and 3 months postinjury. Means and standard

Table. Extent of Depressive Symptoms on the Center for Epidemiologic Studies Depression Scale at Each Assessment Point

Time	Group		
	Concussed (n = 7)	Injured/Nonconcussed (n = 7)	Control (n = 7)
Baseline	6.7 ± 3.9	5.7 ± 2.8	7.4 ± 3.0
Postinjury			
1 wk	11.0 ± 5.3[a]	9.1 ± 4.0[a]	NA
1 mo	8.3 ± 5.0	8.9 ± 4.6[a]	NA
3 mo	6.4 ± 5.4	6.9 ± 2.8	NA

Abbreviation: NA, not applicable.

[a] Indicates that the mean was different from baseline ($P < .05$).

deviations were calculated for concussed and injured/nonconcussed participants at each time point; healthy controls completed a baseline measure only. We also calculated the frequency distributions of depressive symptoms that exceeded the at-risk threshold (≥16).

Longitudinal changes in postconcussion depressive symptoms were analyzed using linear mixed models controlling for time lost due to the injury. Least-squares means were calculated and linear contrasts were used to make post hoc comparisons. A group-by-time interaction assessed differences in depressive symptoms between the subgroups at each time point. All analyses were performed using Stata (version 11; StataCorp LP, College Station, TX).

RESULTS

Descriptive Statistics

The average age of participants among all 3 groups was 19.8 ± 1.4 years. In the concussion group (n = 7) and their sport-matched healthy controls (n = 7), 10 participants were involved in wrestling, whereas 4 were involved in football. In the injury/nonconcussion group (n = 7), 3 were involved in wrestling, 2 in football, and 1 each in men's and women's basketball. The mean length of recovery before receiving physician clearance to resume full sport activity in concussed participants was 16.9 ± 10.7 days (range, 8–45 days), whereas injured/nonconcussed participants averaged 12.7 ± 7.6 days of recovery (range, 7–28 days). These recovery times were significantly different from each other. However, baseline CES-D scores between the subgroups did not differ (concussion, 6.7 ± 3.9; injury/nonconcussion, 5.7 ± 2.8; control, 7.4 ± 3.1).

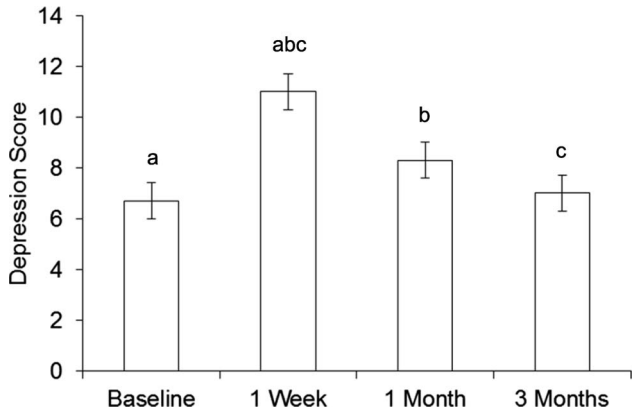

Figure 1. Longitudinal changes in postconcussion depressive symptoms. Variables with the same letter are significantly different.

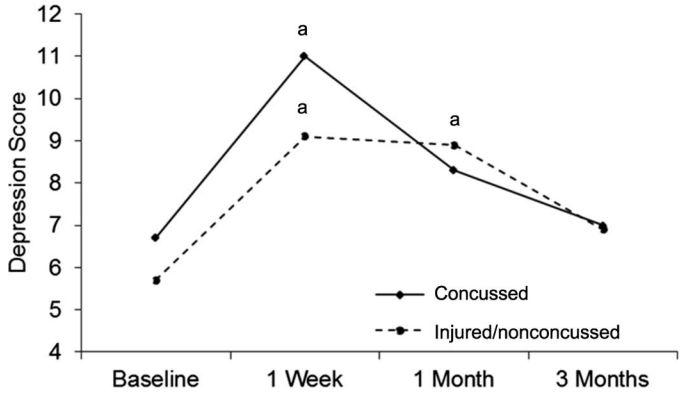

Figure 2. Comparison of depressive symptoms between concussed and injured/nonconcussed participants. [a] Indicates elevated depressive symptoms compared with baseline ($P < .05$).

Extent of Postinjury Depressive Symptoms

Concussed participants and injured/nonconcussed participants had the highest overall CES-D depressive symptoms scores at 1 week postinjury, when the scores of 2 of 14 participants (14.2%) indicated they were at risk for clinical depression. In addition, 2 participants (14.2%) had at-risk levels of depressive symptoms at the 1-month time point. The Table indicates means and standard deviations for depressive symptoms in each group at each assessment point.

Longitudinal Changes in Depressive Symptoms

For the concussed group, depressive symptoms scores at 1 week postconcussion were greater than at baseline (4.3, 95% CI = 0.41, 8.16, $P = .02$), whereas the participants' baseline, 1-month, and 3-month postconcussion depressive symptoms scores did not differ. The injured/nonconcussed group showed differences between baseline and 1 week (4.6, 95% CI = 1.08, 8.17, $P = .009$). Concussed participants' scores decreased between the 1-week and 1-month (–2.7, 95% CI = –4.96, –0.47, $P = .01$) and 1-week and 3-month (–4.0, 95% CI = –6.50, –1.49, $P = .004$) time points (Figure 1).

When we compared depressive symptoms between concussed and injured/nonconcussed participants, no differences existed at any of the time points after injury. Both groups' scores were significantly elevated over baseline at 1 week postinjury. Although the concussed participants demonstrated no other significant differences as compared with baseline, injured/nonconcussed participants' scores at the 1-month time point remained significantly elevated over baseline (3.2, 95% CI = –0.05, 6.30, $P = .03$). Depressive symptoms scores for the injured/nonconcussed participants continued to decrease from 1 to 3 months (–2.0, 95% CI = –4.05, 0.05, $P = .03$) postinjury and were not different from baseline at the 3-month time point (Figure 2).

DISCUSSION

All participants had baseline scores below the at-risk CES-D threshold (≥16) for clinically diagnosed depression.

Furthermore, no significant differences in baseline CES-D scores were evident among the concussed, injured/nonconcussed, and healthy control groups. These findings support previous work[10–12] that suggested emotional dysfunction before injury was not the cause of the postinjury changes in depressive symptoms reported by the concussed and injured/nonconcussed groups.

In the concussion group, depressive symptoms scores at 1 week postconcussion were significantly increased over baseline. The scores may have increased due to a number of different factors, including impaired physiologic function of the brain. Research[5,35,36] has indicated that concussions can impair physiologic function in areas of the brain that are also commonly affected in patients with major depressive disorder. A second factor may relate to athletic identity. A student-athlete's inability to participate in his or her chosen sport may lead to a sense of identity loss.[36] Identity loss is related to depression after an injury; greater identity loss can lead to increasing levels of depression.[37] A final factor may relate to the nature of postconcussion sequelae and their effects on patients' perceptions of disability in the cognitive, emotional, and social realms.[12,25] Concussed individuals may feel physically capable of participating despite cognitive, emotional, or social deficits that preclude safe return; this may create anxiety, anger, and fear, all of which have been linked to depressive symptoms.[1,2]

Depressive symptoms in the concussed participants scores peaked at 1 week postconcussion and then continued to decrease until the 3-month time point. Although we found significant differences between depressive symptoms scores at baseline and 1 week postconcussion, none of the other assessment points differed from baseline. However, there were significant differences between 1 week and 1 month and between 1 week and 3 months postinjury. This may have occurred for a number of reasons. First, the natural course of postconcussion recovery suggests that as physical symptoms subside, so too should psychological symptoms, including those related to depression. Our findings closely mimicked those of Mainwaring et al,[12] who observed that after an initial spike in depressive symptoms, concussed patients reported postinjury depression scores that gradually decreased toward baseline. The postconcussion pattern of depressive symptoms also may be explained by stress and the ability to cope. Perceived stress has been implicated as a significant contributor to depressive symptoms.[20] Furthermore, the availability of cognitive and psychosocial resources and social support is critical to a patient's ability to cope with stressful life events, including brain injuries.[21] Participants in this study may have perceived the necessary resources as available and adequate in helping them cope with their concussions. One aspect of our participants' postconcussion pattern of depressive symptoms that warrants further attention is the relationship to length of recovery. Multiple researchers[1,4] have noted that an inability to participate in one's chosen sport due to injury may lead to depression. However, similar to Mainwaring et al,[12] our results indicated that regardless of participation status, depression continued to decrease. This suggests that time removed from participation may not be a primary cause of depressive symptoms.

When the depressive symptoms scores of the concussed participants and the injured/nonconcussed participants were compared, no differences were present at any of the assessed time points. Despite this finding, the injured/nonconcussed participants displayed a slightly different pattern of postinjury depressive symptoms compared with the concussed participants. Concussed participants' scores peaked at 1 week and then decreased from 1 week to 1 month postconcussion. In contrast, depressive symptoms scores in the injured/nonconcussed participants peaked at 1 week postinjury and remained elevated over baseline at the 1-month time point before decreasing toward baseline at 3 months. Our findings support previous research in which patients who sustained anterior cruciate ligament injuries had elevated postinjury depressive scores for a longer duration than did concussed patients.[12] However, our results contrast with those of Hutchison et al,[11] who demonstrated that athletes who sustained minor musculoskeletal injuries experienced 2-week postinjury depressive symptoms that were not different from preinjury levels. Both groups used the Profile of Mood States short version, a scale consisting of 7 subscales: Tension, Depression, Anger, Vigor, Fatigue, Confusion, and Self-Esteem.[11,12,38] Regardless, prior research along with our own results suggest that injured/nonconcussed participants in our study may have perceived their injuries as severe rather than minor.[8,10–12] In addition, given that the average length of recovery in the injured/nonconcussed participants was less than the average length of recovery in the concussed participants, the perception of injury severity may not necessarily be linked to time loss. The differential response in depressive symptoms between the concussed and injured/nonconcussed participants may be rooted in different causative factors, thus warranting further investigation.[10,12]

Although concussed and injured/nonconcussed participants both showed increases in postinjury depressive symptoms, average scores at each time point remained below the at-risk threshold for clinically diagnosed depression. However, 2 of 14 participants exhibited at-risk depressive symptoms scores at 1 week postinjury. One of these participants retained an at-risk level of depressive symptoms at the 1-month time point, whereas the other did not. This could have been due to several factors, including the patient's perceptions of the severity of injury,[1,5,7,8,10–12,39] age, eligibility status, gender, or individual coping. We found it interesting that 1 participant who fell below the at-risk threshold at the 1-week time point had an at-risk score at the 1-month time point. This may have been because the student-athlete did not fully comprehend the nature and severity of the injury at the initial 1-week assessment point.[7] The clinical implications of these findings are twofold. Clinicians should routinely incorporate patient-centered outcomes measures into their postinjury patient care; doing so will provide clinicians with an important patient perspective as to the level of disability associated with the injury.[39,40] Furthermore, considering the potential risks associated with depression,[1] our findings suggest that postinjury psychological assessments, in particular those that focus on specific emotional disturbances such as depression, should be used immediately after injury as well as in a longitudinal fashion to ensure that injured patients achieve the best overall physical and psychological outcomes.

Limitations

The study was limited by the number of injuries that occurred during the assessment period. However, given the pilot nature of this investigation and the significant findings, the number was adequate for the purpose. We focused on sport teams from 1 college campus, which may not represent collegiate student-athletes as a whole. Although all postinjury assessments occurred at the same intervals, some depression may have been linked to recent life events or time of semester, which were not controlled. In addition, data were collected at different times during each team's sport season. In doing so, seasonal stressors, such as an inability to compete in postseason play versus regular-season play due to injury, were not taken into consideration. Also, we measured the matched controls only at baseline, which did not allow us to track changes in depressive symptoms between injured and noninjured participants over time. Although we categorized injured participants into either the concussion group or injured/nonconcussion group based on valid guidelines,[26] we recognize that future work regarding postinjury depressive symptoms may benefit from defining more specifically the types of injuries experienced by participants. Finally, the CES-D is not a diagnostic tool; rather, it is a symptom scale for depression. Therefore, the results must be interpreted as reflecting the extent of depressive symptoms as opposed to the actual rate of depression.

CONCLUSIONS

Sport-related injuries can have a substantial psychological influence on athletes. This influence includes the potential for the development of postinjury depression. Our results indicated that depressive symptoms in concussed and injured/nonconcussed participants increased from baseline to 1 week postinjury. Whereas the concussed participants' symptoms continued to decrease toward baseline by the 3-month time point, the injured/nonconcussed group's symptoms remained elevated at the 1-month time point before decreasing. No significant differences occurred between groups at any of the time points. This pattern and the overall extent of postinjury depressive symptoms among participants suggests that athletic trainers need to be prepared not just for the physical ramifications of injury but also for the psychological ramifications, including depression. This preparation may include recognizing the need for and facilitating the referral to an appropriate mental health professional. Furthermore, it would be wise for athletic trainers to consider having mental health services available as a routine part of the postinjury management process. As much as their postinjury recovery allows, student-athletes should remain engaged in their normal preinjury activities. Used as a preseason baseline and postinjury screening tool, the CES-D may prove valuable in the recognition and management of individuals who display at-risk depressive symptoms scores.

Given the potential for long-term negative effects on HRQOL in patients with TBI, future researchers using a larger participant population should evaluate depressive symptoms concurrently with patient-centered HRQOL measures, particularly in a longitudinal manner. Moreover, future investigators need to examine the role of additional factors that may affect postconcussion depressive symptoms, including perceived injury severity, prior history of injury, perceived social support, and team versus individual nature of a participant's sport. An understanding of these additional variables would allow for a better appreciation of the depressive symptoms that occur with concussed and injured/nonconcussed individuals, thereby improving the overall management of these conditions.

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