

## Student-athlete health and well-being: looking at the past to inform the future

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*Currently, there is a lack of literature assessing former student-athletes' health and well-being after their collegiate careers. There is conflicting evidence concerning how former athletes maintain their health compared to non-athletes. This study aimed to measure student-athlete and non-athlete student alumni on measures of health and well-being in an observational nature at a single time-point. A total of 44 student-athlete and 65 non-athlete student alumni participated by completing a self-report survey. Few differences were found between them, with both groups reporting healthy scores on all measures. A group difference was found on the Epworth Sleepiness Scale, with former athletes reporting higher daytime sleepiness. A sex difference was found within controls on the Grit Scale, with females reporting higher grittiness. The results of this study suggest few differences in health status between these groups. Further research is warranted to fully assess former student-athlete health and wellness over time, in a systematized, long-term, prospective manner.*

KEY WORDS: Student Athlete, Health, Wellness, Alumni.

### Introduction

Total student-athlete participation in United States National Collegiate Athletic Association (NCAA) Division I sports is estimated to be greater than 5.2 million for the academic years between 1981 and 2021.<sup>1</sup> Current research primarily focuses on these athletes during their collegiate careers, with few studies examining the health and well-being of these athletes' post-college. With such a large network of current and former athletes, understanding the

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levels of health and well-being in past athletes would be an important contribution to forming strategies and best practices that not only maximize the health and well-being of student-athletes while they are on campus, but also to prepare them for optimal post-collegiate trajectories.

Sports participation is associated with many benefits related to physical health. Specifically, student-athletes demonstrate significantly higher levels of exercise volume and are more likely to comply with American College of Sports Medicine (ACSM) guidelines than non-athletes.<sup>2</sup> ACSM guidelines outline exercise recommendations for the general population (adults aged 18-65) to maintain health and wellness and suggest adults achieve 150 minutes of moderate aerobic activity per week alongside muscle strength training at least twice per week.<sup>3</sup> At the same time, the evidence for sustained benefit from collegiate sport participation throughout life is mixed. Sorenson et al. found that student-athlete alumni had lower exercise volume, were less likely to comply with ACSM guidelines, and report greater joint health concerns than non-athletes.<sup>2,4</sup> Simon et al. found similar results with former athletes reporting more daily limitations due to previous injuries, chronic injuries, and pain compared to non-athletes.<sup>5-7</sup>

In addition to higher levels of exercise and fitness in elite athletes, there is also evidence for improved psychosocial function in this same group compared to non-athlete students, with the caveat that the effect was small and of only “possible” clinical relevance.<sup>4</sup> Psychosocial function in the Sorenson et al. study included relationships, body image, substance use, academic/professional concerns, mental health concerns, adjustment, and sports performance concerns.<sup>4</sup> A large study of former Finnish professional athletes reported lower levels of depression and neuroticism, greater satisfaction with life, and greater extroversion in athletes when compared with non-athletes in addition to benefits of increased physical activity later in life.<sup>8-10</sup> Additionally, a study of former professional soccer players found that athletes had a lower lifetime risk of hospital admission due to common mental health disorders such as anxiety and other mood disorders.<sup>11</sup> In contrast, a 2019 review suggests athletes face specific risk factors to mental health, including injury and retirement, specifically suggesting that these factors may affect the onset and severity of mental health concerns.<sup>12</sup>

Given the conflicting evidence that exists for health and well-being of former student-athletes and the importance of assessing health status following sport participation, further research is warranted. To this end, the current study aimed to compare student-athlete alumni with non-athlete control alumni on a variety of measures of health and well-being at a university in the western United States. It is hypothesized that health and well-being in former student-athlete alumni will be more positive and sustained than non-athlete control alumni on physical and psychological measures.

## Methods

### STUDY DESIGN

Participants in this study consisted of student-athlete and non-athlete student alumni of a NCAA Division I University located in the western United States. Student-athlete alumni were recruited based on participation in the following sports: Football, Women's Soccer, Men's and Women's Basketball, and Men's and Women's Cross-Country. Eligibility additionally included receiving an undergraduate degree from the University between the graduation years of 1993-2018. This range was selected to provide sampling at mid-decadal increments (5, 10, 15, 20 and 25), as well as a quarter-decadal sample to reflect more recently graduated alumni (~2.5 years). Demographic information such as sex, ethnicity, and race were collected. Non-athlete alumni were recruited to serve as a comparison to the athlete group. These controls were considered eligible by receiving an undergraduate degree from the same graduation years as the athletes and matched with athlete demographics before surveys were sent. Eligible participants' contact information were made available by various databases (containing contact information, year of graduation, etc.) embedded within the university, with which students "opt-in" to University-related communication by providing updated contact information. Participant demographic criteria was given to the governors of these databases whose contact information was then given to the researchers. Use of these databases within the university were approved by the IRB.

### MEASURES

All participants provided informed consent electronically prior to participating in the study, and all procedures and measures were approved by the University of Colorado Institutional Review Board (IRB #19-0078). Participants were notified of the study being voluntary and having the option to withdraw at any point without consequence. Additionally, participants were compensated with an electronic gift card for participation.

Both athlete and control alumni were sent an identical electronic survey. The survey consisted of several measures concerning mental and physical health, as well as demographic information, including: The 12-Item Grit Scale, Alcohol Use Disorders Identification Test (AUDIT), Quality of Life Inventory (QOLI), 39-Item Health Status Questionnaire (HSQ), the 25-Item Connor Davidson Resilience Scale (CD-RISC), World Health Organization 5 (WHO-5), Perceived Stress Scale (PSS), Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale, and the Brief Assessment of Mood (BAM).<sup>13-22</sup> Further description of these measures can be found in the supplemental information.

### PRESENCE OF DIAGNOSES

The presence and history of chronic conditions (e.g., diabetes, cardiovascular disease, neurodegenerative disease, etc.), as well as mental health diagnoses (e.g., depression, anxiety, PTSD, etc.) were assessed using self-report as part of demographics (46 questions in total). These items were formatted in the following example to capture history and presence of diagnoses: "Have you been diagnosed with a psychiatric disorder such as...". Questions regarding tobacco history and use, as well as healthcare access were also included in the survey.

## RECRUITMENT

Participants were recruited and enrolled between September of 2019 and October of 2020 based on contact information provided by databases embedded within the University. Participants were invited to take the survey via email, text messages, phone calls, and finally a letter and postcard in the mail. All recruitment methods were utilized for each participant, unless there was no contact information available in one or more of the modalities. All forms of recruitment included a description of the study as well as instructions on how to participate. Enrolled (i.e., consented) participant data was collected and managed using REDCap electronic data capture tools hosted at the University of Colorado Boulder.<sup>23</sup> REDCap (Research Electronic Data Capture) is a secure, web-based application designed to support data capture for research studies, providing an intuitive interface for validated data entry, audit trails for tracking data manipulation and export procedures, automated export procedures for seamless data downloads to common statistical packages, and procedures for importing data from external sources. Recruitment began with the most recent graduates and continued in chronological order.

## ANALYSES

Data analysis was conducted using R Studio (Version 1.4.1103). Scores on all measures were analyzed using a two-way analysis of variance model comparing group and sex, as well as the interactions between these variables. A significance level of  $p < 0.05$  was used for all analyses.

## Results

### DEMOGRAPHICS

Participants consisted of 44 student-athlete alumni and 65 non-athlete alumni. Demographic information such as sex, ethnicity, sport group, specific sport, and graduation year can be found in Table 1. The athlete group consisted of 44 participants, 32 who identified as male and 12 as female. Of the athlete group 75% listed their race/ethnicity as White, 4% African American or Black, 2% as Asian or Pacific Islander, and 17% as Multi Racial. Of the 65 controls, 35 identified as male and 30 as female; 70% identified as White, 18% as African American or Black, 10% as Multi Racial. Mean age was assessed with both groups averaging 32 years, with ages ranging from 19-64 years. The athlete group was distributed across the following sports: Football 33%, Men's Basketball 9%, Women's Cross-Country 15%, Men's Cross-Country 29%, and Women's Soccer 11%. Demographic distribution of both groups plus representation of sports and graduation years can be found in Table 1.

TABLE I  
Demographic information by group and sample size.

| Demographics           | Athlete | Control |
|------------------------|---------|---------|
| <b>n</b>               | 44      | 65      |
| <b>Male</b>            | 32      | 35      |
| <b>Female</b>          | 12      | 30      |
| <b>White</b>           | 33      | 46      |
| <b>Non-White</b>       | 11      | 19      |
| <b>Mean Age</b>        | 32.6    | 32.5    |
| Age Range              | 23-51   | 19-64   |
| <b>Graduation Year</b> |         |         |
| 2016-2018              | 12      | 16      |
| 2013-2015              | 17      | 15      |
| 2008-2010              | 5       | 21      |
| 1993-2003              | 10      | 13      |
| <b>Sport Type</b>      |         |         |
| Football               | 15      |         |
| Basketball             | 4       |         |
| Soccer                 | 5       |         |
| Cross Country          | 20      |         |

All results from the two-way analysis of variance can be found in Table 2. On the 12-Item Grit Scale, a main effect was found for sex ( $F(1,105)=7.56$ ,  $p<0.001$ ), with males ( $M=3.78$ ,  $SD=0.58$ ) reporting slightly lower scores than females ( $M=3.79$ ,  $SD=0.59$ ). On the Epworth Sleepiness Scale, a main effect was found for group ( $F(1,88)=4.80$ ,  $p<0.01$ ) with athletes ( $M=5.76$ ,  $SD=4.5$ ) reporting higher scores than controls ( $M=4.73$ ,  $SD=3.58$ ) on daytime sleepiness. No other significant effects were found on the other measures. Scores on all measures for both groups are considered healthy and within normative ranges (Table 3).

ANOVA results for rates of depression and anxiety in this sample can be found in Table 4. No statistically significant differences based on group or sex or their interaction on these items were found. Approximately 18% ( $n=8$ ) of athletes and 28% ( $n=18$ ) of non-athlete controls reported both anxiety and depression. For the question: 'Have you ever been diagnosed with bipolar disorder?' 4 participants answered yes, with all of these participants

TABLE II  
Two-Way Analysis of Variance (ANOVA) Results: health and wellness results assessing sport group, sex, and their interaction.

| Measure                        | Group                 | Sex                     | Group x Sex           |
|--------------------------------|-----------------------|-------------------------|-----------------------|
| 12-Item Grit Scale             | F(1,105)=1.37, p=.244 | F(1,105)=7.56, p=.007** | F(1,105)=0.95, p=.330 |
| AUDIT                          | F(1,96)=1.73, p=.192  | F(1,96)=0.11, p=.743    | F(1,96)=1.08, p=.300  |
| QOLI                           | F(1,101)=1.88, p=.174 | F(1,101)=0.31, p=.580   | F(1,101)=0.07, p=.797 |
| 25-Item CD-RISC                | F(1,96)=0.03, p=.858  | F(1,96)=0.02, p=.881    | F(1,96)=0.49, p=.484  |
| WHO-5                          | F(1,96)=1.28, p=.260  | F(1,96)=1.07, p=.304    | F(1,96)=0.10, p=.747  |
| Perceived Stress Scale (PSS)   | F(1,90)=0.47, p=.496  | F(1,90)=0.15, p=.703    | F(1,90)=0.54, p=.464  |
| PSQI                           | F(1,89)=0.21, p=.651  | F(1,89)=0.92, p=.339    | F(1,89)=0.60, p=.442  |
| Epworth Sleepiness Scale       | F(1,88)=4.80, p=.031* | F(1,88)=0.30, p=.587    | F(1,88)=0.32, p=.573  |
| Brief Assessment of Mood (BAM) | F(1,88)=0.37, p=.545  | F(1,88)=0.91, p=.343    | F(1,88)=0.03, p=.861  |
| 39-Item HSQ Domains            |                       |                         |                       |
| Physical Functioning           | F(1,96)=2.26, p=.110  | F(1,96)=2.11, p=.149    | F(1,96)=0.03, p=.847  |
| Physical Limitations           | F(1,96)=0.85, p=.430  | F(1,96)=0.08, p=.774    | F(1,96)=1.04, p=.310  |
| Emotional Functioning          | F(1,96)=0.10, p=.903  | F(1,96)=0.30, p=.587    | F(1,96)=0.08, p=.774  |
| Emotional Limitations          | F(1,96)=0.58, p=.564  | F(1,96)=0.70, p=.404    | F(1,96)=2.01, p=.159  |
| Social Functioning             | F(1,96)=1.27, p=.287  | F(1,96)=0.92, p=.338    | F(1,96)=1.06, p=.306  |
| Energy/Fatigue                 | F(1,96)=0.17, p=.848  | F(1,96)=0.09, p=.767    | F(1,96)=0.18, p=.670  |
| Pain                           | F(1,96)=1.29, p=.280  | F(1,96)=0.24, p=.623    | F(1,96)=0.31, p=.579  |
| General Health                 | F(1,96)=0.30, p=.739  | F(1,96)=1.95, p=.166    | F(1,96)=0.83, p=.365  |

\*\*p<.001, \*p<.05

also reporting co-morbid depression. A total of 6 participants (5.5% of overall sample) reported PTSD.

There were few cases of the physiological diagnoses reported in either the athlete or control group in this sample. No cases of cardiovascular disease, diabetes, coronary artery, periphery artery, cerebrovascular, or chronic kidney diseases were reported. No use of blood thinning medication was reported. Only 1 case each of heart surgery, stroke, epilepsy, use of blood pressure medication, and use of high cholesterol medication were reported in the overall sample. A total of 3 participants reported thyroid disease, all of whom were female controls. For sleep apnea, 5 participants reported, all of

TABLE III  
Mean scores for both athlete and control groups across measures compared with score ranges and/or normative scores based on general US population.<sup>12-21</sup>

| Measure                            | Athlete Mean Score (SEM) | Control Mean Score (SEM) | Score Ranges/Norm Scores                                        |
|------------------------------------|--------------------------|--------------------------|-----------------------------------------------------------------|
| 12-Item Grit Scale                 | 3.78 (0.09)              | 3.78 (0.07)              | 1-5 with higher scores indicating more 'grittiness'; M=3.65     |
| AUDIT                              | 5.95 (0.72)              | 5.94 (0.61)              | 1-7 considered low alcohol use                                  |
| QOLI                               | 2.62 (0.24)              | 2.60 (0.21)              | 1.6-3.5 considered 'Average'                                    |
| 39-Item HSQ Domains General Health | 75.49 (3.90)             | 72.02 (3.21)             | Composite Score of 5 questions regarding overall health; M=80.7 |
| 25-Item CD-RISC                    | 31.16 (1.03)             | 31.47 (0.82)             | 0-40 with higher scores indicating higher resilience; M=31.8    |
| WHO-5                              | 62.69 (3.12)             | 62.05 (2.40)             | 0-100 with higher scores indicating better overall health       |
| Perceived Stress Scale (PSS)       | 21.81 (0.57)             | 21.92 (0.47)             | 0-44 with higher scores indicating poorer health; M=14.2        |
| PSQI                               | 5.35 (0.52)              | 5.26 (0.38)              | 0-21 with lower scores indicating better sleep quality          |
| Epworth Sleepiness Scale           | 5.76 (0.77)              | 4.73 (0.47)              | 0-10 considered 'normal' daytime sleepiness                     |
| Brief Assessment of Mood (BAM)     | 6.27 (0.82)              | 6.17 (0.62)              | 0-24 with higher scores representing greater mood disturbance   |

them male and 4 of the 5 were controls. History and current use of tobacco was collected. Of all participants, 32% (n=35) reported a history of tobacco use, while only 6% (n=7) reported current use. Five participants reported exposure to secondhand smoke on a regular basis on an average of 4.6 hours per week.

Information regarding access to healthcare was also collected. Of the total sample, 96% stated that their healthcare was currently covered in some form, with 62% having a plan through their employer/spouse's employer, 7.5% through a purchased plan, 10% through Medicare or Medicaid, and 10% through an unspecified other plan. Only 5.5% of the total sample reported that they were unable to obtain healthcare in the past year, with half of these individuals saying this was due to cost.

TABLE IV  
*Self-Report mental health diagnoses including two-way analysis of variance results.*

| Diagnosis  | Group                 | Sex                   | Group x Sex           |
|------------|-----------------------|-----------------------|-----------------------|
| Depression | F(1,104)=0.73, p=.486 | F(1,104)=0.09, p=.762 | F(1,104)=0.53, p=.466 |
| Anxiety    | F(1,104)=0.73, p=.486 | F(1,104)=0.09, p=.726 | F(1,104)=0.54, p=.466 |

Two-way ANOVA results for self-report mental health diagnoses of depression and anxiety. General adult US population prevalence of a major depressive episode is 7.1%. Question from survey: Have you ever been diagnosed with a Psychiatric disorder such as Depression? General adult US population of an anxiety disorder is 31.1%. Question from survey: Have you ever been diagnosed with a Psychiatric disorder such as Anxiety?<sup>23-24</sup>

## Discussion

The goal of the present study was to assess patterns of physical and psychological health and well-being in post collegiate alumni (former student-athletes and non-athletes) in a cross-sectional nature. Overall, the data suggest that both former athletes and non-athletes are considered healthy (Table 3) and do not differ from one another. The results of the 12-item Grit scale suggest that sex has an effect on overall grit, with females scoring slightly higher on grittiness than males. The results of the Epworth Sleepiness Scale show controls scoring lower, meaning athletes in this sample have higher levels of daytime sleepiness. We found no differences between group or sex on any other measures.

Although there were no statistically significant differences found on rates of mental health diagnoses between athletes and controls, the finding that 24% of overall participants have received a diagnosis of depression, anxiety, or both in their lifetime can be compared to the national average. In the United States, the national average of depression is found to be 8.4% and anxiety at 31.1%, suggesting lower rates of anxiety but higher rates of depression in our sample.<sup>24-25</sup> Of our participants, 5.5% reported PTSD, which is not dissimilar to the national average of 6.8% of US adults.<sup>25</sup> Despite the lack of differences between groups concerning mental health, the difference between our sample for depression and the national average may be worth considering. Because this study was conducted during the coronavirus pandemic, it is possible that the findings are linked to pandemic restriction measures that were implemented nationwide. The implications of the timing of data collection with this study is discussed further below.

We additionally find across all measures that student-athlete alumni and controls report scores within healthy and normative ranges. This result is further supported by the self-reported physiological diagnoses data. There are

low levels of physiological diseases present in this sample, as well as usage of medications. These findings suggest that athletic participation does not have physiological consequences later in life. However, with an average sample age of 32 years, many participants have not reached the disease onset age present for many of these diagnoses.<sup>26</sup> We also found very low levels of tobacco usage at 6% of overall participants compared to a national average of 14.2%.<sup>27</sup> However, the present study did not ask about electronic cigarette, vaping, or marijuana use.

Both former student-athletes and non-athlete controls appear to have excellent access to healthcare with 96% of the total sample reporting current healthcare coverage. 65% of former student-athletes and 78% of former non-athletes report access to a doctor's office if it is needed. The Centers for Disease Control and Prevention (CDC) data states that 8.3% of US adults were unable to obtain healthcare in the past year due to cost of care, which can be compared to 5.5% of our sample.<sup>27</sup> The data suggests that regardless of athlete status, alumni of the University have equivalent access to healthcare. This is further supported by low levels of physiological diseases reported by both groups in the survey.

There is mixed evidence in the literature concerning whether participating in athletics during college enables lifelong health benefits or other effects.<sup>2,4,12</sup> The results of this study contribute to the body of research by suggesting that there are few differences between former student-athletes and non-athletes in post-college health status in this sample. These findings imply that participation in athletics does not affect physiological or psychological well-being after graduation from sport. This study also suggests that regardless of athlete status, there are considerations for monitoring and providing support for mental health of all students. These would include increased psychological support during college which could serve as or foster coping mechanisms that students could utilize later in life outside of the framework of the university.

There are several considerations and caveats worth mentioning, the majority of which relate to the timing of this survey and its overlap with the coronavirus pandemic. This study began before the onset of the pandemic in the United States; however, data collection was primarily completed during 2020. Considering the self-report nature of the survey, there are some implications that mental health concerns were much higher during this year of data collection. It must be stressed that the survey asked questions concerning history of official diagnoses, which may not reflect the current status of mental health of participants. However, participants may have felt the strain of the pandemic and have reported higher rates of depression and anxiety without an official

diagnosis. Additionally, group sample sizes are relatively low for this period of recruitment. This may be due to the effect of the pandemic not only on participants, but also on university contact data resources available to the study for recruiting eligible participants. The average age of participants being 32, with an age range of 19-64. This age range taken together with the sample size limits the comparisons that can be made to the general population. Lastly, this study asked participants about professional sports participation, but not current recreational sports participation post-college. Assessing activity levels in sports post-college into middle or later life is an area of further research that would benefit understanding of former student-athlete's health status.

Considering the urgent and emergent challenges the university faced in response to the pandemic's impact on campus life, the capacity to aid in research recruitment and study related requests was reduced. What became apparent in doing forensics on the present study is the need for easily accessible, and up-to-date contact information on all student alumni, including student athletes, that allows for the long-term assessment and study of health and well-being across the life-course. A value of this information overall is that, in general, universities have no systematic means by which to determine how former student-athletes are faring relative to former non-athlete controls. The design and results of this study are suggestive in providing insight as to how universities may begin to assess alumni health and well-being after they leave the care of the university.

## Conclusions

With the goal of examining health trajectories in former student-athletes, this study finds that regardless of former athlete status, alumni appeared relatively healthy. We find that this sample of alumni score within healthy ranges on physical and psychological measures, as well as having excellent access to healthcare. We find some implications for mental health in this sample, which may be attributed to the coronavirus pandemic running concurrently with data collection. These results provide a starting point and framework for the university to assess the health and well-being of alumni in a systematic manner, using what appear to be sensitive measures. Although the present study shows only slight differences between former student-athletes and non-athletes, these findings and the methodology utilized, may help inform future studies of alumni. These types of studies would be important to inter-collegiate athletics to optimize programming for student-athletes, as well as campus-wide students in general.

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## SUPPLEMENTAL INFORMATION

### Description of Measures

#### 12-ITEM GRIT SCALE

The 12-item Grit Scale was designed by Angela Duckworth to measure individual levels of grit. Grit is defined as the “tendency to sustain interest in

and effort towards very long-term goals". The 12 items on the measure are rated from 'Not like me at all' to 'Very much like me'. Items 1, 4, 6, 9, 10, and 12 assign a score of '5' to Very much like me whereas items 2, 3, 5, 7, 8, and 11 assign a score of '1' to Very much like me responses. The responses from each question are added up and divided by 12 to give a final score of grittiness. The maximum score is '5' representing an extremely gritty individual, and the lowest possible score is '1' representing not at all gritty.<sup>1</sup>

### ALCOHOL USE DISORDERS *Identification Test (Audit)*

The AUDIT was developed by the World Health Organization (WHO) as a brief assessment to screen excessive drinking. The first edition of the AUDIT was published in 1989 and was updated in 1992. The assessment is intended for use with general hospital populations, populations with depression or at risk for suicide, patients in emergency or psychiatric services, and general populations. AUDIT consists of 10 questions which are summed to create a total score. Scores on the AUDIT of 8-15 represent a medium level of alcohol problems and a score of 16 or higher represents high alcohol problems. A total score of 20 or higher indicates the need for further assessment for alcohol dependence.<sup>2</sup>

### QUALITY OF LIFE INVENTORY (QOLI)

The Quality of Life Inventory (QOLI) is a 32-item questionnaire which assess life satisfaction across 16 different areas of life. The QOLI was first published by Michael B. Frisch and can be administered by anyone with a master's degree in psychology, education, or a related field. The 16 areas included in the assessment are Health, Self-Esteem, Money, Goals/Values, Work, Play, Learning, Creativity, Love, Friends, Helping, Children, Home, Neighborhood, Relatives, and Community. The measure is scored by multiplying the 'importance' score and the 'satisfaction' score for each of the domains. These scores are then added to create a global score and compared to the QOLI global inventory of scores. The QOLI overall scores can be interpreted as follows: an overall score of -6.0-0.8 indicates 'Very Low' quality of life, 0.9-1.5 indicates 'Low', 1.6-3.5 indicates 'Average', and 3.6-6.0 indicates 'High' quality of life. If taken multiple times, movement from one classification to the next is considered significant. Additionally, respondents who score Low or Very Low should be closely assessed for depression.<sup>3</sup>

*Health Status Questionnaire (SF-36)*

The Health Status Questionnaire (SF-36) is a widely used measure assessing health-related and quality of life variables. Questions are each rated differently based on how limited the participant feels in doing a specific activity. Questions include rating on scales from 0-3 as well as yes or no options. Eight subscales are scored from the measure: physical functioning, role limitations due to physical problems, pain, energy/vitality, social functioning, emotional functioning, role limitations due to emotional problems, and general health.<sup>4</sup>

*25-Item Connor Davidson Resilience Scale (CD-RISC)*

The CD-RISC 10 is a 10-item self-report measure designed to measure an individual's level of resilience. The 10-item version was adapted from the original 25-item scale, and developed at the University of California, San Diego by Drs. Campbell-Sills and Stein. Each question of the CD-RISC 10 is rated on a five-point Likert scale ranging from 0 (not true at all) to 4 (true nearly all of the time). Subjects are instructed to rate each question based on the past month. All items are summed to create a composite score ranging from 0-40, with higher scores representing higher resilience. Scores in US populations may be interpreted into four quartiles as follows: 0-29, 30-32, 33-36, and 37-40. The CD-RISC 10 has been validated among many populations and cultures, including college students. Additional Information: General population mean 31.8 (SD 5.4), College Undergraduate population mean 27.2 (SD 5.8), Mild to Severe TBI mean 22.0 (SD 8.8).<sup>5</sup>

*World Health Organization Five Well Being Index (WHO-5)*

The WHO-5 is a brief assessment which aims to current mental well-being. First published in 1988, the WHO-5 has shown validity in screening for depression, as well as use in young adults and the elderly. The assessment can be taken by anyone aged 9 or older and consists of 5 questions rated on a 6-point Likert Scale from 0 (at no time) to 5 (all of the time). The responses are totaled to give a raw score ranging from 0-25 which is then multiplied by 4, to give a final score form 0-100. Higher scores indicate overall better functioning and well-being.<sup>6</sup>

*Perceived Stress Scale (PSS)*

The Perceived Stress Scale is the most widely used measure for assessing an individual's perception of stress. The items in the PSS ask about feelings and thoughts from the past month and can be used in general populations for anyone with at least a junior high school education. The PSS consists of 11 questions, all rated on a Likert scale from 0 (Never) to 4 (Very Often). All scores are summed to create an overall score. Higher scores on the PSS may be associated with smoking habits, greater vulnerability to stress, and poorer general health. Items 4, 5, 7, and 8 are reversed scored.<sup>7</sup>

*Pittsburgh Sleep Quality Index (PSQI)*

The Pittsburgh Sleep Quality Index is a self-report questionnaire which measures sleep quality over the past month. The measure was initially created at the University of Pittsburgh in 1988. The assessment consists of 19 questions which are then scored to create 7 component scores. These component scores are then used to create a global score ranging from 0-21, with lower scores representing healthier sleep quality.<sup>8</sup>

*Epworth Sleepiness Scale*

The Epworth Sleepiness Scale is designed to measure daytime sleepiness and can be utilized to screen sleep disorders. The scale was introduced in 1991 by Murray Jones at Epworth hospital. The scale consists of 8 questions which are rated on a 4-point Likert scale ranging from 0 (would never doze) to 3 (High chance of dozing). Each answer is summed to create a total score with 0-10 considered 'normal', 10-12 as 'borderline', and 12-24 as 'abnormal' sleepiness.<sup>9</sup>

*Brief Assessment of Mood (BAM)*

The BAM is a 6'-item inventory utilized to measure changes in mood across time. The six items from the BAM consist of mood adjectives that gauge how an individual is feeling in the moment. These include whether an individual is anxious, depressed, or sad, confused, angry, energetic, and fatigued. Each mood adjective is assessed on a Likert scale ranging from 0 (not at all) to 4 (extremely). The score obtained for energy is first reverse coded

and then combined with the remaining mood adjective scores to create a composite score representing Total Mood Disturbance (TMD). The higher the TMD is, the more mood disturbance is reflected within the individual.<sup>10</sup>

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