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Examining Factor Structure of a Widely Used Measure of Psychiatric Symptoms in Collegiate Athletes

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The Symptom Checklist 90 – Revised (SCL-90-R; Derogatis, 1994) is one of the most widely utilized measures of general psychiatric distress. However, its factor structure varies across populations, and psychometric properties of this scale have yet to be investigated in athletes. In this study several frequently reported factor structures of the SCL-90-R were examined in 311 collegiate athletes. None of the tested models were a good fit based on Confirmatory Factor Analysis (CFI) criteria, although the bi-factor model was reasonable using RMSEA (.06) and AIC (55951) criteria. The explained common variance of the global factor was 73%, reflecting a stronger general factor relative to specific construct factors. Indeed, several items did not significantly load on previously identified factors. Results suggest the SCL-90-R is a good tool to determine general symptom severity of mental health disorders in collegiate athletes.

Keywords: SCL-90-R, athlete mental health, assessment, CFA

Historically, the mental health of athletes has been overlooked due to assumptions that athletes are not at the same risk of experiencing mental health challenges as non-athletes (Hughes & Leavey, 2012). Although some aspects of student-athletes' unique culture prove beneficial, such as protective effects of exercise and perceived higher levels of resilience, other aspects present a more detrimental impact on athletes' mental health (Despres et al., 2008). For instance, sport competition may contribute to unique stressors, placing athletes at higher risk for binge drinking alcohol use, eating, gambling, and sleep disorders (Breslin et al., 2018; Brown et

al., 2014; Castaldelli-Maia et al., 2019; Kimball & Freysinger, 2003). Generally, there is evidence to suggest athletes may present, experience, and report symptoms of mental health differently than their non-athlete counterparts (Castaldelli-Maia et al., 2019; Despres et al., 2008; Giannone et al., 2017). Indeed, there are inherent factors that may lead collegiate athletes to under-report mental health symptom severity, relative to non-athlete peers, including loss of playing time and negative perceptions from others.

Mood Disorders

Some studies have indicated that athletes' rates of depression are higher than those of the general population (Wolanin et al., 2015), while others suggest athletes experience similar rates of depressive disorders (Donohue et al., 2004; Rice et al., 2016). Athletes may underreport their symptoms (Brown et al., 2014) due stigma, fears of jeopardizing one's position on the team, and perceptions of weakness (Watson, 2006). Appaneal et al., (2009) recommend the use of easy to complete, self-report depression measures for athletes during preseason physical examinations.

Athletes tend to endorse fewer depressive symptoms as compared to non-athlete peers (Proctor & Boan-Lenzo, 2010). However, some important gender differences regarding depression symptomatology have been reported (Storch et al., 2005). Specifically, female athletes demonstrate significantly higher rates of social anxiety and depression as compared to male athletes, and all non-athletes (Storch et al., 2005). It is important to appreciate, however, that athletes may under-report their symptoms due to stigma (Brown et al., 2014; Watson, 2006).

Anxiety Disorders

Rates of anxiety disorders for collegiate athletes are varied and inconclusive. Some research shows no difference in anxiety between athletes and non-athletes (Rice et al., 2016), some shows athletes typically report lower levels of anxiety as compared to non-athletes (Tahtinen & Kristjansdottir, 2018), and other study results suggest athletes experience more performance and competition anxiety than non-athletes (Patel et al., 2010).

Alcohol Use Disorders

Alcohol use disorders are the most prevalent substance use disorders in athletes. In comparing athletes and non-athletes in their consumption of alcohol, intramural athletes display more frequent drinking and alcohol-related consequences (Barry et al., 2015; Marzell et al., 2015). Indeed, athletes engage in more binge drinking and endorse more alcohol related negative consequences as compared to non-athlete peers (Barry et al., 2015; Ford, 2007; Yusko et al., 2008). Similar findings show that intramural and club athletes consume more than three drinks in one sitting at higher rates than non-athletes (Marzell et al., 2015).

Eating Disorders

Some investigators have found collegiate athletes are at an increased risk for eating disorders (Martinsen et al., 2014), while others have found no difference in the frequency of

eating disorders between athletes and non-athletes (Somasundaram & Burgess, 2018). Athletes tend to show less body dissatisfaction, disordered eating, and body image disturbance as compared to the general population (DiBartolo & Shaffer, 2002; Reinking & Alexander, 2005). However, multiple studies highlight the role of specific sport types (i.e., lean sports) in elevated rates of disordered eating (Reinking & Alexander, 2005). Additionally, much of the current literature only examines differences in disordered eating between female athletes and non-athletes.

Sleeping Disorders

Research indicates increased likelihood of insufficient sleep, sleep disturbance, and poor sleep practices among student-athletes as compared to their non-athlete counterparts (Brown et al., 2014; Castaldelli-Maia et al., 2019; Driller et al., 2017). Athletes generally report more difficulties with sleep as compared to non-athlete peers (Brown et al., 2014; Castaldelli-Maia et al., 2019; Driller et al., 2017).

General Psychiatric Symptoms

Some measures examine multiple psychiatric domains, which offer greater utility as screens than single domain questionnaires, such as those reviewed above. These measures are also more parsimonious in providing broad-based assessments of intervention outcomes than mental health symptom specific measures. The results of studies in which researchers have examined general mental health of athletes and non-athletes are mixed. Some researchers found no significant differences between female athletes and non-athletes on the measure of general emotional distress (Davis & Strachan, 2001). Others, however, have found that athletes (NCAA and recreational combined) report less severe psychiatric symptoms as compared with their non-athlete peers (Donohue et al., 2004).

NCAA, Club, and Intramural Athlete Comparisons of Mental Health

Annually in the United States approximately eight million athletes are involved in high school sports (NFHS, 2019), approximately half a million students participate in the NCAA (NCAA, 2019), about two million collegiate students participate in club sports (Pennington, 2008), and over eight million collegiate students are engaged at the intramural level (Dugan et al., 2014). Student-athletes evidence a distinct culture (Carless & Douglas, 2013) and may experience mental health symptomology differently than their non-athlete counterparts (Castaldelli-Maia et al., 2019; Despres et al., 2008; Giannone et al., 2017). Collegiate athlete types in the U. S. (i.e., NCAA, Club, intramural) differ in their competitiveness, levels of commitment, and requirements for sport participation. Moreover, NCAA athletes participate in one of three divisions. Division III represents the largest number of schools (40%), while Division I include the most athletes (nearly 9000; NCAA, n.d.). To participate in NCAA sports, an athlete must comply with clearly specified academic standards (i.e., minimum GPA, course load requirements), ethical standards (i.e., honesty and sportsmanship), financial aid standards, and practice standards (i.e., maximum of 20 hours of training per week during a playing season

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and while school is in session; NCAA, 2009). Additionally, NCAA athletes are limited to four seasons of intercollegiate competition in any one sport (NCAA, 2020).

According to the National Intramural-Recreational Sports Association (NIRSA), club sports involve students that are voluntarily organized to promote their common interests in an activity through participation and competition (Lifschutz, 2012), and contrary to NCAA sports, club sports do not have a formally defined organizational structure. In the United States, club sports may be attractive to athletes pursuing nontraditional sports that are not offered at the NCAA level (e.g., cycling, martial arts, Beidler et al., 2018). Although some clubs remain solely recreational, most are highly competitive. Club sports do not have consistent regulations for participation regarding academic or practice requirements. However, to be eligible to compete, club sport athletes in most colleges and universities in the United States, must be undergraduates with a minimum of half full-time enrollment status. Additionally, some limitations regarding competing at both, NCAA and club levels exist (NIRSA, 2016). Outside the U.S., competitive athletes across the world participate in club sports and do not have amateur athletic leagues that pay college tuition, such as the NCAA, thus club sports outside the United States are often recognized as “elite” or intramural depending on location or setting (Swann et al., 2015).

In the United States, intramural sports originated as student-led and sponsored athletic competitions (Stewart, 1992). Intramural sports are bound to compete within the university setting, as opposed to interinstitutional (i.e., occurring between universities) NCAA competitions. NIRSA established guidelines for the intramural sports, including traditional formats, staffing, rules, and variations (NIRSA, n.d). However, intramural sports are not bound to follow the NIRSA intramural sport rules. It is, of course, important to emphasize the extent of competitiveness varies across and within athlete types.

There are extant studies that have compared mental health symptoms among athlete groups, including club, intramural, NCAA, and professional athletes (Barry et al., 2015; Donohue et al., 2004; Marzell et al., 2015; Wilson, 2016). When looking at various athlete types we know that some substance use differences exist. Two studies previously examined patterns of alcohol consumption among club, intramural, and NCAA level athletes (Barry et al., 2015; Marzell et al., 2015). In these studies, intramural athletes displayed higher risk drinking (i.e., higher frequency drinking and blood alcohol concentration) as compared with athletes from other sport participation levels. Additionally, NCAA athletes report less use of tobacco as compared with club and intramural athletes (Primack et al., 2010). Other differences in addiction patterns have been found. Martin et al. (2016) demonstrated that males who participated in club and intramural sports evidenced higher rates of gambling, as compared with NCAA male athletes.

Reinking and Alexander (2005) suggest athletes participating in lean sports (i.e., sports that place a competitive or aesthetic worth on leanness, such as cross-country, swimming, gymnastics, and dance) display higher rates of disordered eating as compared to non–lean-sport athletes. Additionally, athletes participating in weight-class sports (i.e., wrestling) may be particularly at risk for development of eating psychopathology (Bratland-Sanda & Sundgot-Borgen, 2013).

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Wilson (2016) found no differences between NCAA athletes and intramural athletes in depression and anxiety, and Donohue et al. (2004) found NCAA athletes and recreational athletes evidence similar severity of psychiatric symptoms. Donohue et al. (2019) found intramural athletes reporting significantly more problems in sport competition as compared to NCAA athletes, while there were no significant differences found between club and NCAA, and club and intramural athlete groups.

As evident by the lack of literature in this area, there is still much to learn about what differences may exist between NCAA, club, and intramural athletes. Some argue that these groups are inherently different from one another, while others consider all three groups to be a part of the unique athlete culture. In Europe, for example, there is no equivalent to the NCAA. As a result, researchers examine mixed samples of regional, national, and international level athletes (Araujo & Scharhag, 2016; Gomes et al., 2011; Nicolas et al., 2014). Araujo and Scharhag (2016) recommend researchers clearly describe their athlete samples to permit adequate comparisons across athlete types and non-athletes, thus, informing mental health practice.

Need to Psychometrically Examine the SCL90R in NCAA, Club and Intramural Athletes

The SCL-90-R (Derogatis et al., 1994) is a commonly used inventory of general psychiatric functioning, and a primary focus in the current study. Although psychometric properties of the SCL-90-R in collegiate athletes are unknown, Davis and Strachan (2001) compared Global Severity Index (GSI) scores between female athletes with non-athlete peers and Donohue et al. (2004) utilized SCL-90-R GSI scores to assess general psychiatric symptomatology in a sample of athletes and non-athletes, showing collegiate club and NCAA athletes demonstrated lower Global scores than the normative population. Previous studies examining the SCL-90-R in non-athlete samples have found mixed factorial structure. For instance, although scale developers originally proposed nine-factor model (Derogatis et al., 1994), others have determined single factor (Ardakani et al., 2016; Ronan et al., 2000; Smits et al., 2014), eight factor (Arrindell et al., 2006; Arrindell & Ettema, 2005), and bi-factor models to be optimal fits (Urbán et al., 2016) in non-athlete samples.

In their original examination of the SCL90R, the authors performed confirmatory variation of factor analysis in a sample of 1,002 psychiatric outpatients (an orthogonal Procrustes procedure as well as varimax rotation), binding items to theoretically postulated structure (Derogatis & Cleary, 1977). Out of 90 items, Derogatis et al. (1994) proposed nine subscales (i.e., Somatization, Obsessive Compulsive, Interpersonal Sensitivity, Depression, Anxiety, Hostility, Phobic Anxiety, Paranoid Ideation, and Psychoticism) and one global scale (Global Severity Index). The proposed nine factors accounted for 53% of the variance. Seven out of 90 items were not included under any of the primary symptom subscales and, in fact, loaded on several of the dimensions. However, Derogatis and Cleary (1977) justified their inclusion due to clinical relevance. Orthogonal Procrustes procedure results showed that all postulated items loaded significantly on Somatization, Depression, Anxiety, Hostility, Phobic Anxiety, Paranoid Ideation, and Psychoticism dimensions, while one item did not significantly load on Obsessive Compulsive and Interpersonal Sensitivity dimension each. Eight items loaded on additional, non-

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postulated factors, with moderate correlations between anxiety and phobic anxiety dimensions. It is important to note that there were significant differences between the results of an orthogonal Procrustes procedure and varimax rotation, with varimax results showing 14 items that failed to significantly load on the proposed dimension.

Ardakani et al. (2016) conducted Confirmatory Factor Analysis (CFA) on the Malaysian version of the SCL-90-R in 660 Malaysian normal male adults and patients with chronic disease. CFA failed to support the nine-factor structure of the SCL-90-R. Therefore, questioning the proposed multidimensional nature of the scale. The authors concluded that SCL-90-R is best utilized as a unidimensional measure of the overall psychological distress. Similar results were found in adult inpatient sample utilizing principal component analyses (Ronan et al., 2000) and Dutch psychiatric outpatient sample using a two-layer confirmatory hierarchical factor model (Smits et al., 2014). These studies suggest that much of the variance of the SCL-90-R is accounted by a strong general factor.

Arrindell and Ettema (2005) published the Dutch version of the SCL-90-R. Upon initial examination using a varimax rotation in a general population sample of 2,368 adults, factor analysis resulted in eight instead of the original nine dimensions. Those were defined as Anxiety, Agoraphobia, Somatic Symptoms, Depression, Inadequacy of Thinking and Acting, Obsessive-Compulsive, Distrust and Interpersonal Sensitivity, Hostility, and Sleeping Problems (Arrindell & Ettema, 2005). Another study utilizing multiple group method of confirmatory analysis found that 93% of all items loaded on theoretically proposed subscale, with eight factors explaining 46% of the total variance (Arrindell et al., 2006). The Dutch version of the SCL-90-R has since been utilized in a variety of samples, including female lumbopelvic pain patients (Arrindell et al., 2006), adults undergoing gender-affirming surgery (van de Grift et al., 2018), adult patients presenting to neurological outpatient clinic (Ruis et al., 2014), as well as adult patients with DSM-V anxiety disorders (Kunst et al., 2021).

Lastly, Urbán et al. (2016) found that a bi-factor model best fits the SCL-90-R multidimensional nature. The authors conducted CFA examining one-factor, nine-factor, second-order factor, and bi-factor models in two independent samples of 972 Hungarian inpatient adults and 1,902 Dutch inpatient and outpatient patients. In both samples, the bi-factor model with correlating nine specific factors resulted in best fit across chi-square, CFI, and RMSEA indices. Results confirming bi-factorial model of the SCL-90-R suggest that scores are influenced by at least two factors, general distress and a specific dimension factor.

Results of the studies suggest samples may demonstrate unique SCL-90-R factor structures, necessitating further investigation of this scale in unique populations, such as collegiate athletes. The primary aim of the current study was to determine an ideal factor structure for the SCL-90-R in collegiate athletes.

Method

Participants

The current study includes 311 collegiate student-athletes from a Division I southwestern university who were interested in participating in goal-oriented psychological programming within the context of controlled clinical trial aimed at improving sport performance and performance in life. As can be seen in Table 1, participants represent diverse ethnic backgrounds, half are women, and they were approximately 20 years old. Most are freshman (36%) and NCAA athletes (48%). Approximately half of the participants entered the study through a departmental research subject pool. To enhance external validity, participants were not required to evidence psychiatric diagnoses. Inclusionary criteria were (a) full or part-time enrollment in the university; (b) at least 18 years of age; and (c) formally participating in sports (i.e., NCAA, club, intramural).

Measure

The Symptom Checklist 90 – Revised (SCL-90-R; Derogatis, 1994) was used as a measure of a broad range of psychological problems and symptoms. The SCL-90-R is a 90-item self-report measure that assesses overall psychological distress over the past seven days. Participants are asked to rate the degree to which they have experienced each of the symptoms on the distress Likert scale from zero to four (0 = Not at all, 1 = A little bit, 2 = Moderately, 3 = Quite a bit, and 4 = Extremely) with higher scores indicating greater distress. The SCL-90-R can be interpreted at the symptom, dimension (i.e., across nine subscales), and/or global (i.e., Global Severity Index; GSI) levels. The SCL-90-R assesses symptoms across nine dimensions, including Somatization, Obsessive Compulsive, Interpersonal Sensitivity, Depression, Anxiety, Hostility, Phobic Anxiety, Paranoid Ideation, and Psychoticism. The SCL-90-R is frequently utilized as a global measure of psychological distress, which is computed by summing all items and dividing them by 90, creating GSI. The SCL-90-R demonstrated acceptable convergent-discriminant validity, internal consistency, and test-retest reliability in non-athlete samples (Derogatis et al., 1994). The SCL-90-R requires 12 to15 minutes to complete and its psychometric properties are good in non-athlete populations (see review of SCL-90-R above).

Procedures

Participants were recruited through the university research participation pool (n = 163; 52%), promotion of goal-oriented programming for student athletes via classroom presentation (n = 97; 31%), coaches and teammates (n = 38; 12%), and athletic department (n = 13; 4%). First, an initial intake was conducted. In this intake athletes were engaged in an interview designed to determine their interest in participating in goal-oriented programming. Athletes were screened for inclusionary criteria and completed an assessment battery after consent was determined. A large battery of psychological measures was administered during three times points (baseline, 4-months post-baseline, and 8-months post-baseline). In this study, only baseline SCL-90-R scores were utilized. The study was approved under exempt review by the university's Institutional Review Board.

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Statistical Plan and Approach

Data Screening

Descriptive statistics for demographic variables (i.e., age, gender, ethnicity, sport status, year in school, and referral type) were performed. Prior to addressing study aims, the data was inspected for univariate and multivariate outliers by examining high leverage points. Data was evaluated for normality and linearity, Mardia's multivariate kurtosis test and multivariate skewness test were performed (Mardia, 1970). Multicollinearity of the data was assessed through a correlational matrix. Correlation values above .85 were considered multicollinear, which tends to indicate problematic discriminant validity (Kline, 2015).

Primary Analyses

Confirmatory factor analysis (CFA) was performed on the SCL-90-R inventory. CFA was assessed to determine the best fitting factor structure of the SCL-90-R using Maximum Likelihood as an estimator. The purpose of CFA is to identify factors that account for the variation and covariation among a set of indicators (Brown, 2015). CFA requires a priori hypotheses about factor-indicator correspondence and the number of factors (Kline, 2015). CFA was chosen due to the validated factor structure of the SCL-90-R in other populations (Ardakani et al., 2016; Ronan et al., 2000; Smits et al., 2014). Additionally, CFA analysis is preferred for measurement models that have well-established underlying theory (Hurley et al., 1997).

To identify adequacy of model fit, goodness-of-fit evaluation, comparative fit index (CFI; Bentler, 1990), root mean square error of approximation (RMSEA; Steiger, 1980), and Akaike information criterion (AIC; Akaike, 1987) were performed. These indexes examine important aspects of the model fit. CFI values above .95 represent good fit (Hu & Bentler, 1999). RMSEA values at or below .05 are indicative of close fit, values at or below .08 indicate reasonable fit, and values at or above .10 represent unacceptable fit (Browne & Cudeck, 1992). AIC allows for direct comparison of competing models. Since AIC is not scaled between 0 and 1, relative model fit is determined by smaller value.

It is typically recommended that studies examining factor analysis collect a sample size of 300 or more (Tabachnick & Fidell, 2007). The current study meets this requirement. Finally, given potential preexisting differences between different sport levels (i.e., NCAA, club, and intramural) one-way analyses of variance (ANOVAs) were performed to compare response patterns on the SCL-90-R across these groups. Post-hoc analyses were performed to further examine significant differences.

Hypotheses

The current study extends previous work of the SCL-90-R psychometric properties by examining the factorial structure of the SCL-90-R in collegiate athletes. It was hypothesized that (a) the SCL-90-R factor structure in collegiate athletes will differ from that of the general population with athletes reporting less psychological problems and symptoms. Given the

inconsistent findings of the SCL-90-R factor structure in different populations, a single-factor loading was hypothesized to occur due to some previous studies finding unidimensional one-factor model being the best fit and GSI consistently being most supported in the literature. Other frequently reported factor structures were evaluated to determine the best fit in this population, including the original nine factor, eight-factor, and bi-factor models. Next, it was hypothesized that (b) NCAA, club, and intramural athletes will differ in their reports of mental health symptomatology as measured by the SCL-90-R. It is hypothesized that intramural and club athletes will report more psychological problems and symptoms on the SCL-90-R as compared to NCAA athletes, which is consistent with previous research (Donohue et al., 2004).

Results

Data Screening and Descriptive Analyses

Data screening revealed no significant outliers. Participant demographic information is presented in Table 1. Additionally, means and standard deviations of the SCL-90-R GSI *t*-scores for total sample and across athlete types can be found in Table 2.

Primary Analyses

Hypothesis 1:

It was hypothesized that the SCL-90-R factor structure in collegiate athletes will differ from that of the general population with athletes reporting less psychological problems and symptoms. We also proposed that the one-factor model will result in the best fit. Mean raw score responses of the SCL-90-R were gathered from literature across different sample populations to examine if athletes generally report less psychological problems. Table 3 shows the SCL-90-R mean raw scores for the current sample of athletes in comparison to other populations, i.e., original SCL-90-R manual data for the USA Nonpatients (Derogatis, 1994), USA Outpatients (Derogatis, 1994), Danish community adult sample (Olsen et al., 2004), and German normal healthy adults (see Schmitz et al., 2000). Overall, mean subscale values are higher in the collegiate athlete sample as compared to the other samples.

Table 4 presents a correlational matrix for the SCL-90-R original subscales. All the correlations were significant (*p*s < .01) and ranged between .26 and .80. CFA for one-factor, eight-factor, original nine-factor, and bi-factor models was performed. To measure overall model fit for CFA, multiple indices were used, including comparative fit index (CFI; Bentler, 1990), root mean square error of approximation (RMSEA; Steiger, 1980), and Akaike information criterion (AIC; Akaike, 1987). The results of these fit indices for each of the four models can be found in Table 5.

One-Factor Model. CFA results indicate that the one-factor model provided a poor fit for this sample of data. Although the overall chi-square was significant χ^2 (3915, N = 311) = 10043, p < .001, CFI did not meet the accepted value indicative of good fit (CFI = .54). As seen

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in Table 5, the one-factor model had the largest RMSEA and AIC values, suggesting poor fit (RMSEA = .07; AIC = 62918).

Eight-Factor Model. Based on the CFA results, the eight-factor model showed significant chi-square value χ^2 (3131, N = 311) = 7359, $p < .001$. CFI did not meet the accepted value indicative of good fit (CFI = .63). RMSEA criteria demonstrated reasonable fit (RMSEA = .07). While AIC demonstrated a second-largest value (AIC = 56721), suggesting that eight-factor model fit is worse than the original nine-factor and bi-factor models.

Original Nine-Factor Model. Results of the CFA on the originally proposed nine-factor model showed a significant chi-square value χ^2 (3284, N = 311) = 7598, $p < .001$. However, CFI value revealed inadequate fit (CFI = .64). RMSEA criteria demonstrated reasonable fit (RMSEA = .06). AIC comparison of competing models revealed the nine-factor relative model fit was larger than the bi-factor model (AIC = 56166).

Bi-Factor Model. Like other models, the bi-factor model chi-square test was significant χ^2 (3237, N = 311) = 7289, $p < .001$. As shown in Table 5, none of the examined models reached CFI value above .95, which is indicative of good fit. However, the bi-factor model demonstrated the largest CFI value (CFI = .66). RMSEA criteria value was indicative of reasonable fit (RMSEA = .06). The bi-factor model was also closest to approaching close fit (>.5). When comparing relative model fit based on the AIC, the bi-factor model demonstrated the smallest value (AIC = 55951). Based on the results of fit indices, the bi-factor model was determined to be the best fitting model.

Factor loadings for the bi-factor model are presented in Table 6. Apart from item 16, all other items significantly load on the general distress factor (i.e., global factor). The significant factor loadings of the general global factor ranged from .05 to .88. As shown in the table, most of the items had strong loadings on their respective specific factors, with twenty-four items that did not significantly load on the relevant construct (item numbers 3, 6, 8, 14, 15, 16, 21, 22, 23, 26, 31, 32, 33, 41, 65, 71, 72, 73, 77, 78, 80, 85, 86, 88). Variance explained (sum of squared loadings) can be found in the bottom portion of Table 6. These values are used to determine explained common variance (ECV) index. The ECV is defined as the "ratio of variance explained by the general factor divided by the variance explained by the general plus the group factors" (Reise, 2012). In this data, ECV of the global factor is 73%, reflecting that the SCL-90-R has a stronger general global factor relative to the specific construct factors. The ECV for specific factors is also reported at the bottom of Table 6. Specific factors' ECV values ranged from 6.4% to 1.3%, with psychoticism factor displaying least explained common variance.

Hypothesis 2:

Next, it was hypothesized that NCAA, club, and intramural athletes will differ in their reports of mental health symptomatology as measured by the SCL-90-R. It was proposed that intramural and club athletes will report more psychological problems and symptoms on the SCL-90-R as compared to NCAA athletes.

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Given little support for the presence of nine unique dimensions, only SCL-90-R GSI mean *t*-scores for the whole sample, as well as NCAA, club, and intramural groups are reported in Table 2. Results of analysis of variance (ANOVAs) yielded significant differences in response patterns across groups. Post-hoc analyses were performed to further examine those differences. Overall, results indicate significant group differences on Global Severity Index (NCAA: M = 53.95, SD = 10.33 vs. intramural: M = 59.78, SD = 8.71 and Club: M = 61.97, SD = 9.04), $F(2, 297) = 16.80$, $p < .001$, such that NCAA athletes endorsed significantly less symptoms than club and intramural athletes. Club and intramural athletes did not significantly differ in their SCL-90-R GSI *t*-scores.

Discussion

The purpose of this study was to examine the SCL-90-R factor structure in the NCAA, club, and intramural student athletes, as consistent with scientists who have indicated the need to psychometrically examine mental health measures in sport populations. In this study, we wanted to first explore whether the currently recommended nine-factor model of the SCL-90-R scale is appropriate for athletes. To our knowledge, this is the first study to investigate confirmatory factor analysis (CFA) of the SCL-90-R in collegiate athletes. Conducting this study advances what is known about collegiate athlete endorsement of global psychiatric symptomatology on the SCL-90-R, and provides mental health providers and researchers with a validated measure of the general psychiatric functioning.

Several of the SCL-90-R factor models were examined for fit, including the original and currently published nine-factor model, as well as other models found by researchers investigating the SCL-90-R (i.e., one global factor, eight-factor, and bi-factor models). In line with the most stable finding from previous research, we hypothesized that one global factor will result in the best fit (Ardakani et al., 2016; Ronan et al., 2000; Smits et al., 2014). Findings revealed the bi-factor model outperformed alternative models of the SCL-90-R across RMSEA and AIC criteria. However, none of the tested models reached reasonable (.90) or good (.95) fit based on CFI criteria (Hu & Bentler, 1999). This suggests that none of the tested models provided a good fit for the data. One possible explanation of these inconsistent findings could be examination of a non-clinical sample in the present study. Previous research supporting the bi-factorial structure of the SCL-90-R involved inpatient and outpatient samples (Urbán et al., 2016).

Several reasons may explain why the bi-factor model exhibited higher fit indices than other models. First, bi-factor modeling allows each item to load on a general global factor and only one specific construct factor, suggesting the SCL-90-R items demonstrate both, a single common factor (i.e., general psychological distress) and specific construct factors (i.e., depression, somatization, etc.) to some extent. Recently, the scientific community investigated multidimensional complexity of psychometric scales (Reise, 2012), suggesting that bi-factor modeling can resolve some of the important problems in conceptualizing and measuring psychological constructs that appear multidimensional in nature (Reise, 2012). This implies that the scores of some psychometric self-report scales, including the SCL-90-R, are influenced by at least two factors, general distress and a specific construct factor. In our data, the bi-factor model is likely to display a better fit to the general one factor model due to a relatively small degree of

multidimensionality. Specifically, the general factor explained roughly two thirds of the common variance, whereas specific construct factors accounted for roughly one third of the explained common variance.

Additionally, inconsistencies in the SCL-90-R factor structure may be reflective of differences in population samples. Indeed, collegiate athletes are a unique population which has been found to be qualitatively different from the general sample control group (Darcy et al., 2013; Sundgot-Borgen et al., 2004). As extensively reviewed in the literature review section, athletes may deny or minimize symptoms on the SCL-90-R due to a variety of reasons, including stigma and worries related to jeopardizing their athletic career, even though those symptoms may be interfering with their performance and life in general. Collegiate athletes may also differ from other populations in the kinds of symptoms they report. Thus, unique sample differences may have contributed to inadequate fit of the bi-factor model compared to previous findings by Urbán et al. (2016).

Results of the best-fitting model show that all but one item (#16, hearing voices) loaded on the general distress factor. Notably, item 16 did not load on either the general distress factor or the designated psychoticism construct factor. This could be due to low psychoticism construct validity, as four out of ten items in this subscale did not show significant factor loadings. The psychoticism subscale also accounted for the least amount of explained common variance (1.3%). Notably, nearly identical results were found by the scale developers, with only four of the ten items loading significantly on this factor (Cyr et al., 1985). The authors proposed an item alteration which has not been conducted to date. Other studies additionally raised questions regarding the uncertain validity of the SCL-90-R psychoticism symptom dimension. One exploratory factor analysis study yielded re-organized psychoticism and paranoid ideation dimensions into “schizotypal signs” and “schizophrenia nuclear symptoms” (Rössler et al., 2007), while Bakhshaie et al. (2011) reports the paranoid ideation and psychoticism subscales remain separated though some items were removed to improve construct validity. In another study, items from the original subscales of interpersonal sensitivity, paranoid ideation, and psychoticism were reformulated and combined to comprise a new Distrust and Interpersonal Sensitivity subscale (Ruis et al., 2014). In addition, authors concluded that psychoticism and paranoid ideation dimensions should be reformulated (Rief & Fichter, 1992). On one hand, these inconsistent findings raise concerns regarding the validity of the psychoticism symptom dimension and prompt the need for re-analysis. On the other hand, these discrepancies may also be reflective of the considerable sample differences across studies (i.e., age, socio-cultural background, and socioeconomic status).

Results of the CFA analyses also suggest that the anxiety subscale may be unstable. While some initial research supported anxiety subscale as a unique construct (Derogatis, 1994), the results of the present study show a high number of items that did not load on the designated factor. Six out of ten items in the anxiety subscale did not reach statistical significance and accounted for 2.15 percent of the explained common variance. These findings are consistent with Rief and Fichter (1992) who examined the ability of the SCL-90-R to identify and discriminate between anorexia nervosa, dysthymia, and anxiety disorders. In their study, as well as some earlier studies (e.g., Holcomb et al., 1983), the authors encountered difficulty reproducing

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anxiety factor, suggesting it be merged with phobic anxiety factor. Holcomb et al. (1983) also noted that some of the SCL-90-R items could be related to multiple constructs (i.e., anxiety and interpersonal sensitivity), and thus would not emerge as separate factors in their analyses. Therefore, researchers should be cautious when interpreting anxiety and psychoticism subscales in athletes as valid constructs of specific and unique dimensions.

The nine-factor model that was initially proposed by the scale developers (Derogatis, 1994) demonstrated second-to-best fit in our study, outperforming one-factor and eight-factor models. Other studies similarly failed to confirm the nine-factor structure, raising concerns about the SCL-90-R postulated dimensions. Many reached consensus that the SCL-90-R is a measure of general distress, rather than distinct dimensions of psychopathology (Cyr et al., 1985). Contradicting those studies, Rief and Fichter (1992) confirmed different profile shapes of the SCL-90-R in different diagnostic groups (i.e., dysthymia, anxiety, and anorexia nervosa). Overall, these inconsistencies may suggest an outdated conceptualization of mental health used in the SCL-90-R. Published in 1994, the scale is yet to be updated. Moreover, current gold standard self-report measures, such as The Achenbach System of Empirically Based Assessment (ASEBA) or the PROMIS, tend to reflect the DSM-V criteria to assist with diagnostic clarity (Rescorla & Achenbach, 2004; NIH).

Results of this study support the idea that the general distress global factor remains of clinical value as it has accounted for roughly two thirds of the explained common variance. Consequently, the subscale scores contributed to one third of the explained common variance. This may suggest that the SCL-90-R is best to be utilized as a unitary screening tool, a measure of severity of symptoms, or as a measure of change over time, rather than a diagnostic tool with distinct dimensions (Schmitz et al., 1999; Urbán et al., 2016). Indeed, the SCL-90-R may be useful at highlighting problem areas, such as elevated negative affect, which could signal to the provider to further evaluate those concerns for the purposes of a clear diagnosis (i.e., differential diagnosis of major depressive disorder vs. adjustment disorder with depressed mood).

Although the ANOVA results indicate significant differences between NCAA, club, and intramural athletes across the SCL-90-R GSI, it is unlikely that combining these subgroups affected results of the confirmatory factor analysis. It is reasonable to assume that there would be some variation between NCAA athletes and recreational sport athletes, as described in earlier sections of this paper. Separate examination of the NCAA, club, and intramural athlete subgroups may be an area of focus in future research.

In summary, we present the confirmatory factor analysis on the SCL-90-R in collegiate student athletes. To our knowledge, there have been no studies examining the SCL-90-R factorial structure in this unique population. In this study, the SCL-90-R demonstrated a small degree of multidimensionality explaining the better fit of the bi-factor model over the hypothesized one-general factor model. The difficulty reproducing at least two constructs, prompts a revision of the SCL-90-R, which has also been suggested by other researchers (Bakhshaie et al., 2011; Holcomb et al., 1983; Rief & Fichter, 1992; Rössler et al., 2007). Although the SCL-90-R remains to be clinically useful as it covers a wide range of psychological symptoms, is relatively easy to complete, and is a good tool for repeated measurement and

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symptom severity, future studies should examine revised symptom dimensions of this scale. An exploratory factor analysis, followed by a confirmatory factor analysis, post item reformulation is needed to determine if the bi-factor model is robust and if more variance is explained by the specific constructs (i.e., increased multidimensionality) after the revisions. Another implication of these results is that more research is needed on the factor patterns of symptoms with collegiate athletes, since the current bi-factor model differs from previously proposed factor structures in the general population.

Limitations

Although there is a plethora of literature around CFA and its use in measurement development and examination, it is important to note that the nature of CFA is of finding "good fit" which does not by definition equivalent to a "correct" or "true" model, but only a plausible model. This study examined a limited number of models, therefore other models that fit the data better or approximately the same level of goodness-of-fit may exist.

Overall, results of the CFA analyses provide some support for the multidimensional nature of the SCL-90-R. However, some items failed to load significantly on their proposed construct, with psychoticism factor explaining the least amount of common variance. Given past factor analysis findings of the SCL-90-R in non-athlete samples, this study only examined previously found factor structures (i.e., one factor, nine-factor, eight-factor, and bi-factor models). Future research may examine other factorial models in this population, as well as explore anxiety and psychoticism subscale validity. Furthermore, examination of NCAA, club, and intramural athlete subgroups may be an area of focus in the future research. Replication of the bi-factor model of the SCL-90-R in other athlete samples will be needed to provide further support for the validity of this structure. It is a limitation that there was no data on previous or current mental health treatment or conditions of participants in this study, and whether mental health conditions varied among the groups. Lastly, results of the current study suggest other mental health scales that have been explicitly developed in athlete samples, such as the Sport Interference Checklist (Donohue et al., 2020; Donohue et al., 2007), Athlete Psychological Strain Questionnaire (Rice et al., 2020), Sport Mental Health Continuum Short Form (Foster & Chow, 2019), and Mental Health Disorders Screening Instrument for Athletes (Donohue et al., 2023), may offer distinct advantages over the SCL-90-R, both psychometrically and clinically.

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Table 1

Participant Demographic Characteristics with Numbers Shown as Mean (SD; Range) or Frequency (%), (N = 311)

Demographics	Total (N = 311)		
	M	*SD*	*Range*
Age in Years	19.87	1.92	(18-33)
	λ	*%*	
Gender			
Female	156	50.2	
Male	155	49.8	
Ethnicity			
White/Caucasian	129	41.5	
Black/African American	54	17.4	
Other (multiple or not listed)	51	16.4	
Hispanic/Latino	39	12.5	
Asian/Asian American	26	8.4	
Pacific Islander	12	3.9	
Level of Sport Participation			
NCAA	150	48.2	
Intramural	125	40.2	
Club	36	11.6	
Year in School			
Freshman	112	36.0	
Sophomore	92	29.6	
Junior	66	21.2	
Senior	41	13.2	
Referral Type			
Class Credit/Subject Pool	163	52.4	
Presentation	97	31.2	
Coach/Teammate	38	12.2	
Athletic Department	13	4.2	

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Table 2

SCL-90-R Global Severity Index t-Scores across Sport Level in Athletes with Numbers Shown as Mean (SD), (N = 300)

SCL-90-R Subscale	All Athletes *n* = 300 mean *(SD)*	NCAA *n* = 147 mean *(SD)*	Intramural *n* = 121 mean *(SD)*	Club *n* = 32 mean *(SD)*	Statistic (One-way ANOVA)	*p*	Group differences
GSI, Global Severity Index	57.16 *(10.07)*	53.95 *(10.33)*	59.78 *(8.71)*	61.97 *(9.04)*	*F* = 16.80	.00	NCAA vs. Club NCAA vs. Intramural

Note. NCAA = National Collegiate Athletic Association; GSI = SCL-90-R Global Severity Index. Estimated *t*-scores are based on Derogatis, 1994 for individuals in the community who are not currently patients. *t*-scores for 11 participants were not available.

Table 3

SCL-90-R raw scores in Athletes Compared to Other Samples with Numbers Shown as Mean (SD), (N = 311)

SCL-90-R Subscale	Athletes *n* = 311 mean *(SD)*		Norms, USA Nonpatients[1] *n* = 974 mean *(SD)*		Norms, USA Outpatients[2] *n* = 1002 mean *(SD)*		Norms, Danish[3] *n* = 1153 mean *(SD)*		Norms, Germany[4] *n* = 1006 mean *(SD)*	
1. Somatization	.60	*(.46)*	.36	*(.42)*	.87	*(.75)*	.49	*(.53)*	.35	*(.30)*
2. Obsessive-compulsive	.94	*(.71)*	.39	*(.45)*	1.47	*(.91)*	.63	*(.61)*	.47	*(.38)*
3. Interpersonal Sensitivity	.64	*(.61)*	.29	*(.39)*	1.41	*(.89)*	.54	*(.56)*	.41	*(.38)*
4. Depression	.78	*(.68)*	.36	*(.44)*	1.79	*(.94)*	.59	*(.63)*	.40	*(.38)*
5. Anxiety	.41	*(.44)*	.30	*(.37)*	1.47	*(.88)*	.44	*(.51)*	.29	*(.32)*
6. Hostility	.51	*(.53)*	.30	*(.40)*	1.10	*(.93)*	.34	*(.41)*	.31	*(.34)*
7. Phobic anxiety	.19	*(.35)*	.13	*(.31)*	.74	*(.80)*	.13	*(.34)*	.14	*(.22)*
8. Paranoid ideation	.68	*(.65)*	.34	*(.44)*	1.16	*(.92)*	.46	*(.59)*	.35	*(.37)*
9. Psychoticism	.34	*(.47)*	.14	*(.25)*	.94	*(.70)*	.22	*(.32)*	.18	*(.24)*
GSI, Global Severity Index	.60	*(.45)*	.31	*(.31)*	1.26	*(.68)*	.45	*(.43)*	.33	*(.24)*

Note. [1]Derogatis, 1994 Raw Score Mean and Standard Deviations for adult individuals in the community who are not currently patients, mean age = 46.0; [2]Derogatis, 1994 Raw Score Mean and Standard Deviations for adult psychiatric outpatients, mean age = 31.2; [3]Olsen et al., 2004 Raw Score Mean and Standard Deviations for adult Danish citizens, age range = 20–79; [4]see Schmitz et al., 2000 Raw Score Mean and Standard Deviations for German normal healthy college students, mean age = 34.0.

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Table 4

SCL-90-R Construct Correlation Matrix (N = 311)

SCL-90-R Subscale	1	2	3	4	5	6	7	8	9
1. Somatization	-								
2. Obsessive-compulsive	.55**	-							
3. Interpersonal Sensitivity	.49**	.67**	-						
4. Depression	.51**	.73**	.80**	-					
5. Anxiety	.59**	.67**	.67**	.74**	-				
6. Hostility	.42**	.48**	.51**	.53**	.56**	-			
7. Phobic anxiety	.26**	.35**	.39**	.41**	.53**	.33**	-		
8. Paranoid ideation	.47**	.61**	.69**	.67**	.62**	.50**	.49**	-	
9. Psychoticism	.48**	.65**	.73**	.80**	.69**	.47**	.39**	.70**	-

Note. SCL-90-R = Symptom Checklist-90-Revised. N = 311. ** p < .01 (2-tailed).

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Table 5

Results of Fit Indices (N = 311)

Models	χ2 (df)	CFI	RMSEA [90% CI]	AIC
1	10043 (3915)	.54	.071 [.069, .073]	62918
8	7359 (3131)	.63	.066 [.064, .068]	56721
9	7598 (3284)	.64	.065 [.063, .067]	56166
B9*	7289 (3237)	.66	.063 [.062, .065]	55951

Note. χ2 = chi-square statistic. df = degrees of freedom. CFI = comparative fit index. RMSEA = root mean-square error of approximation. RMSEA [90% CI] = root mean-square error of approximation 90% confidence interval. AIC = Akaike's information criterion; B = bifactor with a general factor, and numbers represent the number of specific factors.

***** indicates the best fitting model

Table 6

Standardized Factor Loadings of the Bifactor Model of SCL-90-R in Athletes (N = 311)

Item number & Short descriptor	λ SOM	λ O-C	λ I-S	λ DEP	λ ANX	λ HOS	λ PHOB	λ PAR	λ PSY	λ General
1. Headaches	**.38**									**.21**
4. Faintness	**.35**									**.15**
12. Pains in heart/chest	**.30**									**.24**
27. Pains in lower back	**.30**									**.44**
40. Nausea	**.22**									**.34**
42. Soreness of muscles	**.36**									**.20**
48. Trouble getting breath	**.34**									**.28**
49. Hot/cold spells	**.21**									**.19**
52. Numbness	**.24**									**.18**
53. Lump in throat	**.21**									**.18**
56. Weakness of body	**.39**									**.44**
58. Heavy arms/legs	**.24**									**.28**
3. Unpleasant thoughts		-.02								**.77**
9. Trouble remembering		**.58**								**.47**
10. Worried about sloppiness		**.42**								**.51**
28. Feeling blocked		**.42**								**.71**
38. Doing things slowly		**.35**								**.46**
45. Having to double-check		**.43**								**.53**
46. Difficulty deciding		**.34**								**.68**
51. Mind going blank		**.48**								**.42**
55. Trouble concentrating		**.55**								**.63**
65. Repeating same actions		.09								**.27**
6. Feeling critical of others			.13							**.41**
21. Feeling shy opposite sex			.05							**.40**
34. Feeling easily hurt			**.20**							**.59**
36. Others are unsympathetic			**.21**							**.58**
37. People dislike you			**.60**							**.55**
41. Feeling inferior to others			.06							**.59**
61. Uneasy when people are watching			**.32**							**.66**
69. Self-conscious with others			**.29**							**.77**
73. Uncomfortable eating/drinking in public			.03							**.10**
5. Loss of sexual interest				**.10**						**.27**
14. Low energy/slow				-.14						**.64**
15. Thoughts of ending life				.04						**.19**
20. Crying easily				**.19**						**.48**

22. Feeling trapped	.03				**.52**
26. Blaming yourself	.08				**.85**
29. Feeling lonely	**.65**				**.88**
30. Feeling blue	**.41**				**.72**
31. Worrying too much	-.03				**.80**
32. No interest in things	-.10				**.71**
54. Hopeless about future	**.23**				**.73**
71. Everything is an effort	.03				**.59**
79. Feeling worthless	**.11**				**.76**
2. Nervousness		**.51**			**.43**
17. Trembling		**.10**			**.12**
23. Suddenly scared		.04			**.27**
33. Feeling fearful		-.02			**.45**
39. Heart pounding/racing		**.45**			**.39**
57. Feeling tense		**.25**			**.51**
72. Spells of terror/panic		.06			**.24**
78. Can't sit still/restless		.02			**.45**
80. Something bad is going to happen		-.07			**.59**
86. Frightening thoughts		-.07			**.21**
11. Easily annoyed			**.19**		**.58**
24. Temper outbursts			**.35**		**.37**
63. Urges to harm someone			**.34**		**.23**
67. Urges to break things			**.40**		**.32**
74. Arguing frequently			**.39**		**.20**
81. Shouting/throwing			**.33**		**.18**
13. Afraid on the street				**.44**	**.14**
25. Afraid to go out alone				**.31**	**.12**
47. Afraid of public transport				**.17**	**.05**
50. Having to avoid things/places/ activities				**.33**	**.26**
70. Uneasy in crowds				**.12**	**.33**
75. Nervous when alone				**.26**	**.27**
82. Afraid to faint in public				**.06**	**.06**
8. Others are to blame				.04	**.35**
18. Most people can't be trusted				**.33**	**.54**
43. Feeling watched				**.13**	**.60**
68. Having beliefs that others do not share				**.20**	**.41**
76. Not getting enough credit				**.22**	**.47**
83. People will take advantage				**.77**	**.60**

7. Someone can control your thoughts									**.33**	**.37**
16. Hearing voices									-.00	.01
35. Others knowing your private thoughts									**.11**	**.41**
62. Thoughts not your own									**.38**	**.28**
77. Feeling lonely with others									-.02	**.76**
84. Thoughts about sex that bother you									**.15**	**.24**
85. You should be punished									.08	**.25**
87. Something is wrong with your body									**.11**	**.44**
88. Never feeling close to another person									-.06	**.59**
90. Something is wrong with your mind									**.16**	**.71**
$(\sum\lambda^2)$	1.10	1.65	0.65	0.74	0.55	0.70	0.51	0.81	0.34	18.62
Explained common variance %	4.27	6.44	2.55	2.89	2.15	2.71	2.00	3.15	1.31	72.54

Note: SOM: Somatization; O-C: Obsessive-Compulsive; I-S: Interpersonal Sensitivity; DEP: Depression; ANX: Anxiety; HOS: Hostility; PHOB: Phobic Anxiety; PAR: Paranoid Ideation; PSY: Psychoticism. **Boldfaced** factor loadings are significant at least $p < .05$. λ is a factor loading.