**The Validity of the State-Trait Anxiety Inventory and the Brief Scale for Anxiety in an Inpatient Sample with Alcohol Use Disorder**

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**ABSTRACT**

**Aims**

The Brief Scale for Anxiety (BSA) and the State-Trait Anxiety Inventory Form Y-2 (STAI Y-2) are self-report scales used to gauge anxiety symptoms in clinical settings. Co-occuring anxiety is common in alcohol-use disorders, however no prior studies have assessed the validity of the BSA and STAI Y-2 in comparison to a clinical diagnostic tool of anxiety in alcohol treatment programs. This study aimed to examine the validity of the BSA and STAI Y-2 to predict a clinical diagnosis of an anxiety disorder (via the Structured Clinical Interview for DSM [SCID]) in patients seeking treatment for alcohol use disorder (AUD).

**Methods**

Inpatients receiving treatment for AUD in a clinical research setting were administered the BSA (n = 1,005) on day 2 and the STAI Y-2 (n = 483) between day 2 and 10 of the detoxification program. Clinical diagnoses of AUD and anxiety were made via the SCID on day 10. Empirical receiver operating characteristic (ROC) curves were generated using estimates of sensitivity, 1‐specificity, and positive and negative predictive values for each cut‐point to determine the accuracy of scale outcomes in relation to SCID diagnoses.

**Results**

In the BSA-completing sample, 358 (35.6%) patients had an anxiety disorder. In the STAI Y-2-completing sample, 199 (41.2%) patients had an anxiety disorder. The BSA demonstrated low accuracy relative to a clinical diagnosis of anxiety with an area under the curve (AUC) of 0.67 at the optimal cut point of ≥ 10. The STAI Y-2 demonstrated moderate accuracy relative to a clinical diagnosis of anxiety with an AUC of 0.70 at the optimal cut point of ≥51. The accuracy of the STAI Y-2 in distinguishing anxiety disorders increased (AUC = 0.74) when excluding post-traumatic stress disorder and obsessive-compulsive disorder from anxiety disorder classification.

**Conclusions**

Use of the BSA and/or STAI Y-2 is not a reliable substitute for clinical diagnoses among inpatients with AUD. The BSA and STAI Y-2 could serve as a screening tool to rule out the presence of anxiety disorders rather than for detecting an anxiety disorder. Given the prevalence of anxiety symptoms in AUD, further research is needed to validate the tools used to measure it.

**Keywords**: alcohol use disorder, inpatient treatment, anxiety disorder, State-Trait Anxiety Inventory, Brief Scale for Anxiety

**1. INTRODUCTION**

The largest (N > 43,000) comorbidity study to date, the National Epidemiological Survey on Alcohol and Related Conditions (NESARC), reported that in individuals with anxiety disorders that sought treatment, there was a prevalence rate of 12.1% for a comorbid alcohol use disorder (AUD): furthermore, 33.4% of individuals who sought treatment for AUD also met criteria for an anxiety disorder ([1](#_ENREF_1)). A more recent NESARC study found an association between AUD and anxiety disorders across most levels of AUD severity ([2](#_ENREF_2)). Furthermore, research in clinical settings has also shown that up to 55% of individuals receiving treatment for unhealthy alcohol use have also met diagnostic criteria for an anxiety disorder ([3](#_ENREF_3)). A meta-analysis featuring 22 publications of alcohol comorbidity data, across various countries, reported an odds-ratio (OR) of 2.11 between AUD and any anxiety disorder ([4](#_ENREF_4), [5](#_ENREF_5)). From a treatment perspective, effective care relies on accurate diagnoses to ensure appropriate care for both anxiety and AUD. Individuals displaying AUD with comorbid anxiety often do not respond to treatments for AUD ([6](#_ENREF_6), [7](#_ENREF_7)). In a study examining 82 individuals seeking treatment for AUD, more than twice as many individuals with comorbidity relapsed within 4 months following treatment discharge compared to individuals with no anxiety disorder (52% vs. 21%; ([3](#_ENREF_3))). Previous clinical trials have found, in patients presenting with an AUD and anxiety comorbidity, that treating anxiety solely ([8](#_ENREF_8)) or supplementing anxiety treatment with AUD treatment ([9](#_ENREF_9)) results in similar outcomes: a reduction of anxiety-related symptoms but no change in alcohol use severity.

The Structural Clinical Interview for DSM (SCID) is considered the ‘gold standard’ examination for diagnosing anxiety and other disorders based on the Diagnostic and Statistical Manual of Mental Disorders ([10-12](#_ENREF_10)). However, the instrument is timely to administer and requires a large breadth of training and skill sets [insert references], which are uniform amongst all SCID diagnostic interviewers. Therefore, brief, self-report questionnaires for detecting symptoms of anxiety are often used, especially in research settings ([13](#_ENREF_13)). These brief questionnaires are convenient and comparable over repeated measures, though their accuracy may vary.

The State-Trait Anxiety Inventory (STAI) is one of the most widely used subjective measures of general anxiety in research and clinical settings ([13](#_ENREF_13)). Of this, the STAI Y-2 subscale (“Trait” scale) contains twenty items that measure the more stable characteristic of anxiety-proneness as a personality trait ([14](#_ENREF_14)). Early studies of the STAI Y-2 scale in an inpatient alcohol dependent population have shown construct validity and a reduction in post-treatment trait-anxiety scores [insert references]. Moreover, the STAI has been found to have excellent psychometric properties across various demographics ([15](#_ENREF_15)), as shown in multiple patient populations, e.g. patients with multiple sclerosis ([16](#_ENREF_16)) and elderly psychiatric outpatients ([17](#_ENREF_17)). In the work done with elderly psychiatric outpatients, the STAI Y-2 demonstrated high internal reliability and discriminant validity in separating patients with and without a current anxiety disorder. This concords with a similar study in treatment-seeking elders with generalized anxiety disorder or panic disorder [insert reference from Melanie]. From a large population-based study of elderly people, higher scores on the STAI Y-2 were found to be associated with being female, higher depressive symptoms, the use of psychotropic medication, and higher cognitive complaints ([18](#_ENREF_18)). The STAI Y-2 has also shown high sensitivity to caregiver distress over time and to changes in support systems and health status ([19](#_ENREF_19), [20](#_ENREF_20)). However, the STAI Y-2 is limited in distinguishing anxiety from depression in certain populations, including one study where the STAI Y-2 did not differentiate patients with depression from anxiety disorders in a study sample involving individuals with including cases of rheumatoid arthritis, demonstrating potentially weak construct validity ([21](#_ENREF_21)). It is unclear how well the STAI Y-2 would perform among those receiving AUD treatment, due to the symptom overlap between anxiety and alcohol withdrawal.

The Brief Scale for Anxiety (BSA) is well established as a diagnostic self-assessment for anxiety. The BSA, being designed as a state measure, assesses current symptoms of somatic and/or psychological anxiety [move reference #25 here]. One of two subscales of the Comprehensive Psychopathological Rating Scale (CPRS), the BSA comprises 10 items each rated on a seven-point scale ([22](#_ENREF_22)). The BSA has shown a high reliability and validity in various healthcare workers (e.g. physicians, social workers) ([23](#_ENREF_23)) and psychiatric inpatients ([24](#_ENREF_24)), and is suitable for the assessment of pathological anxiety alone or anxiety in the presence of a comorbid somatic or mental disorder. Thus, this scale could prove to be advantageous in accurately identifying co-occuring anxiety in an AUD patient population. Moreover, given that the BSA measures state anxiety and the STAI Y-2 measures trait anxiety, there may be differences between the scales. In a highly susceptible alcohol-abstinent population, scales such as the STAI Y-2 which measure more persistent anxiety may potentially present a larger predictive validity when compared to a clinical SCID diagnosis.

In clinical practice, the STAI Y-2 and BSA are commonly used in the early detection of anxiety in AUD patients, however, to the authors’ knowledge, minimal literature has previously assessed the predictive validity of these specific subscales as a diagnostic tool. The need for the aforementioned study is preeminent in this patient population due to the impact an anxiety-AUD comorbidity has on treatment efficacy [insert references #6, #7]. For example, Anker and colleagues found cognitive behavioral therapy (targeted to reduce alcohol consumption and anxiety symptoms) to be more efficacious than a progressive muscle relaxation training program (targeted to reduce anxiety symptoms solely) in individuals with comorbid AUD and anxiety who reported pre-treatment drinking to cope behavior. Conversely, individuals who reported less drinking to cope behavior responded similarly to both treatments [insert reference]. Thus, the aim of this study was to assess the validity of the STAI Y-2 and BSA, among an inpatient sample seeking treatment for AUD in a clinical research setting, by evaluating the sensitivity, specificity, and positive and negative predictive power of each scale at different cut-points compared to a SCID diagnosis of an anxiety disorder. In addition, this study aimed to explore whether the validity of the STAI Y-2 and BSA differed by the type of SCID diagnosis of anxiety. The most updated DSM-5 has made several changes from the DSM-IV, including the removal of post-traumatic stress disorder (PTSD) and obsessive-compulsive disorder (OCD) from anxiety disorder classification [insert reference]; it may be expected that both scales would show a larger convergence in a more homogenous grouping.

**2. METHODS**

***2.1 Participants and Procedures***

Data were extracted from a larger database maintained by the National Institute on Alcohol Abuse and Alcoholism (NIAAA). Participants in this study included individuals seeking treatment for AUD, who were admitted to an inpatient unit at the National Institutes of Health (NIH) Clinical Center in Bethesda, Maryland for detoxification and evaluation for participation in clinical research protocols. Participants whose data were analyzed for the purpose of this study (n = 1010) were recruited from December 2006 to December 2019 through physician referrals, word of mouth, community outreach, NIH online resources, newspaper advertisements. Individuals were medically evaluated under NIAAA Screening and Natural History Protocols, to which all participants provided written informed consent. On average, participants stayed in the inpatient unit for approximately one month. The BSA was administered on the second day of inpatient stay, while the STAI Y-2 was administered several days after and the SCID interview was administered on approximately day 10 of the inpatient stay.

For this analysis, inclusion criteria included a current diagnosis of alcohol dependence (AD) according to DSM-IV-TR, or moderate to severe AUD according to DSM-5-RV ([10](#_ENREF_10)), as well as available baseline BSA and/or STAI Y-2 data. A total of 1010 participants met the inclusion criteria for this study. Of these, 1005 participants had a baseline BSA measure, and 483 participants had a baseline STAI Y-2 measure, as reflected in Table 2. The sample size was smaller for the STAI Y-2 analyses as this assessment was not administered to all participants in the earlier phase of NIAAA screening protocols. Five participants were missing baseline BSA data due to noncompliance to the study procedures; however, these 5 participants did have the STAI-Y2 measure and thus are included in the total sample size of 1010.

***2.2 Measures***

**Clinical DSM Psychiatric Diagnosis**

The SCID-IV-TR ([11](#_ENREF_11)) or SCID-5-RV ([12](#_ENREF_12)) were administered by trained research professionals for diagnosing AD (SCID-IV) or AUD (SCID-5) and anxiety disorders. AD diagnoses via the SCID-IV were made by endorsement of at least 3 of 7 symptoms. AUD diagnoses via the SCID-5 were classified as mild (2-3), moderate (4-5), or severe (>5 symptoms). Comorbid substance use disorders were also diagnosed and were not an exclusion criterion. Anxiety disorders via the SCID-IV included the following: generalized anxiety disorder, panic disorder, specific phobia, agoraphobia, social phobia, post-traumatic stress disorder, obsessive-compulsive disorder, and anxiety disorders not otherwise specified. Anxiety disorders via the SCID-5 included the following: generalized anxiety disorder, panic disorder, specific phobia, agoraphobia, social anxiety disorder, and anxiety disorders not otherwise specified. Post-traumatic stress disorders and obsessive-compulsive disorders, now categorized within their own respective modules in the SCID-5 (Module G: Obsessive-Compulsive and Related Disorders; Module L: Trauma- and Stressor-Related Disorders), were recorded as such. While the time frame for current disorders, identified by the SCID-IV, included symptoms present during a two-week period within the past month, the SCID-5 time frame for current disorders varies across disorders and is determined by the duration and symptom clustering requirements stipulated in the DSM-5.

**Anxiety Symptoms**

The STAI Y-2, a 20-item scale (scoring range: 20 to 80), was used to assess for persistent anxiety as an underlying trait, which is less responsive to change over time than Form Y-1 (“State” scale). Subjects rate each statement on a four-point Likert scale, in which higher scores indicate a greater level of anxiety traits. Previous work has shown good internal consistency coefficients for this scale, ranging from .86 to .95, and acceptable test-retest reliability coefficients ranging from .65 to .75 over a time interval of two months ([14](#_ENREF_14)). On average, this scale was administered between day 2 and day 10 of the inpatient stay.

The BSA subscale, a 10-item scale (scoring range: 0 to 70), was used to assess scores for current feelings of somatic and/or psychological anxiety ([25](#_ENREF_25)). This scale was administered on day 2, day 9, day 16, day 23, and day 30 of the inpatient stay.

**Demographic Characteristics**

Gender, age, years of education, and race were collected for all participants at the time of screening.

***2.3 Additional Assessments/Measures***

**Alcohol Drinking**

A 90-day (ranging back from the day of assessment) Timeline Follow-back (TLFB) questionnaire was used to determine the level of alcohol consumption before admission ([26](#_ENREF_26)). This questionnaire estimates the amount of alcohol consumption expressed as number of Standard Drinking Units (about 14 grams of pure alcohol), regardless of the type of alcohol beverages consumed (see: <https://www.niaaa.nih.gov/what-standard-drink>). Several measures that can be estimated from the TLFB include total number of standard drinks, number of drinking days, number of heavy drinking days, and average number of drinks per day over the last 90 days.

**Alcohol Dependence Severity**

The Alcohol Dependence Scale (ADS) was used to assess the severity of AUD in the past 12 month period It is a 25-item self-reported scale with higher scores indicating greater dependence severity (scoring range: 0 to 47) ([27](#_ENREF_27)).

**Severity of Alcohol Withdrawal**

The Clinical Institute Withdrawal Assessment of Alcohol Scale, revised (CIWA-Ar) was used every 2 to 4 hours for the first week of admission (or more, depending on clinical judgment; ([28](#_ENREF_28))). It is a 10-item scale aimed at scoring the severity of alcohol withdrawal and its suitable medical treatment. The highest CIWA-Ar measurement taken across the first 7 days of admission was used to calculate the maximum CIWA-Ar score. If benzodiazepines were administered, dosage was recorded by clinicians.

***2.4 Analyses***

All statistical analyses were conducted with SAS® software version 9.2 (SAS Institute Inc., Cary, NC). Baseline characteristics were organized by those with or without a diagnosis of any DSM-IV or DSM-5 anxiety disorder. In order to determine the accuracy of the STAI Y-2 and BSA in predicting a SCID diagnosis of an anxiety disorder at time of admission, logistic regression analyses were performed and empirical receiver operating characteristic (ROC) curves were constructed using estimates of sensitivity and 1‐specificity for each cut‐point. Each analysis-specific cut-point value was assigned by designation of the most favorable trade-off between sensitivity and specificity. Represented by Table 1, sensitivity can be defined as the true positive rate (TP/N1) and specificity can be definied as the true negative rate (TN/N2). Positive predictive values (PPVs; TP/(TP+FP)) and negative predictive values (NPVs; TN/(TN+FN)) were also estimated. The area under the ROC curve (AUC) was then estimated and categorized as either having low accuracy (>0.5 and <0.7), moderate accuracy (≥0.7 and <0.9), or high accuracy (≥0.9) ([29](#_ENREF_29), [30](#_ENREF_30)). To define the point on the ROC curve which is closest to a perfect predictor (i.e. sensitivity of 100% and false-positive rate of zero), the minimum Euclidean distance was used. Accordingly, the sample with a SCID diagnosis of an anxiety disorder was organized to reflect the anxiety-related module changes from the SCID-IV-TR to the SCID-5-RV. ROC curve analyses were carried out in the following cases of (i) all anxiety disorders via SCID-4-TR criteria (global analysis); (ii) anxiety disorders minus PTSD and OCD (i.e. SCID-5-RV criteria of an anxiety disorder); and (iii) PTSD alone. ROC curves were generated to compare the accuracy of the BSA over different administrations throughout the inpatient stay (days 2, 9, 16, 23, and 30), and to compare the accuracy of each scale in predicting comorbid (>1) anxiety disorders versus a single disorder. The alpha level for determining statistical significance was set at 0.05.

[Table 1]

**3. RESULTS**

**Sample**

Table 2 shows the characteristics of subjects divided into two samples according to baseline BSA and/or STAI Y-2 scores.

[Table 2]

Table 3 provides a breakdown of the number of anxiety disorder diagnoses by disorder type in the sample.

[Table 3]

**BSA Accuracy in Detecting Anxiety Disorders**

A total of 358 (35.6%) participants presented with a current DSM-IV-TR or DSM-5-RV diagnosis of an anxiety disorder (including PTSD and OCD), via the SCID. Values of sensitivity, specificity, PPV, and NPV for BSA scores ranging from 4 to 22 are shown in Table 4. Overall, the BSA showed low overall accuracy for discriminating between participants with or without a current clinical diagnosis of an anxiety disorder. From the ROC curve, the AUC was 0.67, which was statistically significant, χ2 (df = 1, n = 1005) = 77.66, p < 0.0001 (Figure 1a). The optimal threshold for balancing sensitivity and specificity identified by the minimum Euclidean distance was ≥10. At this cut-point, the BSA correctly identified 66% of any anxiety diagnosis cases (sensitivity) and 57% of non-cases (specificity). Only 46% of cases of any anxiety diagnosis identified by the BSA (PPV) were classified as such by the SCID diagnosis, while 76% of patients who were identified by the BSA as non-cases of any anxiety diagnosis (NPV) were classified as such according to the SCID.

[Figure 1]

**BSA Accuracy in Detecting Anxiety Disorders, Excluding PTSD and OCD**

A total of 244 (24.3%) participants presented with a current DSM-IV-TR or DSM-5-RV diagnosis of an anxiety disorder, excluding PTSD and OCD, via the SCID. Values of sensitivity, specificity, PPV, and NPV for BSA scores ranging from 4 to 22 can be found in Table 4. The BSA showed low overall accuracy for discriminating between participants with and without a current clinical diagnosis of an anxiety disorder even after excluding PTSD and OCD. The AUC was 0.65, which was statistically significant, χ2 (df = 1, n = 1005) = 51.81, p < 0.0001 (Figure 1b). The optimal threshold for balancing sensitivity and specificity identified by the minimum Euclidean distance was ≥12. At this cut-point, the BSA correctly identified 55% of any anxiety diagnosis (excluding PTSD and OCD) cases (sensitivity) and 66% of non-cases (specificity). Only 34% of cases of any anxiety diagnosis (excluding PTSD and OCD) by the BSA (PPV) were classified as such by the SCID diagnosis, while 82% of patients who were identified by the BSA as non-cases of any anxiety diagnosis (excluding PTSD and OCD) (NPV) were classified as such according to the SCID.

[Table 4]

**STAI Y-2 Accuracy in Detecting Anxiety Disorders**

In the subsample of participants with a baseline STAI Y-2, a total of 199 (41.2%) participants presented with a current DSM-IV-TR or DSM-5-RV diagnosis of an anxiety disorder (including PTSD and OCD), via the SCID. Values of sensitivity, specificity, PPV, and NPV for STAI Y-2 scores ranging from 40 to 70 are shown in Table 5. Overall, the STAI Y-2 showed moderate overall accuracy for discriminating between participants with and without a current diagnosis of an anxiety disorder. The AUC was 0.70, which was statistically significant, χ2 (df = 1, n = 1005) = 48.14, p < 0.0001 (Figure 1d). The optimal threshold for balancing sensitivity and specificity identified by the minimum Euclidean distance was ≥51. At this cut-point, the STAI Y-2 correctly identified 64% of any anxiety diagnosis cases (sensitivity) and 66% of non-cases (specificity). Only 57% of cases of any anxiety diagnosis by the STAI Y-2 (PPV) were classified as such by the SCID diagnosis at day 10, while 73% of patients who were identified by the STAI Y-2 as non-cases of any anxiety diagnosis (NPV) were classified as such according to the SCID.

**STAI Y-2 Accuracy in Detecting Anxiety Disorders, Excluding PTSD and OCD**

In the subsample of participants with a baseline STAI Y-2, a total of 122 (25.3%) participants presented with a current DSM-IV-TR or DSM-5-RV diagnosis of an anxiety disorder, excluding PTSD and OCD, via the SCID. Values of sensitivity, specificity, PPV, and NPV for STAI Y-2 scores ranging from 40 to 70 can be found in Table 5. The STAI Y-2 showed moderate overall accuracy for discriminating between participants with and without a current diagnosis of an anxiety disorder when excluding PTSD and OCD. The AUC was 0.74, which was statistically significant, χ2 (df = 1, n = 1005) = 55.26, p < 0.0001 (Figure 1c). The optimal threshold for balancing sensitivity and specificity identified by the minimum Euclidean distance was ≥51. At this cut-point, the STAI Y-2 correctly identified 74% of any anxiety diagnosis (excluding PTSD and OCD) cases (sensitivity) and 63% of non-cases (specificity). Only 40% of cases of any anxiety diagnosis (excluding PTSD and OCD) by the STAI Y-2 (PPV) were classified as such by the SCID diagnosis, while 88% of patients who were identified by the STAI Y-2 as non-cases of any anxiety diagnosis (excluding PTSD and OCD) (NPV) were classified as such according to the SCID.

[Table 5]

**BSA Accuracy Trends Throughout the Duration of the Inpatient Stay**

In the subsamples of participants with available BSA data at subsequent administrations, 352 (n = 989; 35.6%; Day 9), 349 (n = 961; 36.3%; Day 16), 222 (n = 898; 24.7%; Day 23), 248 (n = 606; 40.9%; Day 30) participants presented with a current DSM-IV-TR or DSM-5-RV diagnosis of an anxiety disorder via the SCID. Values of sensitivity, specificity, PPV, and NPV for BSA scores ranging from 1 to 23 can be found in Table S1. Overall, the BSA showed a decreasing trend of accuracy in distinguishing between participants with and without a current diagnosis of an anxiety disorder. The successive AUCs were: 0.67, χ2 (df = 1) = 77.66, p < 0.0001 (Figure 1a; Day 2), 0.67, χ2 (df = 1) = 64.96, p < 0.0001 (Figure S1; Day 9), 0.67, χ2 (df = 1) = 71.24, p < 0.0001 (Figure S2; Day 16), 0.64, χ2 (df = 1) = 53.97, p < 0.0001 (Figure S3; Day 23), 0.62, χ2 (df = 1) = 27.84, p < 0.0001 (Figure S4; Day 30).

**BSA and STAI Y-2 Accuracy in Detecting Comorbid (>1) Anxiety Disorders Versus a Single Anxiety Disorder**

In the subsample with available BSA data at baseline and the presence of one or more anxiety disorders via the SCID, 123 (n = 358; 34.4%) participants presented with comorbid anxiety disorders with the inclusion of PTSD and OCD, and 64 (n = 244; 26.2%) participants presented with comorbid anxiety disorders after excluding PTSD and OCD. In the subsample with available STAI Y-2 data and the presence of one or more anxiety disorders via the SCID, 73 (n = 199; 36.7%) participants presented with comorbid anxiety disorders with the inclusion of PTSD and OCD, and 34 (n = 122; 27.9%) participants presented with comorbid anxiety disorders after excluding PTSD and OCD. The values of sensitivity, specificity, PPV, and NPV for BSA scores ranging from 8 to 30 can be found in Table S2 and for STAI Y-2 scores ranging from 40 to 70 can be found in Tables S3. The BSA showed low overall accuracy for discriminating between participants with and without comorbid (>1) anxiety disorders, when including (AUC = 0.65, χ2 (df = 1) = 3.39, p = 0.06; Figure S5) and excluding (AUC = 0.65, χ2 (df = 1) = 2.25, p = 0.13; Figure S6) PTSD and OCD diagnoses. The STAI Y-2 also showed low overall accuracy for discriminating between participants with and without comorbid anxiety disorders. However, accuracy decreased when excluding PTSD and OCD diagnoses from an AUC of 0.65 (χ2 (df = 1) = 12.47, p = 0.0004; Figure S7) to an AUC of 0.58 (χ2 (df = 1) = 1.70, p = 0.19; Figure S8).

**4. DISCUSSION**

To our knowledge, this is the first study intended to examine the validity of the BSA and STAI Y-2 *vis-à-vis* the gold standard SCID-based DSM diagnosis, in a sample of inpatients with AUD undergoing detoxification and treatment. Using ROC analysis standards with respect to AUC, the findings show the BSA does not have strong predictor capabilities for balancing sensitivity and specificity of a SCID-diagnosed anxiety disorders in such a population with the optimal cut points for balancing sensitivity and specificity ≥10. The ROC curve analyses exhibited low AUCs at optimal cut-points which displayed a high rate of false positives. By contrast, the STAI Y-2 showed increased, although moderate, accuracy in detecting anxiety disorders in relation to a SCID-based anxiety disorder diagnosis with the optimal cut points for balancing sensitivity and specificity ≥51. The ROC curve analyses exhibited moderate AUCs at the optimal cut-points. For the cases of both scales, at the optimal cut-points of each ROC analysis, there was an overall tendency of higher NPVs (0.73-0.88) relative to lower PPVs (0.34-0.57). This finding suggests that the use of both anxiety rating scales in this patient population presents a small false negative rate relative to a higher false positive rate.

Our findings indicate two possible directions: i) use of the BSA and/or STAI Y-2 in place of the SCID assessment may not be enough to detect anxiety disorders but can be a useful supplement to the SCID diagnosis; and ii) the BSA and STAI Y-2 may be useful as a screening tool to rule out the presence of anxiety disorders rather than detecting an anxiety disorder diagnosis. For example, lower cut-points of both scales (i.e. BSA ≥4, STAI Y-2 ≥40) could be used as a screening assessment prior to the SCID which would increase the number of false negatives, but while still reducing the amount of anxiety diagnostic assessments required. Alternatively, in settings with fewer administrative resources, a higher cut-point could be used to increase the number of true positives. In addition, the numeric reporting of both scales provide information regarding the severity of anxiety, whereas a clinical SCID assessment provides a binary present/absent diagnosis. This can be beneficial in both clinical or research settings in which there is value in categorizing patients by the severity of anxiety.

Another finding included that the STAI Y-2 showed greater overall accuracy when excluding SCID-based diagnoses of PTSD and OCD from the group of anxiety disorders. When comparing at the optimal cut-point of ≥51 for both ROC analyses (Table 5), sensitivity (true positive rate) and NPV increased while specificity (true negative rate) and PPV decreased. The change in predictive values when using the SCID-5-RV classification of an anxiety disorder highlights that the false negative rate decreased at the expense of an increase in the false positive rate. However, it is important to note that the AUC determined from the ROC curve increased from 0.70 to 0.74, respectively (Figure 1d, Figure 1c). Development of the DSM-5 was guided by descriptions of important differences in symptoms between PTSD, OCD, and more typical anxiety disorders (e.g. GAD, PD, and phobias): for example, patients with PTSD display a range of symptoms including numbing and avoidance, re-experiencing symptoms, guilt, and dissociative responses ([31](#_ENREF_31), [32](#_ENREF_32)), and patients with OCD have more ruminations and compulsions than worrying and somatic anxiety ([33](#_ENREF_33)). It makes intuitive sense that the removal of these diagnoses from anxiety disorder categorization would result in a more homogenous sample. Our findings support the decision of the American Psychiatric Association to define and classify PTSD and OCD as separate mental health disorder modules from anxiety disorders in the DSM 5. Conversely, ROC curves assessing BSA validity did not present differences in overall accuracy when accounting for the two SCID-based anxiety disorder classifications.

When considering the observed differences in accuracy between the BSA and STAI Y-2 in our findings, it is worth noting that there are several differences between the two anxiety rating scales. The BSA assesses current feelings of somatic and/or psychological anxiety ([25](#_ENREF_25)). The STAI Y-2, on the other hand is constructed as a trait measure, is meant to detect more stable, psychological anxiety traits, which are less susceptible to change over time ([14](#_ENREF_14)). Psychological anxiety may be more accurately self-reported than somatic anxiety among this specific population, even though AUD is well-documented as not only a mental health disorder but also a common precursor for numerous somatic symptoms and diseases ([34](#_ENREF_34)). Furthermore, early after admission into an alcohol detoxification program, patients are often in a heightened emotional state. Therefore, the BSA may be less accurate due to a general confound of alcohol-induced symptoms at the time of administration, whereas the STAI Y-2 can better gauge symptomatology related anxiety disorders due to its emphasis on anxiety as a persistent trait measure. To test this effect, supplementary ROC analyses on repeated BSA measures administered throughout the inpatient stay were conducted to see if there was an expected increase in overall accuracy. This was the expected effect because symptoms of anxiety resulting from alcohol withdrawal tend to alleviate over time, thus resulting in a more homogenous sample. Suprisingly, findings showed a slight trend decrease in overall accuracy with respect to AUC (AUC = 0.67 at day 2 and AUC = 0.62 at day 30) (Figure 1a, Figure S4). Results of ROC analyses gauging the accuracy of both scales in predicting comorbid (>1) anxiety disorders versus single anxiety disorders demonstrated weak discriminative properties, when including and excluding for PTSD and OCD diagnoses (Figures S5 – S8).

The findings of this study should be assessed in terms of their strengths and limitations. The target population was inpatients seeking treatment for AUD. This study has one of the largest sample sizes used to assess the validity of BSA (N = 1005) and STAI Y-2 (N = 483) scales. In an inpatient setting, subjects were able to be closely monitored with respect to alcohol abstinence and associated withdrawal symptoms. Limitations of the study include the difference in length of time among the various assessments used to assess anxiety symptoms: 1 week for the BSA, overall length of life for the STAI Y-2, and from 1 month to 6 months for the SCID (depending on assessed disorder). Another associated limitation is the time lapse between administration of the BSA, STAI Y-2, and the SCID. The BSA was administered on day 2 of admission, whereas the STAI Y-2 was administered several days afterwards and the SCID was administered at approximately 10 days after admission. It is understood that the time difference, albeit small and unlike to make a large difference, still could lead to inconsistency between the two anxiety measures, especially within an inpatient setting which was conducive of overall mental improvements in the sample. However, a temporal gap between the self-administered scales and the SCID is preferred when considering the narrative of the PPV and NPV values. Moreover, participants received patient care, medical attention and medications (benzodiazepines, in some cases). Notably, similar temporal differences are commonly reported in studies of this kind ([35](#_ENREF_35)), including a previous study by our lab aimed at examining the predictive value of the Montgomery-Åsberg Depression Rating Scale (MADRS; another subscale of the CPRS) in detecting a SCID diagnosis of a depressive disorder ([36](#_ENREF_36)). Furthermore, with the purpose of accumulating the largest sample size possible, subjects who were administered either the SCID-IV-TR or the SCID-5-RV were included in the sample, and there are differences between assessments in disorder criteria, language, and modules ([10](#_ENREF_10), [37](#_ENREF_37)). Patients with comorbid substance use disorders were included in the study population (Table 2). We understand this presents a challenge in isolating the anxiety-AUD comorbid relationship, however there is certainty that patients were treated for AUD, primarily. While future studies may opt for an exclusively AUD patient population, our approach enhances the generalizability of the present findings, since comorbid substance use problems are common in AUD [insert reference from comment]. Finally, not only are AUD and anxiety disorders both mental health conditions but there is also some degree of symptom overlap between anxiety disorders and alcohol withdrawal-induced anxiety during the early phase of detoxification, for which the amplitude is not entirely uniform ([38-40](#_ENREF_38)). For these reasons, the generalizability is limited to treatment-seeking inpatients with AUD and, thus, a degree of caution is necessary when interpreting the results.

Improving the validity of anxiety measures among an AUD population is an important avenue for increasing the robustness of comorbidity research. Future directions should attempt to replicate this work in an outpatient sample with AUD, with recently abstinent individuals receiving treatment for AUD and/or non-abstinent individuals not receiving treatment for AUD to assess the role of clinical setting and treatment status in the validity of these scales. In fact, clinic-based samples suggest that individuals with multiple mental health disorders are more likely to be referred for treatment than those with a single disorder ([41](#_ENREF_41)), thus an outpatient sample could present a more heterogenous sample with respect to comorbidity. Additionally, given the substantial co-occurence of anxiety within AUD populations, the relationship, from etiological and treatment perspectives, should be further explored in treatment-seeking and non-treatment seeking individuals. Other common anxiety rating scales which were not assessed in this study (e.g. GAD-7 and Hamilton Anxiety Rating Scale) should also be examined for their validity in a population with AUD, so that the relative accuracy between anxiety scales can be compared for efficacy. Finally, while our study included patients examined for diagnostic criteria via the DSM-IV-TR and DSM-5, future work with respect to BSA and STAI Y-2 should be replicated primarily in patients whom were administered the updated DSM-5 assessment, replicating a similar timeline of administration.

In conclusion, our findings demonstrate that the BSA and STAI Y-2 may not be sufficiently robust tools for detecting an anxiety disorder in recently admitted inpatients with AUD, when conducting a full SCID is not possible. Although the STAI Y-2 may be relatively more accurate than the BSA, the overall lack of convergence between the BSA and STAI Y-2 scores in relation to a SCID-based diagnosis of anxiety highlights a potential lack of construct validity in this population, if the goal is to use these scales as a diagnostic tool. If used in tandem with the SCID assessment with a lower desired cut-point, both scales may be most effective as a screening tool to rule out the presence of an anxiety disorder rather than determining an anxiety diagnosis, which has implications for initiating treatment of any co-occuring anxiety disorder. The findings from this study, nonetheless, have significant implications for the BSA and moderate implications for the STAI Y-2 in gauging anxiety symptoms at the beginning of alcohol detoxification treatment.

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**Disclosures**

None

**Contributors**

LL, RA, JS and DSB were responsible for the conceptualization and the rationale of this analysis. NNS, MLS and BH designed the analyses. MLS performed the statistical analysis. NNS, BH and LL assisted with data analysis. All authors contributed to the interpretation of findings. NNS wrote the first draft of the manuscript. All authors critically reviewed content and approved the final version for publication.

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