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ARTICLE

The relationship between the Hopkins symptom checklist-10 and diagnoses of anxiety and depression among inpatients with substance use disorders

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ABSTRACT

Introduction: The Hopkins Symptom Checklist-10 (HSCL-10) is a self-report inventory of anxiety and depression symptoms that may assist clinicians in screening for clinical conditions among patients with substance use disorder (SUD). We examined the HSCL-10 as a screening tool for anxiety and depressive disorders within a general population of SUD inpatients.

Methods: We used data from a cohort study of 611 SUD inpatients. Receiver operating characteristic (ROC) analyses were conducted, with and without covariates, to evaluate the potential of the HSCL-10 as a screening tool. This was explored using any anxiety disorder, especially posttraumatic stress disorder (PTSD), and any mood disorder, especially major depressive disorders, as the outcome criteria. Candidate covariates included gender, age, education, polydrug use and treatment center.

Results: The HSCL-10 had a moderate ability to identify caseness (i.e. having or not having a clinical diagnosis) according to each outcome criterion, with the area under the ROC curve (AUC) varying from 0.64 to 0.66. Adding relevant covariates markedly enhanced the instrument's ability to identify those who met the criteria for any anxiety disorder (AUC = 0.77), especially PTSD (AUC = 0.82).

Conclusion: In a real-world clinical setting, the HSCL-10 has fair-to-good clinical utility for identifying SUD inpatients who have comorbid clinical symptoms of anxiety disorders or PTSD, when combined with common background variables. The HSCL-10, a brief self-report screening tool, may serve as an efficient proxy for comprehensive interviews used in research and for clinical anxiety symptom screening among patients with SUD.

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Self-report symptoms; substance use disorders; post-traumatic stress disorder; major depressive disorder; receiver operating characteristic

1. Introduction

The prevalence of comorbid psychiatric disorders among inpatients with substance use disorder (SUD) is 50–70% [1–4]. However, the prevalence may actually be even higher due to both underassessment and underdiagnosis of psychiatric disorders in SUD treatment settings [5–7]. Those with SUD and comorbid psychiatric disorders represent a challenging patient group [8,9] at elevated risk of poor treatment outcomes [1,10].

Among SUD inpatients with comorbid psychiatric disorders, anxiety disorders are the most prevalent [1]. Within this broad diagnostic category, particularly comorbid posttraumatic stress disorder (PTSD) has been associated with an elevated risk of both dropout [11] and relapse [12]. Depressive disorders, especially major depressive disorders (MDD), represent another category of psychiatric disorders frequently comorbid among SUD inpatients [1]. Several studies have proposed that MDD comorbid with SUD may have a negative prognostic effect on treatment outcomes [13–16].

Early identification of comorbid psychiatric disorders among SUD inpatients is a prerequisite for adequate integrated treatment [6] and allows healthcare professionals to provide tailored follow-up services after an inpatient stay [17].

Diverse self-report screening tools have been investigated in relation to diagnosed psychiatric disorders, to assess their clinical utility among SUD treatment samples [18,19], including brief unidimensional scales such as the K6 [20,21]. However, among the short self-report symptom inventories, the Hopkins Symptom Checklist-10 (HSCL-10) [22] has been recommended as the supplemental anxiety and depression screening tool that may assist clinicians in identifying comorbid psychiatric conditions among patients in treatment for SUD [23]. The HSCL-10 measures two correlated dimensions, anxiety and depression symptoms [24], and is widely used in SUD studies [25–28].

Our recent study showed that the HSCL-10 predicts suicidal ideation in inpatients with SUD, regardless of their psychiatric diagnosis [29]. This may indicate that HSCL-10 scores are associated with mental disorder symptoms that fail to meet diagnostic criteria (i.e. a subthreshold disorder) [30], but which may nevertheless cause psychological distress [31] and impaired quality of life [32]. The HSCL-10 has shown promising results as a potential depression screening tool. For

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instance, it has been validated against the Composite International Diagnostic Interview for the identification of depression among adolescents [33] and adults [34] in primary health care. However, only a single study has examined how well HSCL-10 scores discriminate between the presence and absence of clinical diagnoses within SUD treatment settings. The authors concluded that there is high concordance between the HSCL-10 and clinician diagnoses of MDD among inpatients with alcohol use disorder (AUD) [35]. However, that study included a small sample, focused solely on MDD as the caseness criteria, and did not include potential covariates of psychiatric comorbidity. Previous findings indicate that candidate covariates include gender [36–39], age [40], education level [41,42], SUD type [43] and polydrug use [1,44].

Since previous research has not explored the ability of the HSCL-10 for detecting comorbid anxiety and depression diagnoses among inpatients with diverse SUD diagnoses, we investigated this screening tool for identifying anxiety and depressive disorders (based on diagnostic standards) among a large, heterogeneous sample of nonselected SUD inpatients. Using the HSCL-10, our aims were to evaluate the probability of correctly identifying patients with 1) any diagnosis of anxiety (and PTSD exclusively) or 2) any diagnosis of depression (and MDD exclusively), and to test 3) whether the predictive accuracy of the HSCL-10 is enhanced by relevant covariates.

2. Material and methods

2.1. Setting and design

We conducted a prospective cohort study among patients admitted for inpatient SUD treatment at any of the five public substance use clinics in central Norway. In accordance with the Declaration of Helsinki [45], patients were given both written and verbal information about the study and gave their signed consent to participate. Those who agreed to participate answered questionnaires (including the HSCL-10) within two weeks after enrolling at the clinic, and gave permission for researchers to extract information about their SUD diagnoses and comorbid psychiatric diagnoses (current or in the past year) from their patient records. The two-year study period was from September 2014 to December 2016. The Regional Ethical Committee for Medical Research in Norway approved the study (application #2913/1733). The study followed the Strengthening the Reporting of Observational Studies in Epidemiology (Checklist of items that should be included in reports of cohort studies) (STROBE) guidelines [46]. Detailed study design and participating treatment center characteristics were presented previously [25].

2.2. Participants

Participants were admitted for inpatient treatment at one of the five participating substance use clinics during the study period. To increase the likelihood of a sample representative of the population of SUD inpatients, we approached everyone newly admitted, excluding those considered incapable of giving informed consent. In total, 611 patients were included (response rate 84%). For the current analyses, participant data were excluded if the HSCL-10 was missing.

2.3. Measures

2.3.1. Hopkins symptom checklist-10

The Norwegian version of the Hopkins Symptom Checklist was used [47]. The HSCL-10 is a 10-item self-report inventory assessing anxiety and depression symptoms during the past week [22]. Items are rated on a four-point scale (1–4, "not at all" to "extremely") with higher scores indicating higher mental health distress symptoms. A mean scale score cut-off value of 1.85 is used to identify mental health problems among the general population [47]. The cut-off of 1.85 was chosen since it gave similar rates of mental health problems as the cut-off value (1.75) of the longer version of the instrument (HSCL-25) when validated against clinical interview data [48]. There is currently no corresponding established cut-off value of HSCL-10 for SUD treatment samples, however the instrument has shown feasible psychometric properties when used with both clinical [34] and general population samples [24].

2.3.2. International classification of diseases (ICD-10)

A medical specialist or clinical psychologist diagnosed SUD and any comorbid psychiatric disorders according to the International Classification of Diseases (ICD-10) criteria [49] for each disorder, using standard diagnostic tools and interviews. The diagnostic tool for detecting comorbid psychiatric disorders included the Mini-International Neuropsychiatric Interview (MINI-Plus) [50] according to Norwegian national guidelines [23].

2.3.3. Mood and anxiety disorders

We used the clinical interview diagnoses for all respective anxiety (ICD-10 codes F40–F48) and depression (ICD-10 codes F30–F39) disorders, and standard criteria for MDD (ICD-10 codes F32.*; F33.*) and PTSD (ICD-10 code F43.1) specifically.

2.3.4. Demographics

Demographic data included gender, age at treatment entry and educational level attainment, the latter categorized as lower (i.e. primary) or middle/higher education.

2.4. Statistical analyses

Descriptive statistics were used to describe the sample characteristics in terms of sociodemographic characteristics, SUD diagnoses and types of anxiety and mood disorders. The mean HSCL-10 score was calculated. We excluded five cases with ≥3 nonvalid HSCL-10 items. We excluded five cases with ≥3 nonvalid HSCL-10 items. For the 18 cases with only one non-valid item, we replaced missing values by the sample mean value for that item (see also [47]). Principal component analysis (PCA) with the Kaiser criterion and Promax rotation was conducted

to investigate the dimensional structure of the HSCL-10. Both the Kaiser–Meyer–Olkin (KMO) and Bartlett's test of sphericity showed that the assumptions for PCA were met (KMO = 0.90, χ^2=3025.01, $p<0.001$). The two HSCL-10 subscales were constructed based on their PCA segmentations. The internal consistency of the HSCL-10 and its subscales was assessed using Cronbach's alpha. Independent samples *t*-tests were performed to compare the mean HSCL-10 and subscale scores between patients with each of the clinical diagnostic categories of interest (i.e. any anxiety disorders, PTSD, any mood disorder and MDD) and all other patients combined.

We conducted receiver operating characteristic (ROC) analysis to explore the ability of the HSCL-10 as a screener for the presence of any anxiety disorder, any mood disorder, PTSD and MDD (i.e. true positive/outcome criterion) or absence (i.e. true negative/all other patients combined) of the specified disorders.

The analyses also considered covariates that might influence the relations between screening tool scores and each outcome criterion. Bivariate analyses were performed to identify covariates that might affect the outcome criterion. Candidate variables were demographic measures and SUD diagnosis types. Since this was a multicenter study, center effects may also have affected the outcome criteria. Therefore, we included treatment center (centers A–E as dummy variables, 0/1) in bivariate analyses. Variables significantly ($p<0.10$) associated with the outcome criterion in bivariate analyses were included in separate ROC analyses, to adjust for their potential effect on the predictive performance of the screening tools (i.e. corrected models). We used logistic regression analyses to model the relations between the screening tools, relevant covariates and outcome criteria. To evaluate how well the screening tool correctly classified individuals, the area under the ROC curve (AUC) was calculated using the saved predicted probabilities for each patient in the model as test variables. An AUC from 0.70 to 0.80 was considered a clinically fair outcome; AUCs >0.80 were defined as having good clinical utility [51]. ROC curves provide graphical presentations of how well the screening tool distinguishes between the true positive (i.e. sensitivity) and false positive (i.e. 1 − specificity) rates, with and without covariates.

3. Results

3.1. Sample characteristics

The analytic sample was 606 in patients with valid HSCL-10 test results, among whom 29% were female. The average age at treatment entry was 38 years (SD = 13.87). About one-third of the sample had low-level educational attainment, and 12% had completed higher education. Table 1 presents the sample characteristics by ICD-10-based SUD type and comorbid anxiety or depression diagnoses.

The prevalence of any anxiety disorder type was 22% ($n=132$) among the patients. The most common anxiety disorders were phobias (ICD-10 code F40x) and PTSD, occurring in 8.5% and 7.0% of patients, respectively. The prevalence of any mood disorder was 17% ($n=105$), among whom 79 had MDD (i.e. ICD-10 codes F32x or F33x). MDD prevalence in the overall sample was 13%.

3.2. HSCL-10 and subscales

PCA showed that the 10 items were segmented into the previously reported two-dimensional solution for the HSCL-10 [35] (i.e. anxiety and depression). The total HSCL-10 score and subscale scores (Table 2) showed high internal consistency, with Cronbach's alpha of 0.893 for the total scale and 0.798 and 0.871 for the anxiety and depression subscales, respectively.

Table 1. Sample characteristics in SUD diagnoses and types of co-occurring mood and anxiety disorders ($N=606$).

	ICD-10 codes	*n*	%
SUD diagnoses[a]			
Alcohol	F10	347	57.3
Opiates	F11	112	18.5
Cannabis	F12	227	37.5
Sedatives	F13	173	28.5
Stimula	F15	191	31.5
Polydrug use[b]		287	47.4
Anxiety disorders ($n=132$)[c]			
Phobias	F40.0; F40.1; F40.2	51	8.6
Other anxiety disorders	F41.0; F41.1; F41.2; F41.3; F41.8; F41.9	36	5.9
Obsessive-compulsive disorder	F42.1; F42.2; F42.8	2	<1
Post-traumatic stress disorder	F43.1	43	7.1
Adjustment disorders	F43.0; F43.2	5	<1
Dissosiative disorders	F44.2	1	<1
Somatoform disorders	F45.1; F45.2	5	<1
Mood disorders ($n=105$)[d]			
Bipolar affective disorder	F31.0; F31.1; F31.3; F31.7; F31.8; F31.9	17	2.8
Depressive episode	F32.1; F32.2; F32.5; F32.8; F32.9	11	1.8
Recurrent depressive disorder	F33.0; F33.1; F33.2; F33.4; F33.9	68	11.2
Persistent depressive disorder	F34.0; F34.1; F34.9	10	1.7
Unspecified depressive disorder	F39	1	< 1

[a]Other SUDs not specified included cocaine ($n=20$) (3.4%), hallucinogens (F16) ($n=11$) (1.9%) and multiple substance use (F19) ($n=32$) (5.5%). For 26 patients, missing data on SUD diagnosis were replaced with report of most frequently used drug.
[b]Defined as having two or more SUD diagnoses.
[c]Ten patients had more than one type of anxiety disorder.
[d]Two patients had two types of mood disorders.

Table 3 shows the means for the HSCL-10 and subscales for the total sample and for subsamples of patients with psychiatric diagnoses of interest. Table 3 also presents the p-values for differences in mean scores between subgroups of patients with or without the respective diagnoses.

The mean HSCL-10 score for the overall sample was 2.15. Mean scores for items in the anxiety and depression dimensions were 2.10 and 2.20, respectively. Patients diagnosed with any anxiety disorder had a mean score of 2.41, and those diagnosed with any mood disorder had a mean score of 2.43. Patients diagnosed with PTSD had a mean HSCL-10 score of 2.48, and those diagnosed with MDD had a mean score of 2.43. The mean scores for subgroups of patients with respective psychiatric diagnoses were significantly higher ($p < 0.001$) than those for patients without those diagnoses, except for the mean score on the depression dimension for patients with PTSD.

Table 2. Hopkins symptoms checklist (HSCL-10) and its subscales of anxiety and depression symptoms.

	Anxiety	Depression
Items HSQL-10	Component loadings	
Suddenly scared for no reason	0.88	
Feeling fearful	0.82	
Feeling tense or keyed up	0.81	
Feeling faintness, dizziness or weakness	0.66	
Sleep difficulties	0.52	
Feeling blue		0.92
Feeling hopelessness about the future		0.88
Feeling everything is an effort		0.80
Feeling worthless		0.66
Blaming yourself for things		0.57

Note. The two components correlated at 0.65.

Table 3. Mean scores on the HSCL-10, anxiety and depression dimensions for total sample and subsamples diagnosed with anxiety disorders, PTSD mood disorders and MDD.

	HSCL-10 total	Anxiety	Depression
Sample (n)	Mean (SD)	Mean (SD)	Mean (SD)
Total (606)	2.15 (0.71)	2.10 (0.73)	2.20 (0.81)
Any anxiety disorder (132)	2.41[a]***(0.66)	2.41[a]***(0.70)	2.41[a]*** (0.78)
PTSD (43)	2.48[b]** (0.74)	2.55[b]*** (0.76)	2.42[b] (0.81)
Any mood disorder (105)	2.43[c]*** (0.66)	2.32[c]*** (0.76)	2.54[c]*** (0.76)
MDD (79)	2.43[d]*** (0.64)	2.30[d]* (0.76)	2.56[d]*** (0.76)

Note. *** $p < 0.001$, ** $p < 0.001$, * $p < 0.05$.
[a,b,c,d] denotes p-values for the differences between patients diagnosed with respectively [a]any anxiety disorder, [b]PTSD, [c]any mood disorders, [d]MDD and all other patients combined.

3.3. Potential covariates

Bivariate analyses of the relationship between candidate covariates and outcome criteria (i.e. any anxiety disorder, PTSD, any mood disorder, MDD) are presented in Table 4.

Covariates for having any anxiety disorder included gender (female; OR = 1.79) and younger age (OR = 0.96). Patients with any anxiety disorder were also more likely to use sedatives (OR = 2.07) and be polydrug users (i.e. ≥2 SUD diagnoses; OR = 2.00), and were less likely to have an AUD (OR = 0.67) compared with those without the diagnosis. There was also variation among treatment centers regarding diagnosis prevalence. Patients treated at center A (OR = 0.29) and center C (OR = 0.23) were less likely to be diagnosed with an anxiety disorder, whereas patients at center E were more likely to be diagnosed with an anxiety disorder (OR = 5.06) compared with patients at the other centers.

Many of the same covariates appeared for the subgroup of patients diagnosed with PTSD. Having a PTSD diagnosis was associated with female gender (OR = 2.98), younger age (OR = 0.97), low educational attainment (OR = 2.20) and illicit drug use, including polydrug use (OR = 3.52). Patients with

Table 4. Bivariate analyses of factors associated with the presence of any anxiety disorders, any mood disorders, PTSD and MDD.

		Any anxiety disorder ($n = 132$)		PTSD ($n = 43$)		Any mood disorder ($n = 105$)		MDD ($n = 79$)	
	n	OR (CI: 95%)	p-value	OR (CI: 95%)	p-value	OR (CI: 95%)	p-value	OR (CI: 95%)	p-value
Demographics									
Gender female	173	1.79 (1.12;2.69)	0.005	2.98 (1.58;5.61)	<0.001	1.31 (0.83:2.05)	0.243	1.18 (0.71;1.97)	0.527
Age at intake[a]	606	0.96 (0.95;0.98)	<0.001	0.97 (0.95;1.00)	0.023	0.98 (0.97;1.00)	0.055	0.98 (0.96;1.00)	0.023
Education low	189	1.30 (0.87;1.96)	0.205	2.20 (1.15;4.19)	0.017	1.29 (0.82;2.02)	0.275	1.29 (0.78;2.14)	0.232
SUD diagnoses									
Alcohol (F10)	351	0.67 (0.45;0.98)	0.040	0.51 (0.27;0.95)	0.035	0.75 (0.49;1.15)	0.185	0.69 (0.43;1.11)	0.130
Opiates (F11)	112	1.12 (0.73;1.91)	0.507	2.32 (1.18;4.54)	0.015	1.30 (0.77;2.17)	0.325	1.36 (0.77;2.41)	0.292
Cannabis (F12)	229	1.45 (0.98;2.13)	0.065	1.49 (0.80;2.79)	0.207	1.14 (0.74;1.75)	0.554	1.23 (0.76;1.99)	0.396
Sedatives (F13)	173	2.07 (1.38;3.09)	<0.001	1.73 (0.91;3.27)	0.094	1.18 (0.75;1.86)	0.473	1.36 (0.82;2.24)	0.236
Stimula (F15)	191	1.44 (0.96;2.15)	0.076	3.36 (1.79;6.33)	<0.001	0.89 (0.56;1.41)	0.623	0.94 (0.56;1.57)	0.185
Polydrug use[b]	289	2.00 (1.37;2.99)	<0.001	3.52 (1.74;7.12)	<0.001	1.11 (0.73;1.69)	0.625	1.23 (0.77;1.98)	0.387
Treatment center									
Center A	182	0.29 (0.16;0.48l	<0.001	0.36 (0.15;0.87)	0.023	0.40 (0.23;0.69)	<0.001	0.27 (0.13;0.54)	<0.001
Center B	67	0.68 (0.35;1.33)	0.263	1.07 (0.41;2.83)	0.885	1.47 (0.79;2.73)	0.222	1.06 (0.50;2.24)	0.878
Center C	112	0.23 (0.11;0.49)	<0.001	0.98 (0.01;0.72)	0.022	0.58 (0.31;1.08)	0.087	0.69 (0.35;1.35)	0.281
Center D	49	1.49 (0.78;2.86)	0.231	2.44 (1.02;5.80)	0.045	1.11 (0.52;2.37)	0.786	1.37 (0.62;3.05)	0.438
Center E	201	5.06 (3.37;7.62)	<0.001	2.79 (1.495.23)	0.001	2.23 (1.45;3.42)	<0.001	2.65 (1.64;4.28)	<0.001

[a]Supplementary bivariate analyses using a dichotomized age variable (over/below 30 years) (not shown in table), indicated that compared with older patients, young patients were at an increased risk of having any anxiety disorder ($p < 0.001$, OR = 2.63, CI: 95% 1.77; 3.89) and PTSD ($p = 0.020$, OR = 2.11, CI: 95% 1.13; 3.94). The association between young age and any mood disorder was borderline significant ($p = 0.052$, OR = 2.11, CI: 95% 1.13; 3.94), while the association with MDD appeared non-significant ($p = 0.065$, OR = 1.57, CI: 95% (0.97; 2.52).
[b]Defined as having two or more SUD diagnoses.

PTSD were less likely to have an AUD (OR = 0.51). The likelihood of having a PTSD diagnosis was also higher among patients at center D (OR = 2.44) and center E (OR = 2.79), and lower at center A (OR = 0.36) and center C (OR = 0.98) compared with the other centers.

Among patients diagnosed with any mood disorder or MDD, only younger age (OR = 0.98 and 0.98, respectively) and being at center A (ORs = 0.40 and 0.27, respectively) or E (ORs = 2.23 and 2.65, respectively) were significant covariates.

3.4. ROC analyses

Table 5 presents the ROCs for crude and corrected models. The AUCs reflect the probability that the model rates a randomly selected patient with the diagnosis higher than a randomly selected patient without the respective diagnosis.

The discriminatory accuracy of the HSCL-10 for identifying caseness of any anxiety disorder was 0.640 (95% CI = 0.589–0.691). The accuracy of the screening tool increased to 0.772 (95% CI = 0.729–0.815) with the addition of relevant covariates (i.e. gender, age, polydrug use, center A, center C and center E [corrected model]).

The AUC between the HSCL-10 and PTSD diagnosis was 0.636 (95% CI = 0.554–0.717). In the corrected model, the AUC reached 0.820 (95% CI = 0.742–0.899). The ROC curves in Figure 1 show the ability of the HSCL-10 to discriminate between the true positive (i.e. sensitivity) and false positive (i.e. 1 − specificity) PTSD caseness, with and without covariates.

The AUCs for any mood disorder and MDD were 0.642 (95% CI = 0.587–0.697) and 0.663 (95% CI = 0.577–0.700), respectively. Adding covariates (i.e. age and treatment centers A and E) to the corrected model only had a small influence on the AUCs for the HSCL-10 (any mood disorder: 0.679, 95% CI = 0.623–0.735; MDD: 0.717, 95% CI = 0.659–0.776).

4. Discussion

This study found that, when combined with information about relevant patient variables, the HSCL-10 has a clinically fair-to-good ability to detect SUD inpatients who have comorbid anxiety disorders. In particular, the ROC analyses identified the majority of target cases with a PTSD diagnosis when information about patient age, gender, educational level and polydrug use was added.

The HSCL-10, a self-report anxiety and depression symptom inventory, has been widely used in research [26,27,29]. However, to our knowledge, this is the first study of a general population of SUD inpatients to evaluate the instrument's potential for identifying patients with anxiety and depression disorders. While one study recently concluded that the HSCL-10 had good clinical utility for classifying patients with AUD and comorbid MDD [35], our crude analyses did not support the clinical use of HSCL-10 scores to identify those with psychiatric caseness of either anxiety or mood disorders. In the current study, about half of our sample (57%) had an AUD. Bivariate analysis revealed that MDD was not associated with any SUD type. The prevalence of MDD in this sample was 13%, similar to that reported by Lien et al. [35]. Also consistent with Lien et al. our results showed that patients with SUD who were diagnosed with MDD had significantly higher mean scores on both the HSCL-10 and its anxiety and depression subscales compared with patients without the MDD diagnosis. Our sample was substantially larger and more heterogeneous compared with that of Lien et al. who investigated a small, homogeneous sample, predominantly of patients with AUD. Thus, sample differences may account for these divergent ROC results. The ROC analysis may also have varied with criterion severity (i.e. operational definition of the problem); for example, HSCL-10 performance at detecting caseness might be better in more severe cases. The criteria variables used in the current analyses included both "broad" (i.e. any anxiety disorder, any mood disorder) and "narrow" (i.e. PTSD, MDD) diagnostic criteria. However, the results of the ROC analyzes showed that with crude data, the ability of the HSCL-10 to detect the target cases was roughly the same for the four criterion variables.

In the present study, AUCs for the ROC curves indicated that HSCL-10 accuracy for identifying caseness of any anxiety

Table 5. Crude and corrected models for HSCL-10 and its subscales in ability to discriminate between diagnostic caseness of any anxiety disorder, PTSD, any mood disorder, and MDD.

	Models			
	Crude		Corrected	
	AUC (95% CI)	*p* -value	AUC (95% CI)	*p* -value
Any anxiety disorder[a]				
HSCL-10	0.640 (0.589;0.691)	<0.001	0.772 (0.729;0.815)	<0.001
Anxiety dimension	0.658 (0.607;0.798)	<0.001	0.776 (0.733;0.819)	<0.001
Depression dimension	0.601 (0.548;0.653)	<0.001	0.766 (0.722;0.810)	<0.001
PTSD[b]				
HSCL-10	0.636 (0.554;0.717)	0.003	0.820 (0.742;0.899	<0.001
Anxiety dimension	0.675 (0.594;0.756)	<0.001	0.826 (0.749;0.904)	<0.001
Depression dimension	0.581 (0.498;0.664)	0.077	0.812 (0.734;0.890)	<0.001
Any mood disorder[c]				
HSCL-10	0.642 (0.587;0.697)	<0.001	0.679 (0.623;0.735)	<0.001
Anxiety dimension	0.598 (0.538;0.659)	0.002	0.652 (0.593;0.711)	<0.001
Depression dimension	0.650 (0.596;0.704)	<0.001	0.691 (0.637;0.745)	<0.001
MDD[d]				
HSCL-10	0.663 (0.604;0.772)	<0.001	0.717 (0.659;0.776)	<0.001
Anxiety dimension	0.627 (0.562;0.691)	0.015	0.694 (0.633;0.755)	<0.001
Depression dimension	0.661 (0.602;0.720)	<0.001	0.722 (0.663;0.780)	<0.001

Note. The corrected models included: [a] Gender; age; alcohol, polydrug use, treatment center A; C; E. [b] Gender, age, education, alcohol, polydrug use, treatment center A; C; D; E. [c,d] Age, treatment center A; E.

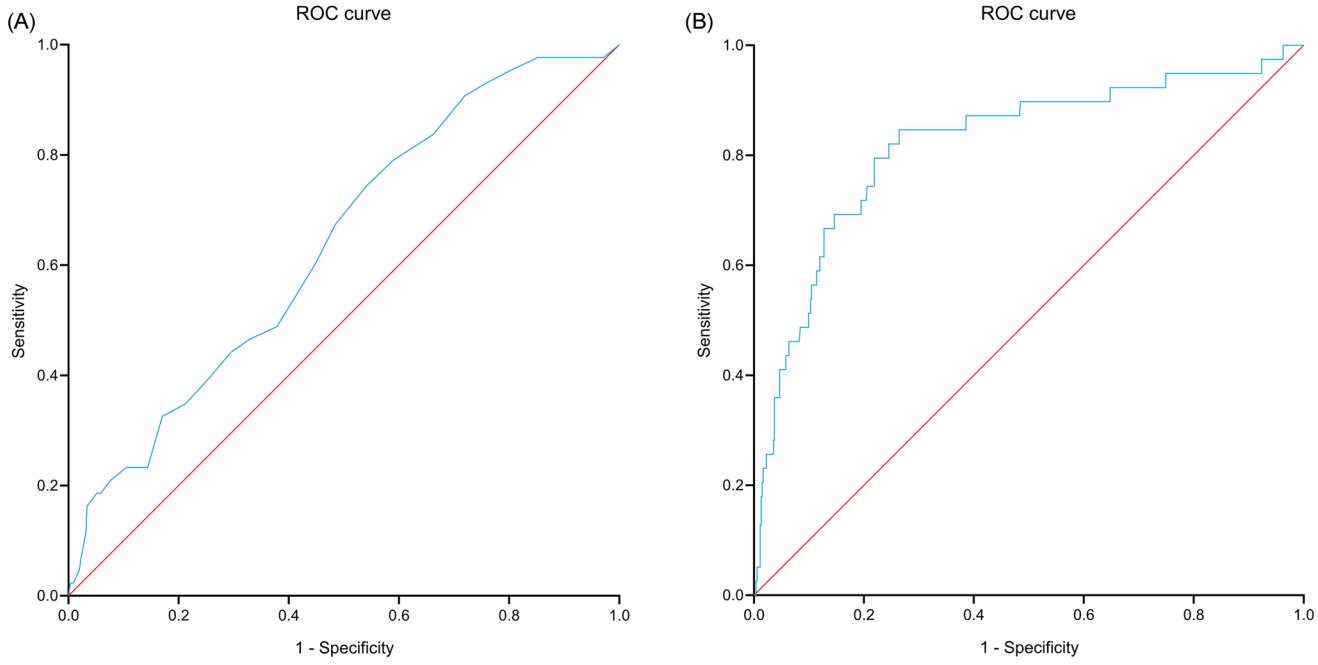

Figure 1. **(a).** The ability of the HSCL-10 to discriminate between individuals with and without PTSD. Crude model. **(b).** The ability of the HSCL-10 to discriminate between individuals with and without PTSD. Corrected model.

diagnoses or PTSD was poor. However, adding covariates improved discriminatory accuracy considerably. Patients with comorbid anxiety disorders constitute a relatively large subgroup within the population of SUD inpatients [1]. Among anxiety disorders, PTSD is particularly associated with an elevated risk of poor SUD treatment outcomes [11,12]. As these patients may go undetected within the SUD treatment setting [5], a supplementary screening tool with high predictive accuracy may be of great clinical value for identifying patients who need further clinical consideration. No previous study has investigated how well the HSCL-10 can discriminate between SUD patients with or without any anxiety diagnosis.

The current HSCL-10 data represented baseline data in a prospective study, administered at the beginning of the inpatient treatment stay, i.e. within 2 weeks after enrollment in the study. Notwithstanding this temporal delay, we cannot entirely rule out the possibility that some patients may have had substance intoxication or withdrawal symptoms that affected both their baseline HSCL-10 symptom responses, and the diagnosing of comorbid psychiatric disorders (i.e. substance-induced psychiatric disorders). However, inpatient treatment requires patients to be abstinent from drug and alcohol, and if necessary to undergo up to 14 days of detoxification prior to intake. Moreover, since studies have shown that comorbid psychiatric disorders among SUD patients are mainly substance independent [54,55], this eventually may apply to only a small proportion of the patients.

We considered common patient variables as potential covariates, including age, gender, education and SUD diagnosis type. Consistent with previous research, several of these variables were associated with any anxiety diagnosis, especially PTSD. For instance, that females were about three times more likely than males to have a PTSD diagnosis coincides with the report by Dore et al. [56] of a sample of inpatients with SUD. Also, as found in previous studies [41,42] we observed an association between having a PTSD diagnosis and education level. In the present data, having low educational attainment more than doubled the risk of a PTSD diagnosis. Furthermore, comorbid anxiety disorders are more likely among younger patients [52]. Thus, the associations between any anxiety disorder and PTSD, and between illicit drug use disorder and polydrug use, might be explained by patients who use illicit substances being younger than general AUD patients [53]. Previous research suggests that anxiety disorders, younger age and polysubstance use may be interconnected. For example, polydrug use has been associated with substance use onset at a younger age [57], and anxiety disorders and PTSD have been related to early onsets of drug use and polysubstance use [58]. Though current data disallow causal determination, one possible explanation may be that these associations result from common risk factors [54], such as early-life traumatic stressors, which are estimated to be particularly high in this patient population [59].

Among the candidate covariates considered in this study, only younger age was associated with the occurrence of mood disorders, including MDD. Few studies have compared demographic characteristics between SUD patients with comorbid mood disorders or MDD versus those with SUD alone [60]. However, our results are partly consistent with the finding [40] that patients with SUD alone are older compared with those who have comorbid anxiety or depression.

We also observed a relationship between treatment center and the occurrences of both anxiety and depression diagnoses. Variation among clinics in comorbid disorder prevalence may be real (i.e. reflecting patient population differences), or it may reflect differences in assessments and diagnostic practices [7]. The latter interpretation may indicate that patients with PTSD are not consistently assessed and may thus be clinically underdiagnosed [5,6]. Our results suggest that treatment center effects may also have affected the ROC curves.

Based on these findings, we suggest that future multicenter studies of patients with SUD and/or psychiatric disorders consider center effects on ROC analyses.

4.1. Strengths and limitations

Few studies have examined the clinical utility of the HSCL-10 among SUD inpatients. Our study's major strengths include the inclusion of common patient variables (i.e. age, gender, education, SUD diagnoses) as potential covariates and our relatively large sample size. The extent of missing data on the HSCL-10 items was low. However, we cannot rule out that missing data may have affected sample representativeness. Another notable strength is that the sample was collected in a real-life setting, mirroring the population of inpatients with SUD and the clinical reality within public specialized inpatient SUD treatment in Norway. Although we cannot ignore possible sample bias, the high response rate of 84% enhance the likelihood of generalizable findings. Because mental health disorders are generally underdiagnosed in SUD treatment settings, we cannot rule out the possibility that some participants who qualified for a comorbid psychiatric diagnosis had not received one. Nevertheless, our multicenter study-design allowed us to account for potential differences in site-specific routines for diagnosing anxiety and/or depression. Despite potential diagnostic uncertainties, the current findings show that HSCL-10 scores should be combined with key patient variables to achieve meaningful identification of anxiety disorders in general and PTSD in particular.

Future intervention studies may assess the comparative effectiveness of HSCL-10 to other self-report screening instruments in detection of psychiatric conditions among SUD samples. Such studies may include clinician-based symptom assessment tools, to avoid possible biases related to participant self-disclosure and subjective symptom interpretations.

5. Conclusion

Inpatient treatment settings constitute a unique opportunity to initiate specific measures for anxiety and depression among SUD patients. A concise screening tool such as the HSCL-10 may allow earlier diagnosis and thus more appropriate treatment initiation. Routine screening of SUD patients using the HSCL-10, in combination with other relevant patient information, may be effective as a supplemental measure for identifying those who would benefit from further assessment for PTSD. This tool may support clinicians if used before inpatient treatment, such as when administered by the referring agent, or during outpatient consultations. Future research should examine the clinical utility of the HSCL-10 for identifying patients with subthreshold symptoms, including those who do not meet diagnostic criteria but who, given their mental health distress symptoms, may benefit from enhanced treatment efforts.

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Authors' contribution

HWA: Conceptualization, Formal analysis, Writing – Original draft preparation, Final Editing. TN: Writing- Reviewing and Editing, Data analyses. MPM: Supervision, Data analyses, Writing- Reviewing and Editing.

Disclosure statement

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