Brief Communication

Psychometric properties and diagnostic utility of the State–Trait Anxiety Inventory in epilepsy with and without comorbid anxiety disorder

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A B S T R A C T

Objective: Anxiety disorders are frequent comorbid disorder in patients with epilepsy (PWEs). The availability of validated screening instruments to detect anxiety disorders in PWEs is limited. The aim of the present study was to validate State–Trait Anxiety Inventory (STAI) in adult PWEs for the detection of anxiety disorders.
Methods: A total of 96 outpatients with epilepsy completed the self-report symptom scale and were diagnosed with the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition Text Revision (DSM-IV-TR) Axis I disorders (SCID-I). The sensitivity, specificity, positive and negative predictive values, and receiver operating characteristic (ROC) curves were assessed to determine the optimal threshold scores for the State-Trait Anxiety Inventory State (STAI-S) and State-Trait Anxiety Inventory Trait (STAI-T) anxiety subscales.
Results: Receiver operating characteristic analyses for STAI-T showed area under the curve at 84.7%. For diagnoses of anxiety disorders, the STAI-T demonstrated the best psychometric properties for a cutoff score ≥ 52 with sensitivity of 81.3%, specificity of 77.5%, positive predictive value (PPV) of 41.9%, and negative predictive value (NPV) of 95.4%.
Conclusions: The STAI-T proved to be a valid and reliable psychometric instrument in terms of screening for anxiety disorders in PWEs. In the epilepsy setting, STAI-T maintains adequate sensitivity, acceptable specificity, and high NPV but low PPV for diagnosing anxiety disorders with an optimum cutoff score ≥ 52.

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1. Introduction

Anxiety disorders are commonly underrecognized psychiatric comorbidities in patients with epilepsy (PWEs) with reportedly higher rates among PWEs than in the general population, ranging from 5% to 25% [1,2]. The detection of anxiety disorders is of vital clinical importance in PWEs as these conditions are often not-diagnosed and when untreated, they have adverse effects on the course and prognosis of epilepsy management [3]. A key reason for this is the lack of well-validated, self-report, screening psychometric instruments in PWEs, which could be easily implemented in a clinical setting. When choosing a psychometric instrument for screening purposes, it is important to optimize cutoff points for the population with epilepsy as substantial variability may be seen in several targeted populations [4–6]. At the moment, there is only a limited number of validation studies concerning screening instruments for anxiety disorders in epilepsy, namely, the Hospital Anxiety and Depression Scale (HADS) [7] and the Generalized Anxiety Disorder-7 (GAD-7) (screening for generalized anxiety disorder [GAD]) [8].

The Spielberger State–Trait Anxiety Inventory (STAI) [9] is a well-known 40-item instrument, measuring respectively transient and enduring levels of anxiety. It is probably one of the most widely used self-reported measures of anxiety in clinical research with versions available in several languages, including Polish [10]. The STAI consists of two separate, self-report scales for measuring the distinct concepts of state and trait anxiety. It is used as an indicator of general anxiety, general psychological distress, and general emotional distress. In a recent meta-analysis involving over 150 studies, the authors concluded that the STAI clearly differentiates between people with anxiety and general populations and demonstrates high reliability (0.87–0.93) for patients across a range of anxiety disorders [11].

A self-report psychometric instrument for screening purposes shall be well-validated with optimized cutoff points for the targeted population. The STAI has not been extensively used in epilepsy studies. Until now, no normative data of the STAI scale are available for PWEs with formal diagnosis of anxiety disorders. The present study explored psychometric properties of the STAI scale in a sample of PWEs with and

Table 1
Demographic and clinical characteristics of study population.
(Modified from Brandt et al. [1]).

	N = 96 (%)
Male sex (%)	31 (32.3)
Age, in years (SD)	36.6 (12.0)
Age of seizure onset (SD)	19.5 (11.6)
Duration of epilepsy (SD)	17.0 (11.8)
Number of seizures/last month – median (IQR)	3 (2.5)
Seizure type (%)	
Focal aware	7 (7.3)
Focal impaired awareness	27 (28.1)
Focal to bilateral tonic–clonic	47 (49.0)
Generalized onset tonic–clonic	10 (10.4)
Generalized absence	2 (1.0)
Generalized myoclonic	1(1.0)
Generalized atonic	2 (2.1)
Number of AEDs (IQR)	2 (1.2)
DSM-IV-TR diagnosis	
Any anxiety disorder	16 (16.7)
Panic disorder	13 (13.5)
Agoraphobia	1 (1.0)
Generalized anxiety disorder	2 (2.1)
Any depressive disorder	40 (42.0)
Major depressive disorder (MDD)[a]	21 (22.0)
Dysthymic disorder[a]	7 (7.0)
Depressive disorder NOS	16 (17.0)

SD – standard deviation.
IQR – interquartile range.
NOS – not otherwise specified.
  [a] Four cases 'double depression'.

without comorbid anxiety disorder as defined by diagnostic interview, in order to provide clinicians with reliable, normative values for the use of the STAI in PWEs.

2. Methods

2.1. Study population

This study used data collected as part of a larger study reported elsewhere [2]. Briefly, 118 consecutive PWEs from a tertiary epilepsy center were screened, with 96 patients enrolled. Subjects who received a diagnosis of active epilepsy according to the International League Against Epilepsy criteria [12] receiving stable antiepileptic treatment in the past 2 months aged 18–65 years were included. The exclusion criteria selected to reduce the impact of periictal and ictal psychiatric symptoms were the last seizure within 24 h of examination and more than 10 seizures in the last month. Exclusion criteria also included history of severe traumatic brain injury with midline shift as determined with neuroimaging, neurosurgery, unstable disease, or serious neurological disorder. Further exclusion criteria were the identification of psychogenic nonepileptic seizures (pseudoseizures), mental retardation, alcohol and/or drug dependence or abuse in the past 6 months, and borderline, antisocial personality disorder as determined by psychiatric interview, as the psychiatric symptomatology manifested in those psychopathologic domains may confound estimates of morbidity rates across Anxiety Disorders (ADs).

The study was performed in agreement with the Declaration of Helsinki following the approval of the Ethic Research Committee of the Institution. For each study participant, written informed consent was obtained.

2.2. Evaluation

All subjects were assessed at a single study visit by the same investigator (MSW) and diagnosed with the Structured Clinical Interview for DSM-IV-TR Axis I Disorders (SCID-I) [13]. The structured interview was used to obtain information on disease history and sociodemographic status of patients, including gender, age, economic situation, marital status, the age of seizure onset, duration of epilepsy, seizure frequency, seizure type, experience of auras and duration of treatment, existence of lesions, and psychiatric history. Computed tomography/magnetic resonance imaging, electroencephalogram, and laboratory tests results were available for the majority of subjects. Data were corroborated with referral source records from the epileptologist.

Anxiety was assessed with the Polish version of the original Spielberger STAI, which is usually referred to as the STAI-X [9,10]. The STAI-X is an extensively used self-administered inventory of two sections containing 20 items each, designed to explore anxiety in its temporary condition of "state anxiety" (STAI-S) and the more general and long-standing quality of "trait anxiety" (STAI-T) [9]. The STAI-S assesses how respondents feel "right now, at this moment", and the STAI-T targets how respondents "generally feel". Each item is scored on a 4-point Likert scale, with choices ranging from 1 ("not at all") to 4 ("very much so") for the state scale, and 1 ("almost never") to 4 ("almost always") for the trait scale. The minimum score for each section is 20, with a maximum score of 80. A total score of 40 or more indicates an anxious condition. The higher the score is, the more severe the anxiety condition [9].

For analyses, patients were assigned to a comprehensive diagnostic group of anxiety disorders including subjects with panic disorder (PD), GAD, and agoraphobia.

2.3. Statistics

In order to determine the diagnostic sensitivity and specificity of both STAI-T and STAI-S for the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition Text Revision (DSM-IV-TR) anxiety disorder diagnoses and to determine an optimal cutoff point, a receiver operating characteristic (ROC) curve was obtained for STAI-T and STAI-S.

The area under the curve (AUC) values were interpreted according to the following guidelines: 0.9–1, excellent; 0.8–0.9, good; 0.7–0.8, fair; and 0.6–0.7, poor. Cutoff values were established with the (0, 1) minimum distance method giving equal weight to sensitivity and specificity. There were no missing data or outliers.

Frequencies and descriptive statistics were analyzed for each variable. Comparisons between patients with current AD and patients without AD were made using Student's t-tests for normally distributed continuous data, Mann–Whitney's U test for nonnormally distributed data, and Fisher's exact test for categorical data. A value of $p < 0.05$ was considered statistically significant.
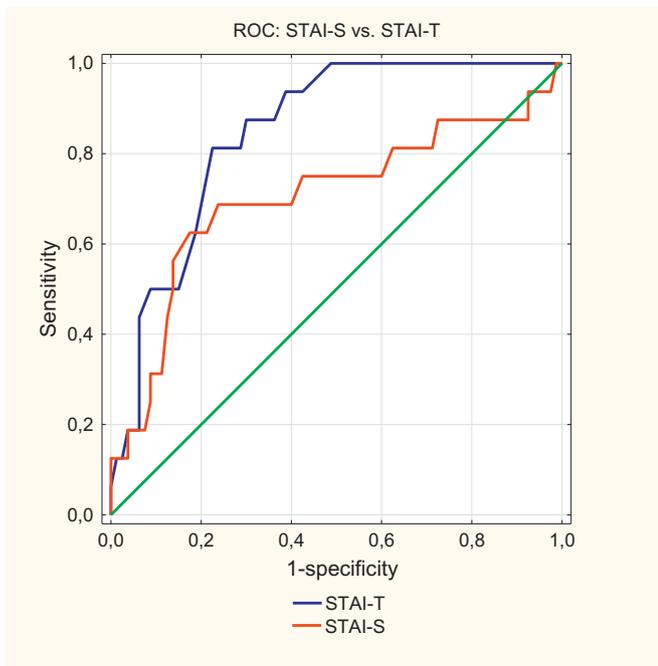
Table 2
Psychometric characteristic of analyzed group.

Rating scale	All patient	Anxiety disorders		Mann–Whitney Z	p	Difference (IQR)
	(n = 96)	(+) (N-16)	(−) (N = 80)			
	Median (IQR)					
STAI-S	41 (30.5)	53.5 (38; 57.5)	38 (30; 48)	2.558	<0.01	11 (2 to 19)
STAI-T	44.5 (38; 53)	54.5 (52; 59.5)	42 (36; 51)	4.368	<0.0001	13 (8 to 18)

Fig. 1. ROC for STAI-S vs. STAI-T: patients with anxiety disorders vs. patients without anxiety disorders.

3. Results

The study group characteristics are presented in Table 1 with detailed analysis of the demographic and clinical variables described elsewhere [2]. According to the SCID-I, the diagnosis of any anxiety disorder was established in 16 (16.7%) patients, mainly PD in 13 (13.5%). None of the patients has been diagnosed with anxiety disorder before entering the study. The antiepileptic drugs (AEDs) used in the study group were carbamazepine (34.2%), sodium valproate (21%), lamotrigine (15.7%), and topiramate (8.5%). Patients in the study group have not received any other neurological/psychiatric medication apart from AEDs.

Both the STAI-S and the STAI-T scores were significantly higher (p < 0.001; p < 0.0001) for subjects with anxiety disorders with a median value of 53.5 and 54.5 respectively compared with 38 and 42 for the nonanxious subjects (Table 2).

For diagnoses of anxiety disorder, the STAI-T demonstrated the best psychometric properties for a cutoff score of 52 with a sensitivity of 81.3%, specificity of 77.5%, AUC of 84.7% (Fig. 1), a positive predictive value (PPV) of 41.9%, and a negative predictive value (NPV) of 95.4% (Table 2). The ROC values for the STAI-S were AUC 0.704 and for the STAI-T were AUC 0.847 (Table 3). We did not find optimal cutoff score for STAI-S because of its low sensitivity at any cut score value (Table 4). Comparing the difference in two areas under the ROC curves, the p-value indicated a significant difference between the AUCs (p = 0.028, Table 3).

4. Discussion

The present study explored psychometric properties of the Spielberger STAI in a sample of PWEs. The STAI-T with a cutoff score of 52 showed significant ability as a screening tool for indicating anxiety disorders' categories in PWEs using ROC as compared with SCID-I.

To our best knowledge, there have been no attempts to validate screening with the STAI as a measure for anxiety disorders in PWEs within the literature to date. Few studies on PWEs using the STAI have used it primarily as a descriptive tool, mainly to assess level of anxiety without reliance to operational definitions as proposed by the DSM.

De Albuquerque and de Campos [14] studied anxiety levels in a population of patients with epilepsy versus nonepileptic control subjects using the STAI and found higher trait anxiety scores (mean score = 48.5; n = 75) in the group with epilepsy compared with healthy controls (mean score = 41.8; n = 80). In addition, the investigators found that briefer duration (less than 2 years) of symptomatic epilepsy was associated with higher trait anxiety levels (mean score = 56.89; n = 9). The STAI-S scores in PWEs were not significantly different from controls (mean score: 42.4 vs. 41.4). Kimiskidis et al. [15] assessed anxiety and mood disturbances in 201 PWEs, administering the State and Trait Anxiety subscales of the STAI and Beck Depression Inventory, 21-item version (BDI-21). The mean STAI-S score was 48.6 ± 6.7 as compared with 25.0 ± 11.4 in controls, and the mean STAI-T score was 42.9 ± 6.7 as compared with 27.9 ± 11.4, which constitutes a significant difference. A higher STAI-S score was associated with symptomatic focal epilepsy, whereas a higher STAI-T score was associated with high seizure frequency, symptomatic focal epilepsy, and being female. Jacoby et al. [16] reported findings from a UK-based survey in which data were obtained via mailed questionnaires from PWEs and age- and gender-matched controls. Based on STAI, PWEs were at higher risk of anxiety. The total median of STAI-S in PWEs was 46 vs 35 in controls (p < 0.001). The total median of STAI-T in PWEs was 50 vs 39 in controls (p < 0.001). The study confirms an increased prevalence of self-reported anxiety, both state and trait, in people with epilepsy compared to matched controls. Interestingly, only trait anxiety emerged as a significant factor for defining overall quality of life (QoL). Maroufi et al. [17] aimed to determine the prevalence of state and trait anxiety in PWEs compared with people without epilepsy. Eighty-four PWEs and 168 healthy persons from relatives of the patients in the case group were recruited and filled out the inventory. The rates of both state (patients: 46.9 ± 14.1; controls: 43.3 ± 10.5; p = 0.042) and trait (patients: 44.6 ± 12.0; controls: 40.6 ± 9.4; p = 0.009) anxiety were higher in patients in the case group compared with the control group.

There is a large normative database available for the STAI for general population and other non-PWE populations. However, it shall be noted that data on using the STAI as a screening tool may be limited because of the fact that the STAI was not designed to provide a diagnosis of anxiety disorder. In the original STAI manual from 1970 [9], normal mean (SD) STAI state and trait scores for general medical/surgical patients without psychiatric disorders was 42.7 (13.8) and 41.3 (12.6), respectively. In summarizing the research conducted since then, a cutoff of 39/40 is normally used for clinically significant symptoms of a state of anxiety [18,19].

Overall in majority of studies, the STAI has been used to measure severity of anxiety symptoms in different populations. In fact, there is only little literature published on the STAI as a screening instrument. In a study comparing the Beck Anxiety Inventory (BAI) with the State-Trait Anxiety Inventory Form Y (STAI-Y) in older adult outpatients with mixed psychiatric disorders (N = 217) [20], no single cutting score for either the BAI or the STAI provided optimum, due to tradeoffs between sensitivity and specificity using the SCID as gold standard. However, patients with an anxiety disorder had slightly, but significantly, higher mean trait scores than patients without an anxiety disorder (55.9 vs.

Table 3
ROC analysis of the STAI-S and STAI-T (presence of anxiety disorders).

	AUC	95% CI	SE	p	AUC difference	95% CI	p	r
STAI-S	0.704	0.504–0.867	0.083	0.015	−0.1438	−0.2716; −0.159	0.028	0.67
STAI-T	0.847	0.763–0.931	0.043	0.0000				

Table 4
ROC analysis of the STAI-S and STAI-T (cutoff scores).

Rating scale	Cutoff score	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
STAI-S	51	62.5% (35.4–84.8)	82.5% (72.4–90.1)	41.7% (22.1–63.4)	91.7% (82.7–96.9)
	52	56.3% (29.9–80.2)	86.3% (76.7–92.9)	45.0% (23.1–68.5)	90.8% (81.9–96.2)
	53	50.0% (24.7–75.3)	86.3 (76.7–92.9)	42.1% (20.3–66.5)	89.6% (80.6–95.4)
STAI-T	51	81.3% (54.3–96.0)	77.5% (66.8–86.1)	40% (24.6–60.9)	95.4% (87.1–99.0)
	52	81.3% (66.8–86.1)	77.5% (66.8–86.1)	41.9% (24.6–60.9)	95.4% (87.1–99.0)
	53	50.0% (24.7–75.3)	85.0% (75.3–92.0)	40.0% (19.1–64.0)	89.5% (80.3–95.3)

52.6, respectively; $p < 0.05$), but there were no between-group differences in state score (53.3 vs. 50.6, respectively).

At this point, it is worth noting that although we identified the STAI-T cutoff score of 52 for any anxiety disorder diagnosis, the majority of the patients in the study sample were diagnosed with PD which consisted of 81% of all anxiety disorder diagnoses.

A review of treatment outcome in general population studies for GAD reports mean pretreatment STAI-T scores for individuals diagnosed with GAD ranging from 47 to 61 [21]. Another community study found mean STAI-T scores for individuals diagnosed according to Diagnostic and Statistical Manual of Mental Disorders-Third Edition (DSM-III) criteria with panic disorder with agoraphobia (PDA) ranging from 51 to 54 and for those diagnosed with PD ranging from 44 to 46 and STAI-S scores for PDA ranging from 47 to 49 and for those diagnosed with PD ranging from 40 to 44 [22]. In a study of patients with one of four DSM-IV anxiety disorders confirmed with SCID-I [23] (PD [N = 67], obsessive–compulsive disorder [n = 54], social phobia [n = 74], or specific phobia [n = 17]) and controls (n = 49), the control group (33.4 [6.3]) scored lower than all patient groups on the STAI-Y trait scale (p < 0.001). Post hoc analyses showed that group with social phobia (55.9 [8.3]) scored higher than either the group with panic (52.0 [8.9]) or specific phobia (47.4 [13.5]), and the group with obsessive–compulsive disorder (54.0 [11.8]) scored higher than the group with specific phobia.

Conversely to our expectations, the proposed cutoff scores in PWEs did not differ substantially from findings in non-PWE. Given that some symptoms might overlap between the STAI items and epilepsy symptoms (seizure-related symptomatology, adverse effects of AEDs), PWEs require population specific approach in order to establish adequate screening reliability. The similar findings to general population may be due to the overall dearth of data on using the STAI as a screening tool for identifying anxiety disorders. However, the approximate 10-point difference between scores for healthy working adults and patients with neuropsychiatric problems was consistent with normative data for the STAI. In chronically ill patients suffering from anxiety disorders, the optimal cutoff score for the STAI state scale has been identified to be between 44 and 51 [19].

According to this study results, the STAI-T maintains, in the epilepsy setting, a good sensitivity, a fair specificity, and an excellent NPV but a low PPV. The high NPV shown suggests that it may be useful in ruling out anxiety. We did not find the optimum cutoff score for the STAI-S for the screening of anxiety disorders in our PWEs sample because the state scale did not provide high sensitivity at any cutoff point using the SCID-I as gold standard. Comparing the differences between the two AUCs the STAI-T performed significantly better. Low sensitivity of state anxiety scale could be related to the time frame of scale which is "right now, at this moment", which in result could be prone to change easily and be sensitive to external, environmental factors during test. Trait anxiety is defined, instead, as a general tendency to respond with anxiety to perceived threats in the environment and as a relatively stable characteristic of an individual.

5. Study limitations

The key study limitation is the small sample size of population and selection bias with regard the tertiary reference center being associated with a risk of complicated course of epilepsy. Although we excluded subjects with the last seizure within 24 h of examination and more than 10 seizures in the last month, still, the presentation of anxiety disorder may be confounded with seizure phenomena. It is important to differentiate between a diagnosis of anxiety disorder and the occurrence of either ictal or postictal anxiety which could be experienced within 72 h of a seizure. These entities were partially excluded at the clinical interview as confounding factors in our patients. We did not explore convergent validity and test–retest reliability of the two STAI scales, but its psychometric properties are well-established [9].

6. Conclusions

The present study explored psychometric properties of the Spielberger STAI (STAI-S and the STAI-T, respectively) in a sample of PWEs from outpatient epilepsy clinic and identified a cutoff score to detect those PWE with anxiety disorders' diagnoses.

The study results indicate that STAI-T (but not STAI-S) is a valid and reliable psychometric instrument and will perform consistently in terms of screening for anxiety disorders in PWEs. In the epilepsy setting, STAI-T maintains adequate sensitivity, acceptable specificity, and high NPV but low PPV for diagnosing anxiety disorders, with an optimum cutoff score ≥ 52. Our results support the use of the STAI for screening for anxiety in PWEs.

Disclosure of conflicts of interest

No conflicts of interest exist.

Acknowledgment

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