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Performance of the GAD-7 in adults with dissociative seizures

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ABSTRACT

Purpose: Little is known about the accuracy of the GAD-7, a self-report anxiety measure, in detecting generalised anxiety disorder (GAD) in people with dissociative seizures (DS). We evaluated the reliability, validity and uniformity of the GAD-7 using a diagnosis of GAD on the Mini-International Neuropsychiatric Interview as a reference.

Methods: We assessed 368 adults with DS at the pre-randomisation phase of the CODES trial. Factor analysis for categorical data assessed GAD-7 uniformity. Diagnostic accuracy was assessed by estimating the area under the curve (AUC). We evaluated discriminant validity, reviewed data on convergent validity and calculated internal consistency. We explored correlations between GAD-7 scores and monthly DS frequency, frequency of severe seizures and measures of behavioural and emotional avoidance.

Results: Internal consistency of the GAD-7 was high ($\alpha = 0.92$). Factor analysis elicited one main factor and general measurement invariance. Diagnostic accuracy was fair (AUC = 0.72) but the best balance of sensitivity and specificity occurred at a cut-off of $\geq$12 and still had a specificity rate of only 68%. Discriminant and convergent validity were good. GAD-7 scores correlated positively with DS frequency, severe seizure frequency, behavioural and emotional avoidance (all $p < 0.001$).

Conclusion: Findings regarding internal consistency and factor structure parallel previous psychometric evaluations of the GAD-7. Correlations between GAD-7 scores and DS occurrence/severity and avoidance are evidence of the concept validity of GAD-7 and provide further support for a fear-avoidance treatment model for DS. However, the utility of the GAD-7 as a diagnostic instrument for generalised anxiety disorder is limited in patients with DS.

1. Introduction

Dissociative seizures (DS) are commonly described as involuntary behaviours, movements and sensations which strongly resemble epileptic seizures or syncope but cannot be explained by these or other medical disorders [1–3]. DS are characterised by reduced self-control and typically involve impairment of awareness. The International Classification of Diseases-10 (ICD-10) classified them as dissociative (conversion) convulsions and the recent ICD-11 guidelines place them in the spectrum of 'dissociative neurological symptom disorder' [4,5].

Despite ongoing uncertainties about the aetiology, it is well accepted that psychological factors are likely to be relevant in DS. Patients with DS have consistently been shown to have a higher incidence of psychiatric disorders, including anxiety disorders (11–50%), compared to the general population [3]. Previous studies also report increased levels of anxiety and depression in patients with DS compared to epilepsy (e.g., [6–10]) as well as heightened fear sensitivity [9] and agoraphobic avoidance [6,10]. Similarities in anxiety-related symptomatology

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between DS and panic disorder have also been identified [11]. Many DS patients experience autonomic arousal, as well as somatic and cognitive symptoms during their attacks, characteristics which also occur during a panic attack. However, these experiences are often not attributed to panic or paroxysmal anxiety by patients with DS [6]. Consistent with this, a study by Dimaro et al. [10] demonstrated a strong relationship between implicit anxiety scores and DS frequency, suggesting that anxiety plays a key role in the aetiology. The study also highlighted a correlation between a measure of explicit anxiety (the Spielberger State-Trait Anxiety scale [12]) and experiential avoidance (the Multidimensional Experiential Avoidance Questionnaire [13]) in people with DS. Indeed, the fear-avoidance model [14,15] has been used to underpin treatment of adults with DS [16–19] whereby a person's activities / behaviours and experiences are modified through fear of having DS and lifestyles become increasingly restricted; in the treatment of DS by our group [20] dealing with avoidance behaviour is a key aspect.

The Generalized Anxiety Disorder Assessment 7-item scale (GAD-7) is a practical, self-report instrument widely used to screen for anxiety in primary care and research settings [21,22]. It has also been used to assess anxiety in patients with DS (e.g., [23–26]). Despite its wide applications and use, the psychometric properties of the GAD-7 have not yet been examined in detail in people with DS; neither has the optimal cut-off score for an anxiety disorder been determined. The original validation article proposed a cut-off score of ≥10 to be the optimal predictor of clinically relevant GAD diagnoses [21], and this is widely applied in clinical services. Spitzer et al. [21] suggested that the GAD-7 might assume utility in assessing symptom severity and measuring change across time.

Our previous study exploring an optimal PHQ-9 cut-off score for the detection of clinically relevant depression in patients with DS [27] found that optimal cut-offs should be higher than those typically used for the scale. In this study we set out to determine whether the existing GAD-7 cut-offs are suitable for DS patients, or whether different cut-off scores may be more appropriate for this patient population.

The aims of this study were to

(a) assess the psychometric properties of the GAD-7 in patients with DS by examining its structural validity and reliability
(b) investigate the diagnostic accuracy of the GAD-7 in ascertaining anxiety symptom levels in DS patients likely to indicate the diagnosis of a current clinical anxiety disorder. We used the GAD-7 data from the CODES (COgnitive behaviour therapy vs standardized medical care for adults with Dissociative non-Epileptic Seizures) multi-centre randomised controlled trial ([19, 20] and the Mini - International Neuropsychiatric Interview [28] as the diagnostic reference
(c) explore clinical correlates of GAD-7 scores in people with DS, guided by Dimaro et al's [10] methodology, on the assumption that the GAD-7 would, as in its original standardisation, prove to have good internal consistency (reliability). As indicated above, Dimaro et al. [10] had investigated the relationships between anxiety and DS frequency and between anxiety and avoidance behaviour. Therefore, we examined the relationship between our current measure of explicit anxiety and seizure frequency. We also explored the correlation between GAD-7 scores and the Avoidance of People Places and Situations, a measure of behavioural avoidance used in the CODES study [29], and the Beliefs About Emotions Scale [30] which may be viewed as a measure of emotional and, potentially, experiential avoidance. By undertaking these exploratory analyses, we set out to find further supportive evidence for the contribution of anxiety and avoidance behaviours to DS.

2. Methods

2.1. Participants

Data were collected from 368 adults with DS who were recruited to the CODES trial, a pragmatic multi-centre randomised control trial that evaluated clinical outcomes and health service use following dissociative seizure specific cognitive behavioural therapy plus standardised medical care, vs standardised medical care alone. Data were collected between January 2015 and May 2017, following the provision of informed consent and prior to randomisation of participants. Details of inclusion and exclusion criteria and the two-stage recruitment process can be found elsewhere [20,31].

2.2. Measures

The Mini-International Neuropsychiatric Interview (M.I.N.I.; version 6) [28] was used in this study to provide a reference for a clinical diagnosis of Generalised Anxiety Disorder (GAD). This structured interview is used to identify psychiatric diagnoses according to DSM-IV criteria and also the ICD-10 [4]. All diagnoses except one (Antisocial Personality Disorder) are from Axis I. There are 17 modules which enquire about the symptoms for major psychiatric diagnoses, one of which is GAD. The reliability and validity of the M.I.N.I. have been described [32,33]. Those administering the M.I.N.I. in the current study were, as previously described [27], postgraduate research assistants with varied professional backgrounds and prior experience in mental health research but who had received a full-day's training from a neuropsychiatrist within the CODES project team in administering the M.I.N.I. The prevalence of the different psychiatric diagnoses identified using the M.I.N.I. in the 368 trial participants has been described elsewhere (e.g., [20,29]).

The General Anxiety Disorder Assessment-7 (GAD-7) [21] is used widely to assess the presence of generalised anxiety and its severity. The original standardisation study in a clinical population indicated good reliability (Cronbach's alpha = 0.92; test-retest-reliability intraclass correlation = 0.83) and it has been shown to have good levels of criterion, construct, factorial and procedural validity [21]. Higher levels of anxiety are represented by higher scores. Scores of ≥ 10 indicate high likelihood of GAD and it has been suggested that scores of 5, 10 and 15 might be used to represent mild, moderate and severe levels of generalised anxiety. The cut-off score of ≥10 was reported to optimise sensitivity (89%) and specificity (82%) when compared to a mental health practitioner diagnosis using DSM-IV [34] diagnostic criteria and a structured psychiatric interview.

Dissociative seizure frequency was measured in terms of monthly seizure frequency (captured from a seizure diary or a single question – see Goldstein et al. [19,20] for further explanation of calculation of the measure of DS frequency). In addition, participants recorded the number of severe seizures they had experienced over this time, either via seizure diaries or via a single question.

The Avoidance of People Places and Situations Scale (APPS) is a three-item scale designed for the CODES study [29] to measure the avoidance of people, activities and situations due to fear of having a seizure. The specific questions were: "How much have you avoided specific situations (e.g. being out in public alone, social gatherings, using public transport) for fear of having a seizure?"; "How much have you avoided other people for fear of having a seizure?" and "How much have you avoided specific activities (e.g. physical exertion, bathing unsupervised) for fear of having a seizure?". It was used in this study as a measure of behavioural avoidance. Each item was rated 0 ("never avoid") to 10 ("always avoid") with a total possible score of 30. The internal consistency of this scale is good (Cronbach's alpha = 0.83) [29].

The Belief About Emotions Scale (BES) [30] was used here as a measure of emotional avoidance. It is a 12-item scale that measures beliefs about the unacceptability of either experiencing or expressing

negative emotions. Example items include "If I am having difficulties it is important to put on a brave face", "I should not let myself give in to negative feelings" and "It would be a sign of weakness to show my emotions in public". The scale has good internal consistency (Cronbach's alpha (α) for patients with Chronic Fatigue Syndrome = 0.91, for controls α = 0.88) and validity; the scale has shown sensitivity to change [30]. Total scores range from 0 to 72 and higher scores reflect stronger self-reported beliefs about the unacceptability of negative emotions.

All of these measures (including the M.I.N.I. and the GAD-7) were administered to participants on the same occasion, following the giving of informed consent and prior to randomisation into the treatment phase of the CODES trial.

In addition, demographic and clinical information was collected about participants that related to their age, gender, dissociative seizure history and semiology, education and employment status, relationships and previous help-seeking for mental health conditions.

2.3. Statistical analysis

2.3.1. Structural validity and invariance

As the data were categorical the weighted least squares estimator method (WLSMV) [35] was used to assess the dimensionality (structural validity) of the GAD-7.

Exploratory factor analysis (EFA) was first conducted on a random split half of the data. Confirmatory factor analysis (CFA) was then conducted on the other half.

In EFA, the Guttman-Kaiser criterion (the number of eigenvalues above 1 [36,37]) and Parallel Analysis (the number of eigenvalues from the sample that are larger than the average of 1000 bootstrapped samples; [38]) were both used to determine how many factors to extract. The latter was computed in the GAD-7 data by using the R package 'random.polychor.pa' for categorical data [39]. Cattell's [40] scree plot was used to visualize the results. CFA was used to confirm the fit of the EFA suggested solutions.

The multiple indicator multiple cause (MIMIC) model [35,41] was used to evaluate the measurement invariance in relation to the gender of the participants. If the direct effect of gender on any item is significant, then measurement non-invariance (bias) with respect to gender is evident for that item.

Relative and absolute fit indices of the models were computed to determine how many factors to retain and to assess the model fit to the data. The goodness of fit indices included the relative chi-square (Relative χ^2: values <5 suggest a close fit) [42], the Root Mean Square Error of Approximation (RMSEA 90% CI: values <0.05 suggest close fit; values <0.08 indicate adequate fit) [43], the Comparative Fit Index (CFI: values > 0.95 are required for close fit) [43], the Tucker-Lewis Index (TLI: values >0.95 indicate close fit) [44], and the Standardized Root Mean Square Residual (SRMR: <0.05 are required for good fit) [43].

2.3.2. Reliability

The reliability of the GAD-7 in terms of internal consistency was assessed through Cronbach's alpha [45,46] and McDonald's Omega [46] (α and ω values above 0.7 were acceptable). Cronbach's alpha if item deleted (AID), inter-item correlations (IIC; satisfactory values between 0.3 and 0.8) and item total correlations (ITC; satisfactory item total correlation is indicated by values between 0.3 and 0.8) were also used to assess internal consistency [47].

2.3.3. Validity

Discriminant validity was assessed by comparing GAD-7 scores for participants who did or did not obtain a diagnosis of GAD on the M.I.N.I.

For this task we also created the receiver operating characteristic curves (ROC) [48] and we also performed ROC regression analysis [49] to assess the diagnostic accuracy of the GAD-7 in the presence of covariates (gender and age). The discriminative validity of each score is evaluated by the area under the curve (AUC) where values 0.9–1 indicate very good validity, 0.8–0.9 good validity, 0.7–0.8 fair validity, 0.6–0.7 poor validity and 0.5–0.6 failed to provide evidence for validity. We also report on Youden's index [50], which varies between zero and 1 (perfect test without false negatives or false positives).

Evidence of convergent validity of the scale, for example with other measures of mood, distress and quality of life in this population have been presented elsewhere [27].

Analyses were conducted in MPLUS v1.8 [51] and STATA 17.0 (StataCorp. 2021). Complete data were available for most of the analysis. In the rare occasion of one or two responses missing (out of 368), listwise deletion was used.

3. Results

3.1. Participants

In our sample of 368 adults with DS, 266 (72%) were women. The sample's median age was 35 years. The median age at DS onset was 29 years (IQR 19, 42) and modal age at onset was 19 years. The median length of time for which participants had experienced their DS prior to diagnosis in the CODES trial was 3 years (IQR 1, 8); mean duration of the disorder prior to diagnosis in the CODES trial was 6.2 (sd 8.8) years. Over half of the participants ($n = 195$; 53%) had received their diagnosis using video-encephalography (video-EEG). Where video-EEG had not been undertaken, diagnosis was achieved based on consensus [20]. In total, 130 (36%) had predominantly hypokinetic and 236 (65%) participants had predominantly hyperkinetic DS as rated by their clinician; this information was unavailable for two participants. Over half the sample (53%) were married or cohabiting, as opposed to being single, widowed or divorced. The majority of the sample (56%) had completed secondary or vocational education. Only 33% were currently in employment or education and there were high rates of receipt of state financial disability benefits (87%) by those aged <65 years, irrespective of whether or not they were working. Forty percent of the total sample reported having a carer who, in 53% of the cases, was their partner. The majority of the sample (241; 65%) reported they had previously sought assistance for a mental health problem. Further details about the sample can be found elsewhere [19,20,29]. As shown in Table 1 the mean GAD-7 score in this sample was 9.8 (sd 6.2). In addition, the mean APPS score was 17.6 (sd 9.0) and the mean BES score was 41.9 (sd 16.9).

While full details about M.I.N.I. diagnoses are reported elsewhere [20,29] the five most frequently identified M.I.N.I.-confirmed diagnoses were agoraphobia (45%), major depressive disorder (31%), generalised anxiety disorder (29%), posttraumatic stress disorder (23%) and social anxiety disorder (20%).

3.2. Structural validity and invariance

Exploratory factor analysis for the GAD-7 was performed on the first random half of the sample ($N = 194$) and CFA on the second ($N = 174$). The sample size was adequate for each model, as only seven items were involved and a one-to-two factor solution was anticipated [52].

The sample correlation matrix that emerged had only one eigenvalue above one (4.9) with the second being as low as 0.6. As depicted in the scree plot (Fig. 1), both parallel analysis and Guttman-Kaiser criteria suggested retaining one factor. The goodness of fit indices indicated acceptable fit (sample 1: rel χ^2=3.7, RMSEA=0.12 90% CI (0.085, 0.15), CFI=0.99, TLI=0.98, SRMR=0.059). Increasing the number of factors to two produced a second factor mainly consisting of secondary cross-loadings. Therefore, the one factor solution was accepted and confirmed in CFA (sample 2: rel χ^2=7.2, RMSEA=0.19 90% CI (0.156, 0.225), CFI=0.99, TLI=0.98, SRMR=0.047). All items had very strong loadings on the underlying trait (Table 1).

According to the MIMIC model in the full sample (rel χ^2=2,9, RMSEA=0.072 90% CI (0.054, 0.091), CFI=0.99, TLI=0.99,

Table 1
Descriptive indices, associations with age, factor analysis loadings, and reliability indices of the GAD-7 ($N = 368$).

Item	mean (sd)	Median (min -max)	Age rho/r	Loadings EFA (CFA)	ITC	AID
GAD-7_01 Feeling nervous, anxious, or on edge	1.4 (1.0)	1 (0–3)	−0.075	0.87 (1.00)	0.77	0.90
GAD-7_02 Not being able to stop or control worrying	1.4 (1.1)	1 (0–3)	−0.058	0.93 (1.08)	0.82	0.90
GAD-7_03 Worrying too much about different things	1.5 (1.1)	1 (0–3)	−0.132*	0.88 (1.02)	0.78	0.90
GAD-7_04 Having trouble relaxing	1.7 (1.1)	2 (0–3)	0.002	0.79 (0.92)	0.77	0.90
GAD-7_05 Being so restless that it is hard to sit still	1.1 (1.1)	1 (0–3)	0.038	0.66 (0.76)	0.64	0.91
GAD-7_06 Become easily annoyed or irritable	1.6 (1.1)	2 (0–3)	−0.105*	0.74 (0.86)	0.69	0.91
GAD-7_07 Feeling afraid as if something awful might happen	1.1 (1.1)	1 (0–3)	−0.039	0.82 (0.95)	0.73	0.91
GAD-7 total	9.8 (6.2)	10 (0–21)	−0.061	–	α=0.917, ω = 0.916	

rho = Spearman correlation coefficient; ITC = Item-total correlation; AID = Alpha if item deleted *$p < 0.05$; **$p < 0.01$.

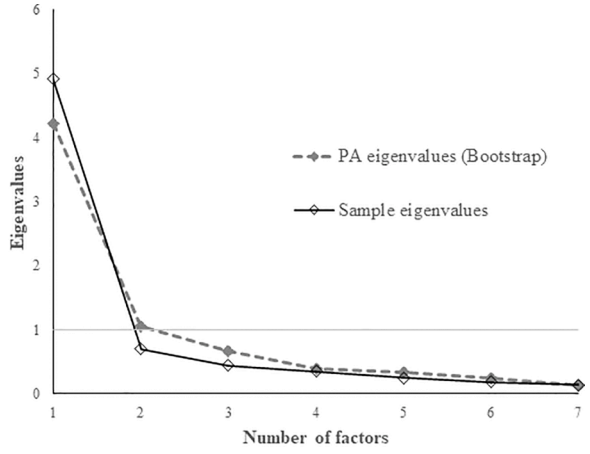

Fig. 1. GAD-7 Scree plot.

SRMR=0.044), two significant direct effects were present with respect to age, adjusted for gender. In particular, negative age effects were present on the GAD-7_03 item (Worrying too much about different things; de=−0.025, $p = 0.008$) and item GAD-7_06 (Become easily annoyed or irritable; de=−0.015, $p = 0.027$). For gender (adjusted for age) no significant direct effects emerged.

3.3. Reliability and validity

The internal consistency of the GAD-7 was satisfactory with both alpha and omega being higher than 0.9 (α = 0.917, ω = 0.916). No problematic items occurred (Table 1). Age correlated negatively and weakly with only two items (i.e., lower age was associated with higher anxiety scores on these measures; Table 1) and no gender differences occurred ($p > 0.1$ in all cases).

According to ROC curve analysis, the diagnostic accuracy of the GAD-7 total score was fair (AUC = 0.72, 95% CI (0.67, 0.79); Fig. 2). Neither participants' age nor gender affected the AUC significantly. Table 2 presents the sensitivity and the specificity of the GAD-7 scores at different levels. According to Youden's J criterion, a cut-off of 12 should be used as it allows for the largest J index. At this value, we observe an acceptable balance between the sensitivity and the specificity of the tool (approximately 68%). Above the value of 12 the sensitivity increases and below this value the specificity of the GAD-7 increases.

Discriminant validity was evident in that those who were diagnosed with GAD on the M.I.N.I. scored significantly higher on the GAD-7 than those without this diagnosis (GAD present: mean = 13.3 (5.4) vs GAD absent mean = 8.4 (5.9), $t = 7.599$, df = 216.9, $p < 0.0011$, Cohen's $d = 0.84$ 95% CI (0.61,1.1).

3.4. Clinical correlates

Higher GAD-7 total scores were associated with increased DS frequency, greater frequency of severe seizures, higher levels of behavioural avoidance (Avoidance of People Places and Situations – individual items and total score) and greater emotional avoidance (BES total score) (Table 3).

4. Discussion

The psychometric evaluation of the GAD-7 shows that, in our sample, the GAD-7 has good structural validity. Analysis revealed a single factor solution, measurement invariance with respect to gender (adjusted for age), and only minimal effects of age (adjusted for gender). In addition, the GAD-7 shows good internal consistency (reliability) in the current sample. The findings of a single factor solution, general measurement

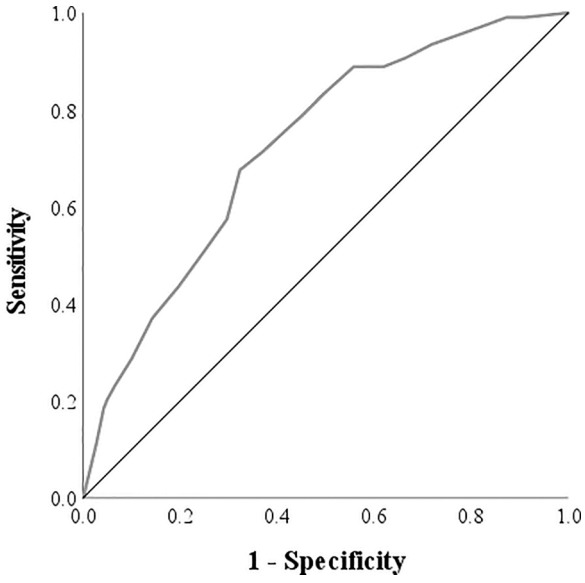

Fig. 2. Receiver operating characteristic curve for the GAD-7 total score, in relation to the M.I.N.I. diagnosis of GAD.

Table 2
Sensitivity, specificity and Youden's index for GAD-7 in relation to M.I.N.I. diagnosis of GAD.

GAD-7 total scores	Specificity	Sensitivity / True Positive Rate	False Positive Rate / (1-specificity)	Youden's Index
1	0.09	0.99	0.91	0.08
2	0.13	0.99	0.87	0.12
3	0.18	0.97	0.82	0.15
4	0.28	0.94	0.72	0.22
5	0.33	0.91	0.67	0.24
6	0.38	0.89	0.62	0.27
7	0.44	0.89	0.56	0.33
8	0.5	0.83	0.50	0.34
9	0.55	0.79	0.45	0.34
10	0.58	0.76	0.42	0.34
11	0.63	0.71	0.37	0.34
12	**0.68**	**0.68**	**0.32**	**0.35**
13	0.70	0.57	0.30	0.28
14	0.75	0.51	0.25	0.26
15	0.8	0.44	0.20	0.24
16	0.86	0.37	0.14	0.23
17	0.9	0.29	0.10	0.19
18	0.93	0.23	0.07	0.17
19	0.95	0.20	0.05	0.15
20	0.96	0.19	0.04	0.14
21	0.97	0.11	0.03	0.08

Table 3
Clinical correlates of the GAD-7: seizure frequency, seizure severity, behavioural avoidance and emotional avoidance.

Variable	GAD-7 Pearson r	p-value	N
Baseline monthly seizure frequency	0.213	<0.001	368
Baseline monthly severe seizure frequency	0.225	<0.001	368
Avoidance of People Places and Situations_01 How much have you avoided specific situations for fear of having a seizure?	0.291	<0.001	368
Avoidance of People Places and Situations_02 How much have you avoided other people for fear of having a seizure?	0.418	<0.001	368
Avoidance of People Places and Situations_03 How much have you avoided specific activities for fear of having a seizure?	0.250	<0.001	368
Avoidance of People Places and Situations Overall total avoidance score	0.383	<0.001	368
Beliefs About Emotions Scale	0.452	<0.001	367

invariance and good internal consistency are similar to results found in previous validation studies in clinical and general populations [21,22].

However, while there was evidence of discriminant validity when comparing GAD-7 scores for those with/without GAD diagnosis on the M.I.N.I., the ROC analysis showed an AUC < 0.8. Even allowing for the optimal value of Youden's Index, a cut-off score of 12 still yielded sub-optimal sensitivity and specificity, since a score of 12 would be likely to correctly identify only 68% of people with likely GAD and 32% would be wrongly categorised as likely to have GAD. The standard cut-off score of 10 based on previous studies would yield better sensitivity but worse specificity, and the correct classification levels at all cut offs are considerably lower in our DS patient population than those obtained in the original validation of the GAD-7 [21]. While previous comparisons were made against different reference standards this indicates that, in DS populations, GAD-7 can be used to measure the extent of anxiety symptoms but that it is not an effective screening test for GAD, and the quoted standard cut-off score of ≥10 should not be used to identify patients with likely GAD.

Evidence for convergent validity of GAD-7 in our population comes from the previous publication [27] of correlations with scores on the CORE-10 [53] (0.791, $p < 0.001$), SF-12v2 Mental Component Summary [54] (−0.712 $p < 0.001$), ED-5Q-5L [55] anxiety/depression subscale (0.675 $p < 0.001$) and the PHQ-9 depression scale [56] (0.779, $p < 0.001$). Thus, across the present and previous studies, we have evidence for structural and convergent validity of the GAD-7 in the DS population, using the GAD-7 as a dimensional measure of symptom severity rather than diagnostic certainty.

GAD-7 scores correlated with seizure frequency, frequency of severe seizures, and behavioural and experiential avoidance. However, we note that the correlations are mostly small in size, despite achieving statistical significance. The relationship between seizure frequency and GAD-7 supports findings from Dimaro et al. [10] using different measures of anxiety symptoms and DS burden. Results also support a relationship between anxiety and behavioural and emotional avoidance in people with DS. We also, in a further analysis, found a correlation between behavioural and experiential avoidance in this study ($r = 0.236$, $p < 0.001$). The correlation reported here between the currently-used measure of anxiety and the BES supports the original validation of the BES. This previous study showed a correlation between anxiety and BES scores in people with Chronic Fatigue Syndrome but not in healthy controls [30]. The finding of a correlation between the GAD-7 and BES in our sample of adults with DS supports Rimes and Chalder's [30] suggestion that the beliefs measured by the BES may actually represent a transdiagnostic vulnerability factor that can contribute to a range of clinical presentations. They posit that people with the kind of emotional difficulties reflected by the BES may have developed these negative beliefs and emotional avoidance as a consequence of having experienced negative reactions or a lack of sympathy from others. In people with DS, frequent accounts of abuse history and family dysfunction, and also stigmatisation by health professionals, may be relevant here. Rimes & Chalder further suggest that these negative beliefs about emotion may then act to perpetuate the person's symptoms or restricted functioning even if they did not contribute to symptom development. Although the current results are correlational, so cannot imply direction of the relationship, these findings, along with the suggestions of Rimes and Chalder, add further support to use of fear-avoidance model in treatment. Furthermore, Whitfield et al. [57] have identified a correlation between GAD-7 scores and measures of repetitive negative thinking (worry, rumination and perseverative thinking) and catastrophising in adults with DS; this interrelationship may further maintain fear (and other aspects of emotional avoidance) in people with DS. Addressing negative thinking is an aspect of the CBT intervention used in the CODES trial [19,20].

Our study has a number of limitations. The eligibility criteria for participants in CODES trial may limit generalisability of our findings as the study may have excluded people with more extreme psychopathology and also those people unwilling to engage in psychological treatment. The GAD-7 is a self-report measure (as are the measures of avoidance and seizure occurrence) which may be prone to response bias. However, the present analyses use patients' baseline scores prior to randomisation so our findings were unaffected by treatment arm allocation.

The M.I.N.I. was used for pragmatic reasons in this study to limit assessment burden for participants. A structured or semi-structured assessment by experienced psychiatrists might have led to different results and enabled us to calculate cut-off scores with better sensitivity and specificity. In addition, as noted with respect to our previous evaluation of the PHQ-9 [27], the GAD-7 is a continuous measure whereas the M.I.N.I. provides a categorical definition of GAD. The original validation of the GAD-7 [21] that yielded high sensitivity and specificity scores reported the assessment of participants by a mental health professional (social worker or clinical psychologist) who undertook structured psychiatric interviews using the SCID, modified with additional questions to assess in greater detail some of the GAD diagnostic criteria. In the CODES trial it was not feasible to use the SCID or have more detailed evaluations of possible GAD undertaken by clinicians.

Nonetheless, the study has a number of strengths. It benefitted from a

large sample of closely studied adults with DS drawn from multiple centres in the UK thereby removing bias that might be associated with recruiting participants from a small number of centres. In addition to the rigorous psychometric approach adopted here, it also adds to the knowledge base through its use of additional measures of experiential avoidance and behavioural avoidance.

5. Conclusions

While we confirmed a single factor structure, general measurement invariance, good internal consistency and evidence of discriminant and convergent validity of the GAD-7 in our sample of adults with DS, the GAD-7 does not appear to offer a stringent means of diagnosing GAD in adults with DS even though it can be used to measure symptom severity. Correlations between the GAD-7 and measures of behavioural and emotional avoidance lend support to a fear-avoidance model that can be employed in the psychological treatment of people with DS. Its convergent validity and correlations with clinically relevant measures suggest that GAD-7 is a useful dimensional measure of anxiety, even if it is only provides a fair estimation of categorical anxiety disorder.

Ethical publication statement

We confirm that we have read the Journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines. Ethical approval was granted by the London-Camberwell St Giles NRES Committee (reference number 13/LO/1595).

Declaration of Competing Interest

AC reports being a paid editor of the Journal of Neurology, Neurosurgery and Psychiatry, and is the director of a research programme on functional neurological disorders; he gives independent testimony in Court on a range of neuropsychiatric topics (50% pursuer, 50% defender). MR is the paid Editor-in-Chief of Seizure : European Journal of Epilepsy and receives authorship fees from Oxford University Press in relation to a number of books about dissociative seizures. JS reports independent expert testimony work for personal injury and medical negligence claims, royalties from UpToDate for articles on the functional neurological disorder and runs a free non-profit self-help website, www.neurosymptoms.org. The remaining authors have no conflicts of interest to declare.

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