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Psychometric properties of the dimensional anxiety scales for DSM-5 in a Brazilian community sample

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Abstract

The DSM-5 highlights the use of dimensional assessments of mental health as a supplement to categorical diagnoses. This study investigated the psychometric properties of the DSM-5 Dimensional Anxiety Scales in a Brazilian community sample. Dimensional scales for generalized anxiety disorder, social anxiety disorder, panic disorder, agoraphobia, and specific phobia were administered to 930 adults aged 18 to 70, 64.2% female. Psychometric properties investigated were: unidimensionality; measurement invariance; internal consistency; composite reliability; test-retest reliability; convergent and divergent validity; category thresholds and item performance analyses. Analyses revealed unidimensionality for all scales except for specific phobia. Measurement invariance, high internal consistency and composite reliability, and convergent and divergent validity were demonstrated. Test-retest reliability was high for all scales but generalized anxiety disorder. Item-based analyses evidenced that none of the items were very easy to endorse and that the scales offered more information about subjects with high severity estimates of anxiety. The DSM-5 Dimensional Anxiety Scales are a valid and reliable alternative to assess anxiety symptomatology in community settings, although further evaluation is needed, especially for specific phobia. The scales seem to be more useful for characterizing dimensionality of symptoms for subclinical or clinical cases than for slight or mildly anxious subjects.

KEYWORDS

anxiety, anxiety disorders, Dimensional Anxiety Scales; DSM, psychometrics

1 | INTRODUCTION

Anxiety and fear are natural responses to threat, involving cognitive, emotional, physiological and behavioral dimensions. However, when frequency, intensity and persistence of these responses are exaggerated, causing significant distress and impairment in people's lives, they may characterize an anxiety disorder (Craske et al., 2009). Anxiety disorders are the most prevalent group of mental disorders (Kessler, Chiu, Demler, Merikangas, & Walters, 2005).

The most up-to-date evidence-based criteria defining each disorder in the group of the anxiety disorders are specified in the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013). The DSM-5 was published as a result of efforts from expert researchers and clinicians all over the world discussing evidence-based revisions to the diagnostic criteria and related clinical features of all mental health disorders that were previously outlined in the fourth edition of the manual

(DSM-IV-TR; American Psychiatric Association, 2000). This previous edition – and all of the prior editions – limited the diagnosis to a categorical perspective, in which a series of fulfilled or not-fulfilled criteria result in a yes/no outcome representing the presence or absence of the mental disorder. One of the most important changes in DSM-5 as compared to previous editions of the manual was the introduction of dimensional assessments (section III) developed in order to complement the categorical diagnoses. Although the previous categorical approach may facilitate the diagnostic process for clinicians, it hinders research endeavors (Kraemer, Noda, & O'Hara, 2004; LeBeau, Bögels, Möler, & Craske, 2015) and does not fit well in current understanding of mental disorders (Coghill & Sonuga-Barke, 2012; Goldberg, 2000), especially of some anxiety disorders such as social anxiety disorder (Ruscio, 2010).

The dimensional approach highlighted in the DSM-5 present the understanding that healthy and pathological states of mental health are two poles in a *continuum*, assessing mental disorders in a

dimensional description of frequency and intensity of symptoms, and severity of impairment and distress related to them. The Dimensional Anxiety Scales (LeBeau et al., 2012) were designed to measure psychopathology considering this approach. The scales measure core symptoms of anxiety disorders in a concise and dimensional perspective (Wittchen, Heinig, & Beesdo-Baum, 2014). The Dimensional Anxiety Scales are a result of efforts from members and advisors from the Anxiety Disorders Subgroup of the DSM-5 Anxiety, Obsessive-compulsive (OC) Spectrum, Post-traumatic, and Dissociative Disorder Work Group, who developed a common template and disorder-specific items for the scales. The Dimensional Anxiety Scales consist of a set of five scales assessing Social Anxiety Disorder (SAD-D); Specific Phobia (SP-D); Agoraphobia (AG-D); Panic Disorder (PD-D); and Generalized Anxiety Disorder (GAD-D; LeBeau et al., 2012).

Psychometric evaluation of the original English version of the Dimensional Anxiety Scales in community and clinical samples revealed adequate internal consistency, convergent and divergent validity, and test-retest reliability (LeBeau et al., 2012), although the SP-D properties performed below expectations indicating the need of further refinement. Further studies have also demonstrated good psychometric properties of the German (Beesdo-Baum et al., 2012) and Dutch (Möller, Majdandžić, Craske, & Bögels, 2014) versions of the scales, including their clinical sensitivity to anxiety disorder categorical diagnoses (Knappe et al., 2013; Knappe et al., 2014).

However, to our knowledge no studies have yet investigated the adequacy of the scales to the Brazilian culture or to any other country in Latin America or in the group of developing countries, which constitute the majority world. Brazil is the largest country in area and population in Latin America and rated as the world's seventh largest economy (World Bank, 2014). Nonetheless the country faces many of the challenges attributed to emerging nations, with the Brazilian population experiencing a number of risk factors to psychopathology, such as pervasive poverty, family vulnerability and violence (Poletto & Koller, 2008). Adequate and up-to-date measures to assess mental disorders symptomatology are highly needed in emerging countries, such as Brazil, since they concentrate the majority of the population worldwide. Moreover, psychiatric disorders seem to be largely unrecognized and untreated due to several factors such as lack of government policy and trained clinicians, as well as inadequate funding in these countries (Kieling et al., 2011). Furthermore, no scale to assess some specific anxiety disorders – specific phobia and agoraphobia – is available as a valid and reliable measure for Brazilian population, as demonstrated in a recent systematic review of the literature about instruments to assess anxiety symptoms in Brazil (DeSousa, Moreno, Gauer, Manfro, & Koller, 2013). Therefore, the aim of this study was to cross-culturally adapt the Dimensional Anxiety Scales to Brazil and to investigate the psychometric properties of the scales in a Brazilian community sample. Specifically we examined: (1) factor structure (unidimensionality of the scales tested by means of confirmatory factor analysis [CFA]); (2) measurement invariance of the scales between genders and different research sites; (3) internal consistency and composite reliability; (4) test-retest reliability; (5) convergent and divergent validity; (6) category thresholds and item performance analyses.

2 | METHODS

2.1 | Participants and procedures

Participants were 930 young adults and adults recruited by convenience sampling from two large universities and five other educational institutions (e.g. schools for adults; post-graduation courses) in the Brazilian states of Rio Grande do Sul (RS, $n = 475$) and Minas Gerais (MG, $n = 455$). Students, teachers, professors, researchers and other workers in the institutions were invited to participate in the study. Classes were selected by convenience sampling within the institutions. The sample was 64.2% female ($n = 597$), and had a mean age of 22.34 years old (standard deviation [SD] = 6.03; range = 18–70). The scales were completed during class periods. After providing informed consent, participants completed the questionnaires individually in classrooms comprised of 20 to 30 subjects.

In order to assess convergent and divergent validity of the Dimensional Anxiety Scales, random subsamples ($143 \leq n \leq 211$) completed one of three other self-report measures of anxiety symptoms or a measure of attention-deficit/hyperactivity symptoms. This approach reduced the response burden of the participants by requesting them to answer fewer questionnaires. The convergent and divergent measures were chosen based on the same measures used in the original study of the development of the Dimensional Anxiety Scales (LeBeau et al., 2012) and considering measures already translated to Brazilian-Portuguese and investigated in Brazilian samples with good psychometric evidence.

In order to assess the test-retest reliability of the Dimensional Anxiety Scales, a subsample of 47 participants completed the scales again seven to nine days later. This subsample was chosen by convenience sampling of one class from each of the two universities where researchers had the permission to conduct a retest data collection. The test-retest subsample was 74.5% female and had a mean age of 20.24 years old (SD = 2.34, range = 18–29).

2.2 | Instruments

Each of the five disorder-specific Dimensional Anxiety Scales is composed of 10 items assessing the frequency of anxiety symptoms on a 5-point scale (0 = “never”; 1 = “occasionally”; 2 = “half of the time”; 3 = “most of the time”; 4 = “all of the time”; LeBeau et al., 2012). After permission was granted by the American Psychiatric Association to this study, the Dimensional Anxiety Scales were cross-culturally adapted to Brazil following recognized procedures based on specialized literature (Gjersing, Caplehorn, & Clausen, 2010) and on the International Test Commission (ITC) guidelines for translating and adapting tests (ITC, 2010). The Brazilian version of the scales is available upon request along with a summary of the cross-cultural adaptation process (set of translations, back-translations, review by experts, and pilot study refinements). The Dimensional Anxiety Scales are copyrighted by the American Psychiatric Association and can be used in clinical practice by acknowledging copyright.

The GAD-7 (Spitzer, Kroenke, Williams, & Lowe, 2006; Moreno et al., 2016) is a 7-item self-report scale that assesses the frequency of symptoms related to generalized anxiety disorder. This measure

was used to investigate convergent validity to the GAD-D. The Social Phobia Inventory (SPIN; Connor et al., 2000; Osório, Crippa, & Loureiro, 2009) is a 17-item self-report scale that assesses symptoms related to social anxiety disorder. This measure was used to investigate convergent validity to the SAD-D. The Panic Disorder Severity Scale – Self Report Version (PDSS-SR; Shear et al., 1997) is a 7-item self-report scale that assesses panic attacks, and anxiety symptoms and avoidance behaviors related to these attacks. This measure was used to investigate convergent validity to the PD-D. No scales were included to investigate convergent validity to the SP-D or AG-D due to the fact that no valid and reliable measures for these specific disorders are available in Brazil (DeSousa et al., 2013).

The Adult ADHD Self-Report Scale (ASRS) Screener (Kessler et al., 2007) is a 6-item self-report scale of the World Health Organization that assesses symptoms related to attention deficit hyperactivity disorder (ADHD). The official Brazilian-Portuguese translation of the ASRS available at the instrument website (Harvard Medical School, 2005) was used to investigate divergent validity to all Dimensional Anxiety Scales. We expected a significant positive correlation between the ASRS and the Dimensional Anxiety Scales scores since ADHD and anxiety disorders are somewhat comorbid conditions (Kessler et al., 2006). Nonetheless once ADHD is a conceptually distinct construct, we expected that the correlation between the ASRS and the Dimensional Anxiety Scales was significantly weaker than the correlations between convergent anxiety measures of the disorder-specific counterparts (e.g. it was expected that the correlation between GAD-D and GAD-7 is significantly stronger than the correlation between GAD-D and ASRS).

2.3 | Data analysis

CFA was used to examine whether the unidimensional structure of each Dimensional Anxiety Scale proposed by previous studies (e.g. Beesdo-Baum et al., 2012; LeBeau et al., 2012) would fit to the Brazilian data. CFA was conducted in Mplus using the weighted least squares means and variance adjusted (WLSMV) estimation method to account for the categorical ordinal nature of the scale items. For fit indices, we calculated the Comparative Fit Index (CFI), the Tucker–Lewis Index (TLI), and the root mean square error of approximation (RMSEA) with 90% confidence interval. Values of the CFI and TLI equal to or higher than 0.90 represent an acceptable fit, and higher than 0.95 represent a good fit. Values of the RMSEA equal to or lower than 0.08 represent an acceptable fit, and lower than 0.05 represent a good fit (Brown, 2006; Hu & Bentler, 1999). Standardized regression weights as factor loadings of the items were calculated in the CFA.

Multigroup CFA (MCFA) were conducted to examine the measurement invariance of the factor structure that best fit the data across genders ($n = 333$ for men and $n = 597$ for women) and research sites ($n = 475$ for RS and $n = 455$ for MG). In each MCFA we tested: (1) an unconstrained model to assess configural invariance, i.e. whether the scale configuration (unidimensionality) was acceptable for both groups; (2) a constrained model to assess metric invariance by constraining the factor loadings to be equal across groups; (3) a constrained model to assess scalar invariance by constraining the factor loadings and the intercepts/thresholds to be equal across groups.

Measurement invariance was tested examining the fit of the configural model, and after comparing the fit of the configural model to the fit of the metric model, and the fit of the metric model to the fit of the scalar model, through Δ CFI tests. A Δ CFI equal to or lower than 0.01 indicates factorial invariance for the evaluated parameter (Brown, 2006).

Cronbach's alpha coefficients were calculated to evaluate the internal consistency for each Dimensional Anxiety Scale. Alpha values above 0.70 were deemed adequate (Onwuegbuzie & Daniel, 2002). However, the Cronbach's alpha presents some limitations, such as the influence of the scale length on the magnitude of the coefficient (Cronbach, 1951). Therefore Raykov's model-based composite reliability was also calculated using the estimated standardized factor loadings and residual variances from the CFA (Raykov, 2004).

Test–retest reliability was determined by calculating the Intraclass Correlational Coefficients (ICCs) between the total score on each Dimensional Anxiety Scale at Time 1 and Time 2. ICCs were calculated in SPSS using Two-Way Mixed Effect Model and Absolute Agreement Type, with a confidence interval set to 95%. ICC estimates that exceeded 0.70 were deemed adequate (Murphy & Davidshofer, 1996).

Pearson correlations were calculated between the Dimensional Anxiety Scales scores and the other measures of psychopathological symptoms to assess convergent and divergent validity. The correlation coefficients for conceptually similar measures (e.g. GAD-D and GAD-7) indicated convergent validity and the coefficients for conceptually different measures (e.g. GAD-D and SPIN, or GAD-D and ASRS) indicated divergent validity. We used Z tests to assess if the magnitude of the correlations were significantly higher for convergent instruments than for divergent instruments (Meng, Rosenthal, & Rubin, 1992).

Regarding item performance analyses, we estimated the category thresholds of the items (T1, T2, T3, and T4), representing the latent factor level at which there is 50% probability of endorsing a given response option or higher. In this case, T1 = endorsing “occasionally” OR higher; T2 = endorsing “half of the time” OR higher; T3 = endorsing “most of the time” OR “all of the time”; T4 = endorsing “all of the time”. The mean of the thresholds for each item was computed to provide an estimate of the item difficulty, i.e. the item location in the severity continuum represented by the latent factor estimate. Item Characteristic Curves were plotted for each item representing a function of the probability of endorsing each of the response option categories along the latent trait of each scale estimated by the latent factor scores. Finally, the Test Information Function (TIF) curves were plotted for each Dimensional Anxiety Scale. The TIF depicts how well the test score discriminates among individuals at various levels of the latent trait being measured and the precision of this measurement at each level of the given trait. All item performance analyses were conducted based on the CFA results in Mplus software version 7.11.

3 | RESULTS

3.1 | Descriptive statistics

Descriptive analyses of means and SDs, medians and quartiles, and ranges of responses to the Dimensional Anxiety Scales and the other

self-report measures are depicted in Table 1. The lowest means were reported in the PD-D, whereas the highest ones were found in the GAD-D. Nonetheless the range of the scores was similar for all scales, showing that although the prevalence of symptoms differs among the disorders, their severity for those who endorse the symptoms does follow a similar pattern.

3.2 | Factor structure

The CFA results are shown in Table 2. Mixed evidence was found for the unidimensional models tested for each of the dimensional scales, i.e. there was acceptable to good CFI and TLI but unacceptable RMSEA for all scales but the PD-D. *Post hoc* analyses investigating modification indices for improving the fit of the model suggested a strong local dependency between items 6 and 7 of all scales. These two items are the ones assessing avoidance and escape behaviors, respectively, associated with the anxiety symptoms.

A new set of CFA were conducted adding the correlations between errors of these two items in the model to account for this local dependency. Fit indices of these new models revealed good CFI and TLI for all scales and acceptable to good RMSEA for all scales but the SP-D (Table 2). The correlation coefficients of these local dependency estimates between the errors of items 6 and 7 were: 0.354 for the GAD-D; 0.620 for the SAD-D; 0.480 for the PD-D; 0.756 for the SP-D; and 0.612 for the AG-D (all significant at $p < 0.0001$).

The standardized regression weights (factor loadings) of the items in the best fit models of are depicted in Table 3. All items showed adequate loadings in all scales, i.e. above 0.40. For all scales with the exception of the AG-D, the item 2 ("felt anxious, worried, or nervous [about each disorder-specific situation of interest]") presented the highest factor loading. For the AG-D, item 3 ("had thoughts about

panic attacks, uncomfortable physical sensations, getting lost, or being overcome with fear in these situations") presented the highest loading, followed by item 2.

3.3 | Measurement invariance

The MCFA results showed that fit indices for the unconstrained and constrained models were similar to the ones of the CFA. Table 2 reports the SAD-D MCFA results as example (further MCFA results are available upon request). Since the ΔCFI were not significant, i.e. were below 0.10, support was found for the measurement invariance of the Dimensional Anxiety Scales for males and females, from both research sites.

3.4 | Internal consistency and composite reliability

Table 4 depicts the reliability estimates of the scales. Cronbach's alpha coefficients were adequate for all scales. Alpha coefficients were also adequate for gender and research site subsamples. The model-based composite reliability was also adequate for all scales (all above 0.70).

3.5 | Test-retest reliability

ICCs calculated between the scores of the Dimensional Anxiety Scales completed at Times 1 and 2 were adequate for all scales but the GAD-D. The highest ICC was found for social anxiety symptomatology (Table 4). All correlations were statistically significant at $p < 0.001$.

3.6 | Convergent and divergent validity

Convergent validity was demonstrated for the three Dimensional Anxiety Scales tested (GAD-D, SAD-D, and PD-D) and their previously validated counterparts (Table 5, italic typeface). Results of the Z tests evidenced divergent validity of the scales as well, since the correlation coefficients for the corresponding measures were significantly higher than the correlation coefficients for the non-corresponding anxiety measures and the correlation coefficient for the ADHD measure (all $p < 0.05$).

3.7 | Category thresholds and item performance analyses

Table 3 depicts the category thresholds of the items in each Dimensional Anxiety Scale and the severity estimation (location) of each item by calculating the mean of its four category thresholds. Some items consistently presented lower (e.g. item 2) or higher (e.g. item 4) severity estimates across all scales, while other items presented low severity estimates for some of the scales and high estimates for others (e.g. item 6). Nonetheless, all items presented location above the mean level of the correspondent latent trait (0 mark in the latent trait estimate), which indicates the items in the Dimensional Anxiety Scales are fairly difficult to endorse in general. More specifically, all items in the PD-D and AG-D presented locations above the +1 SD mark in the latent trait, being the scales that presented the highest mean

TABLE 1 Descriptive statistics of the Dimensional Anxiety Scales and other self-report measures

Instrument	Mean (SD)	Median (quartiles 25%; 75%)	Range	Possible range of scores
<i>Dimensional Anxiety Scales</i>				
GAD-D	8.83 (6.26)	7 (4; 12)	0–35	0–40
SAD-D	6.54 (6.62)	4 (2; 9)	0–37	0–40
PD-D	2.89 (5.54)	1 (0; 3)	0–38	0–40
SP-D	6.49 (7.75)	4 (1; 9)	0–40	0–40
AG-D	3.96 (5.84)	2 (0; 5)	0–35	0–40
<i>Convergent and divergent measures</i>				
GAD-7	7.96 (5.57)	7 (3; 12)	0–21	0–21
SPIN	15.31 (9.50)	14 (8; 22)	0–44	0–68
PDSS-SR	2.01 (3.98)	0 (0; 2)	0–23	0–28
ASRS	11.17 (4.74)	11 (7; 14)	2–24	0–24

Note: SD, standard deviation; GAD-D, generalized anxiety disorder dimensional scale; SAD-D, social anxiety disorder dimensional scale; PD-D, panic disorder dimensional scale; SP-D, specific phobia dimensional scale; AG-D, agoraphobia dimensional scale; GAD-7, GAD-7 questionnaire; SPIN, social phobia inventory; PDSS-SR, panic disorder severity scale – self report version; ASRS, Adult ADHD self-report scale screener.

TABLE 2 Fit indices of the Dimensional Anxiety Scales unidimensional models tested by means of confirmatory factor analysis (CFA) and multigroup CFA (MCFA)

	χ^2 (df)	CFI	TLI	RMSEA [90% CI]	Δ CFI
CFA					
GAD-D	331.04 (35)	.947	.932	.095 [.086–.105]	
SAD-D	526.04 (35)	.946	.930	.123 [.114–.132]	
PD-D	211.97 (35)	.989	.986	.074 [.064–.083]	
SP-D	927.09 (35)	.953	.940	.166 [.156–.175]	
AG-D	300.19 (35)	.982	.977	.090 [.081–.100]	
<i>CFA local dependency items 6 and 7</i>					
GAD-D	249.99 (34)	.962	.949	.083 [.073–.092]	
SAD-D	210.26 (34)	.980	.974	.075 [.065–.085]	
PD-D	169.93 (34)	.992	.989	.066 [.056–.076]	
SP-D	407.38 (34)	.981	.974	.109 [.099–.118]	
AG-D	131.37 (34)	.993	.991	.055 [.046–.066]	
MCFA (SAD-D)					
Gender (male $\times$ female)					
(a) Configural invariance	264.16 (68)	.980	.973	.079 [.069–.089]	
(b) Metric invariance	278.11 (77)	.979	.976	.075 [.066–.085]	.001
(c) Scalar invariance	259.98 (106)	.984	.986	.056 [.047–.065]	.005
Research site (RS $\times$ MG)					
(a) Configural invariance	248.93 (68)	.981	.975	.076 [.066–.086]	
(b) Metric invariance	250.44 (77)	.982	.979	.070 [.060–.079]	.001
(c) Scalar invariance	230.92 (106)	.987	.989	.050 [.041–.059]	.005

Note: GAD-D, generalized anxiety disorder dimensional scale; SAD-D, social anxiety disorder dimensional scale; PD-D, panic disorder dimensional scale; SP-D, specific phobia dimensional scale; AG-D, agoraphobia dimensional scale; CFI, Comparative Fit Index; TLI, Tucker–Lewis Index; RMSEA [90% CI], root mean square error of approximation with 90% confidence interval.

severity estimates for participants to endorse higher categories of response of the items.

Item Characteristic Curves were obtained for each item for all five scales. Figure 1 presents the curves for the items in the SAD-D as an example. The remaining scales presented comparable results (data available upon request). For the majority of the items, the Item Characteristic Curves revealed that the probability of endorsing categories “occasionally”, “half of the time”, “most of the time” and “all of the time” is higher than the probability of answering “never” for respondents who have mean levels of the correspondent latent traits. In addition, the categories indicating more frequent symptoms are only endorsed by respondents with very severe levels of the latent trait of anxiety.

Figure 2 depicts the TIF curves of each of the scales total scores as a measure of how well the scales scores discriminate among individuals at various levels of the anxiety latent traits being measured. All scales scores offer more information about subjects who presented high severity estimates of their latent trait (i.e. above the mean). Moreover the PD-D and the AG-D were the scales that had the highest precision of measurement at these high estimate levels of the latent trait.

4 | DISCUSSION

The present study investigated psychometric properties of the Dimensional Anxiety Scales in a Brazilian community sample. Our

results suggest that the Dimensional Anxiety Scales have appropriate psychometric properties and can be considered a valid and reliable instrument to the assessment of anxiety symptoms, as examined in six domains: (1) factor structure (unidimensionality); (2) measurement invariance across genders and research sites; (3) internal consistency and composite reliability; (4) test–retest reliability; (5) convergent and divergent validity; (6) category thresholds and item performance analyses.

Considering the frequency means and medians of anxiety symptoms in the sample across the scales, generalized anxiety disorder symptomatology demonstrated the highest prevalence whereas panic disorder symptomatology demonstrated the lowest one. This would be expected in a community sample assessment given that daily worries and tension at times are common to normal individuals whereas panic attacks are much less frequent. Nonetheless, there was a wide range of scores for all scales. Therefore even though less people endorsed the items in the PD-D, the ones who did endorse them presented severity estimates similarly to the ones who endorsed the items in the more prevalent symptoms scales such as GAD-D. This differentiation is important to highlight the fact that low means in the scale scores refer to the prevalence of symptoms in that sample rather than rates of severity of the disorders (LeBeau et al., 2012).

Results of the CFA showed evidence of unidimensionality for each of the scales but the SP-D, which presented mixed results. The SP-D already presented mixed evidence of adequacy in previous studies when considering test–retest reliability (LeBeau et al., 2012; Knappe

TABLE 3 Confirmatory Factor Analysis (CFA) factor loadings and category thresholds (difficulty/severity) of the Dimensional Anxiety Scales items

Scale	Item	CFA factor loadings		CFA item performance analyses				
		Loading	SE	T1	T2	T3	T4	LOC
GAD-D	1	.692	.025	.355	1.477	—	2.003	1.278
	2	.758	.02	−1.600	.011	.639	1.600	.163
	3	.601	.026	−.138	1.030	1.493	2.263	1.162
	4	.682	.027	.568	1.394	1.929	2.627	1.630
	5	.745	.019	−.549	.543	1.136	1.753	.721
	6	.459	.031	−.201	.793	1.251	1.895	.935
	7	.648	.026	.396	1.162	1.671	2.169	1.350
	8	.709	.021	−.473	.455	1.025	1.629	.659
	9	.644	.024	−.378	.700	1.228	1.806	.839
	10	.724	.025	.396	1.141	1.535	2.024	1.274
SAD-D	1	.815	.019	.497	1.461	1.983	2.551	1.623
	2	.852	.014	−.440	.707	1.332	1.929	.882
	3	.707	.021	.008	.998	1.423	1.864	1.073
	4	.774	.021	.603	1.373	1.766	2.339	1.520
	5	.812	.017	.084	1.067	1.493	2.263	1.227
	6	.655	.026	.267	1.146	1.671	2.263	1.337
	7	.664	.023	.092	1.020	1.553	2.067	1.183
	8	.761	.018	−.204	.659	1.223	1.766	.861
	9	.757	.021	.242	1.025	1.477	1.946	1.173
	10	.730	.025	.800	1.493	1.834	2.091	1.554
PD-D	1	.903	.013	.842	1.571	2.141	2.627	1.795
	2	.932	.011	.967	1.535	1.895	2.382	1.695
	3	.885	.015	.857	1.438	1.820	2.263	1.595
	4	.855	.018	.819	1.671	2.003	2.627	1.780
	5	.793	.020	.278	1.200	1.609	2.115	1.301
	6	.859	.018	.963	1.581	1.879	2.229	1.663
	7	.888	.017	1.211	1.820	2.263	2.551	1.961
	8	.902	.014	1.057	1.619	2.003	2.431	1.778
	9	.877	.015	.873	1.430	1.792	2.339	1.609
	10	.921	.015	1.234	1.661	1.912	2.263	1.768
SP-D	1	.873	.012	.149	1.111	1.501	2.003	1.191
	2	.909	.009	−.201	.885	1.394	1.946	1.006
	3	.792	.016	.182	1.034	1.544	2.169	1.232
	4	.871	.012	.443	1.136	1.553	2.091	1.306
	5	.894	.010	.078	.913	1.359	1.983	1.083
	6	.727	.020	.165	.861	1.189	1.493	.927
	7	.719	.022	.364	1.025	1.306	1.682	1.094
	8	.870	.014	.571	1.146	1.477	1.912	1.277
	9	.800	.016	.204	.897	1.211	1.729	1.010
	10	.753	.027	1.067	1.509	1.779	1.983	1.584
AG-D	1	.862	.015	.603	1.394	1.946	2.724	1.667
	2	.866	.014	−.084	1.081	1.600	2.229	1.207
	3	.876	.014	.735	1.430	1.834	2.382	1.595
	4	.863	.016	.804	1.485	1.929	2.724	1.735
	5	.861	.014	.332	1.223	1.779	2.299	1.408
	6	.795	.020	.753	1.469	1.834	2.263	1.580
	7	.791	.021	.845	1.527	1.864	2.724	1.740
	8	.824	.019	.804	1.469	1.895	2.339	1.627
	9	.846	.015	.515	1.206	1.619	2.024	1.341
	10	.802	.023	1.126	1.729	2.115	2.486	1.864

Note: GAD-D, generalized anxiety disorder dimensional scale; SAD-D, social anxiety disorder dimensional scale; PD-D, panic disorder dimensional scale; SP-D, specific phobia dimensional scale; AG-D, agoraphobia dimensional scale; SE, standard error; LOC, location of the difficulty (severity) of the item in the latent trait (i.e. mean of the T category thresholds).

TABLE 4 Reliability coefficients of the Dimensional Anxiety Scales unidimensional models: Cronbach's alpha for internal consistency; Raykov's Ω for model-based composite reliability; and Intraclass Correlation Coefficient (ICC) for test–retest reliability

Scale	Internal consistency – Cronbach's alpha					Raykov's Ω	ICC
	Male (n = 333)	Female (n = 597)	RS (n = 475)	MG (n = 455)	Total (N = 930)	Total (N = 930)	Total (n = 47)
GAD-D	.842	.847	.849	.849	.851	.787	.544
SAD-D	.899	.899	.903	.894	.899	.883	.836
PD-D	.925	.936	.917	.942	.934	.965	.799
SP-D	.899	.928	.928	.920	.925	.935	.790
AG-D	.905	.925	.921	.922	.923	.944	.789

Note: GAD-D, generalized anxiety disorder dimensional scale; SAD-D, social anxiety disorder dimensional scale; PD-D, panic disorder dimensional scale; SP-D, specific phobia dimensional scale; AG-D, agoraphobia dimensional scale.

TABLE 5 Pearson correlations between convergent and divergent validity instruments

	GAD-7	SPIN	PDSS-SR	ASRS
GAD-D	.769**	.500**	.647**	.558**
SAD-D	.615**	.713**	.658**	.474**
PD-D	.518**	.345**	.824**	.418**
SD-D	.468**	.226*	.460**	.343**
AG-D	.548**	.396**	.732**	.408**

Note: GAD-D, generalized anxiety disorder dimensional scale; SAD-D, social anxiety disorder dimensional scale; PD-D, panic disorder dimensional scale; GAD-7, GAD-7 questionnaire; SPIN, Social Phobia Inventory; PDSS-SR, Panic Disorder Severity Scale – Self Report Version; ASRS, Adult ADHD Self-report Scale Screener.

*P-value <0.01; **P-value <0.001.

et al., 2014) and sensitivity and specificity to differentiate individuals with and without threshold for anxiety diagnosis (Beesdo-Baum et al., 2012). In line with the argument of LeBeau et al. (2012), the SP-D seems to be the scale most in need of further refinement. However in our study the adjustment of the fit of the CFA models in the Brazilian sample acknowledged a strong local dependency

between items 6 and 7 for all Dimensional Anxiety Scales. Previous CFA results with the German version of the scales (Beesdo-Baum et al., 2012) did not assume this local dependency and demonstrated CFI and TLI results very similar to the indices in our first CFA not assuming local dependency as well. However our residual indices of the first CFA recommended the local dependency estimation between items 6 and 7. These two items assess behavioral responses in anxiety symptomatology (avoidance and escape behavior, respectively). Further CFA studies in different settings testing these unidimensional models with and without local dependency assumptions are needed to provide more evidence about the factor structure of the scales. Nonetheless our results suggest that behavioral responses are strictly connected in anxiety disorders, and that avoidance and escape behavior co-occur presenting a higher correlation between themselves than with the remaining anxiety symptoms assessed by the Dimensional Anxiety Scales. This is in line with DSM-5 criteria for anxiety disorders in general, which highlight avoidance as a specific criterion for these disorders (American Psychiatric Association, 2013). Indeed the generalized anxiety disorder in the DSM-5 is the only one of the five anxiety disorders investigated in this study that does not specify avoidance behavior as a criterion for its diagnosis (American Psychiatric Association, 2013). However, the local dependency was

FIGURE 1 Item response curves of the social anxiety disorder dimensional scale (SAD-D)

FIGURE 2 Test Information Function curves of the Dimensional Anxiety Scales

still recommended for the GAD-D, suggesting that avoidance/escape behavior is a somewhat specific feature of generalized anxiety disorder as well.

Results of the MCFA supported a similar pattern of anxiety symptoms between men and women, from both research sites where data were collected, suggesting that the Dimensional Anxiety Scales can be scored and interpreted similarly in these groups in the Brazilian population. To our knowledge this was the first study to test the measurement invariance of the Dimensional Anxiety Scales by means of multigroup CFA. Measurement invariance is an important feature because it supports that the measured constructs have the same meaning across these groups, and therefore group comparisons of the scale scores reflect true group differences in the latent trait rather than being driven by group-specific attributes unrelated to the construct of interest. Furthermore all items in all scales presented factor loadings above 0.45, evidencing the construct validity of the Dimensional Anxiety Scales.

Our findings showed good internal consistency indices for all Dimensional Anxiety Scales scores, in line with previous results from the samples examined in the study of LeBeau et al. (2012). Good internal consistency indices were maintained in the gender subsamples and the research sites subsamples in the present study, providing reliability evidence for the scales. Furthermore, our model-based composite reliability coefficients were adequate for all scales, in line with the findings of Beesdo-Baum et al. (2012).

The test-retest reliability estimates were adequate for all scales but the GAD-D, in contrast with previous findings (Knappe et al., 2014; LeBeau et al., 2012) that showed acceptable test-retest reliability for the GAD-D but not for the SP-D. One possible explanation for this conflicting finding might be the different time frame used in the scales in the present study. In the study of LeBeau et al. (2012), the first version of the Dimensional Anxiety Scales used requested participants to answer about their symptoms during the past month. In the present study, we used the final version of the Dimensional Anxiety Scales that is available in the DSM-5, which requests responders to focus on the past seven days. However further studies are needed to clarify this finding. Our current test-retest analysis is also limited due to the relatively low sample size and arbitrary seven-day time frame between test and retest applications. Future studies should examine

larger samples and different retest time frames to search for evidence to understand these conflicting results.

The convergent validity of the GAD-D, SAD-D, and PD-D was demonstrated with strong correlations to other valid measures of these constructs, in line with previous results from LeBeau et al. (2012) that used the same concurrent measures (i.e. GAD-7, SPIN, and PDSS-SR). We also demonstrated divergent validity of these scales by stronger correlations with their anxiety measure counterparts than to with the ADHD measure used here. However as previously mentioned, concurrent validity analyses could not be conducted for SP-D and AG-D due to the non-existence of valid and reliable self-report measures for these specific anxiety disorders in Brazil (DeSousa et al., 2013). Future studies can also benefit from investigating the discriminant validity of the Dimensional Anxiety Scales in Brazil through the use of interview schedules and other instruments that are available to assess anxiety disorder diagnoses in the Brazilian population.

In line with previous findings from Item Response Theory analyses (Beesdo-Baum et al., 2012), our item performance results within the CFA demonstrated that none of the items in the scales was very easy to endorse. Some specific items were extremely difficult, especially those related to needing help to cope with the anxiety symptoms (the examples given in the scales refer to use of alcohol, medicine, seek for social support from others, and use of superstitious objects). The difficulty in these items indicate that even the participants who presented a high estimated anxiety level as their latent trait still had higher probability of endorsing lower frequencies when considering seeking for help to cope with their anxiety. Results of the category thresholds of the items, item characteristic curves and TIF curves altogether demonstrated that the Dimensional Anxiety Scales easily capture the variance in subjects who present levels of symptoms above the mean estimated latent trait, whereas the variance of anxiety in subjects with levels of symptoms below the mean of the latent trait seems under-represented. This suggests that the scales are well-suited for differentiating subjects within the spectrum of high level of anxiety symptoms, but not for subjects with low levels of anxiety. Therefore the scales might be more useful for characterizing dimensionality of anxiety symptoms for subclinical or clinical cases than for little or mildly anxious subjects.

The present study has some limitations that need to be taken into consideration. First, our participants were recruited from urban areas from two specific regions in Brazil. Brazil is the largest and most populous country in South America, with several regional variations. Hence, the extent to which our results apply to other Brazilian regions and population living in non-urban settlements is unknown. Second, our sample was predominantly young and actively engaged in some type of educational institution, which limits the generalizability of our findings to older and less-educated populations. Third, although investigating evidence of validity in non-clinical samples is an important first step in test construction, further studies should examine the psychometric properties of the Brazilian-Portuguese version of the Dimensional Anxiety Scales in clinical settings as well. Fourth, there are psychometric properties of the Dimensional Anxiety Scales yet to be tested in the Brazilian population, such as the discriminant validity of the scales, their sensitivity and specificity regarding the diagnosis of anxiety disorders, extent to which they are sensitive to treatment response, and differential item functioning. Previous research has proven the clinical utility of the scales in other countries, such as Germany, focusing on sensitivity to clinical severity (Knappe et al., 2013) and treatment response (Knappe et al., 2014), and therefore future studies examining these properties in samples from the majority of the world are encouraged.

Despite these limitations, there are some strengths in the present study that should be emphasized. First, our study examined refined psychometric properties related to the factor structure of the scales, such as the measurement invariance of the unidimensionality of the scales across genders and research sites. Second, the use of widely recognized measures for investigating convergent and divergent validity strengthen our criterion validity evidence. Third, item performance analyses provided psychometric evidence of adequacy of the scales on an item-based approach, surpassing the limitations of classical test theory analyses, and offering information about item responses rather than just scale total scores.

The recent changes in the psychiatric assessment of anxiety disorders brought by the DSM-5 acknowledge the limitation of using solely a categorical diagnostic system. The dimensional scales provided in the fifth edition of the manual supplement the traditional categorical diagnoses with continuous measures of anxiety symptomatology. The Dimensional Anxiety Scales are a set of brief scales consistent in form and content across the different anxiety disorders. Their common template allows researchers to use data collected with the instrument to compare disorder presentations across the various anxiety disorders. In conclusion, evidence of adequate psychometric properties was found for the Brazilian-Portuguese version of the scales in general, supporting their use to help clinicians, researchers and other practitioners in the assessment of anxiety symptoms and disorders.

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