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Marwin Carmo, Ila Marques Porto Linares, Leo Paulos-Guarnieri, Maria Laura Nogueira Pires, Kristoffer Bothelius, and Renatha El Rafihi-Ferreira

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Psychometric examination of the Sleep Problems Acceptance Questionnaire with a Brazilian sample: Insights on validity and measurement invariance

Short title: Psychometric examination of the Sleep Problems Acceptance Questionnaire

Marwin Carmo[1,2], Ila Marques Porto Linares[2], Leo Paulos-Guarnieri[2], Maria Laura Nogueira Pires[3], Kristoffer Bothelius[4], and Renatha El Rafihi-Ferreira[5]

[1]Department of Psychology, University of California, Davis, Davis, USA.
[2]Department of Psychiatry, University of São Paulo, São Paulo, Brazil.
[3]Department of Psychiatry, Universidade Estadual Paulista Julio de Mesquita Filho, Assis, São Paulo, Brazil.
[4]Department of Surgical Sciences; Pain, Uppsala Universitet, Uppsala, Sweden.
[5]Department of Clinical Psychology, University of São Paulo, São Paulo, Brazil.

Corresponding Author:
Marwin Carmo 135 Young Hall, One Shields Avenue, Davis, CA 95616, USA
Email: mmcarmo@ucdavis.edu
Phone: +1 530-760-8026

Abstract

Objective: Sleep health has evolved from focusing on specific disorders, such as insomnia and sleep apnea, to a broader perspective that includes regularity, efficiency, and socio-environmental influences. Psychological flexibility, particularly the acceptance process, has been identified as a key protective factor for sleep health. Therefore, assessing acceptance of sleep difficulties is essential for both research and clinical practice, as it provides insights into adaptive coping and informs interventions. The Sleep Problem Acceptance Questionnaire (SPAQ) is the only validated instrument for assessing acceptance of sleep difficulties, making it a valuable tool for interventions based on Acceptance and Commitment Therapy (ACT). This study aimed to adapt the SPAQ for Brazilian Portuguese, ensuring both semantic and psychometric equivalence.

Methods: The adaptation process included translation, back-translation, expert review, and pilot testing. The final version was validated in a sample of 1,352 participants, including individuals with insomnia and healthy controls.

Results: Confirmatory factor analysis supported the original two-factor structure (Activity Engagement and Willingness) with good model fit indices. We found evidence for stability of measurement properties across 14 days, but inconclusive evidence regarding the structural invariance between groups of good and poor sleepers. Reliability was high for both factors. Convergent validity was confirmed, showing negative correlations between acceptance and insomnia severity, psychological inflexibility, anxiety, and depression.

Conclusion: The Brazilian adaptation of the SPAQ shows adequate psychometric properties and is a valuable tool for clinicians and researchers. However, caution is needed when comparing scores across groups of good and bad sleepers, as item-level differences may affect structural comparability.

Keywords: sleep problems, acceptance, validation, psychometrics.

Introduction

Sleep research, initially focused on specific issues such as insomnia, sleep apnea, and inadequate sleep duration, has evolved into the concept of sleep health. This broader and more positive perspective considers regularity, efficiency, satisfaction, and socio-environmental influences.[1] Research shows that 35% of adults do not get the recommended minimum of seven hours of sleep per night, 30–35% exhibit insomnia symptoms, and up to 10% meet the criteria for clinical insomnia.[2–4] Sleep health reflects the absence of sleep disorders and overall well-being, highlighting racial and socioeconomic disparities and providing opportunities for interventions to improve health outcomes1.[5]

Sleep health views sleep as a vital aspect of physical, mental, and social well-being. This perspective closely aligns with the principles of Acceptance and Commitment Therapy (ACT), which emphasizes the individual's relationship to internal experiences, such as thoughts, sensations, and emotions in the context of sleep, rather than attempting to eliminate or alter those experiences.[6]

Unlike traditional Cognitive-Behavioral Therapy (CBT), which typically seeks symptom reduction by challenging and modifying dysfunctional cognitions and behaviors,[7] ACT

cultivates psychological flexibility.[6,8] Psychological flexibility and associated processes are particularly relevant to sleep health, as they act beyond merely reducing sleep problems or controlling symptoms.[9]

Psychological flexibility is a key concept in Acceptance and Commitment Therapy (ACT).[7] It is defined as the ability to engage with ongoing current experiences while intentionally directing attention in a flexible manner. This process allows individuals to maintain a fluid sense of self, enabling value-based actions.[10] One of the key processes underpinning psychological flexibility is acceptance.[7] In insomnia, acceptance means experiencing unwanted perceptions, feelings, and thoughts related to sleep difficulties without trying to change them.[8] Psychological flexibility has been identified as an important protective factor for sleep health in clinical and non-clinical populations, with acceptance playing a vital role in this relationship.[6,11]

Review studies provide compelling evidence that lower levels of psychological flexibility are linked to symptoms of depression and anxiety.[12–15] Additional evidence suggests that psychological inflexibility correlates with higher levels of sleep difficulty, even after accounting for depressive symptoms.[16] Compared to other components of psychological flexibility, acceptance shows stronger associations with sleep quality and insomnia severity.[11] Thus, adopting an adaptive stance that embraces naturally occurring sleep processes may help reduce arousal and prevent the perpetuation of sleep disturbances.[17]

The Sleep Problem Acceptance Questionnaire (SPAQ)[18] one of the only measure of acceptance of sleep difficulties with validated scores, other than the recently published Sleep Acceptance Scale (SAS)[19]. Adapted from the Chronic Pain Acceptance Questionnaire,[20] SPAQ is increasingly used as an assessment tool in ACT-based interventions for insomnia, either alongside or as an alternative to broader measures of acceptance.[9] Randomized clinical trials evaluating the efficacy of ACT for insomnia have used the SPAQ to assess changes in acceptance of sleep problems finding that participants who received the treatment not only showed significant reductions in insomnia severity but also demonstrated significant improvements in psychological flexibility and in the acceptance of sleep problems.[21-23]

The SPAQ aims to examine the role of acceptance concerning sleep quality. Its items were intentionally designed to resemble acceptance questionnaires used in other behavioral medicine contexts. The questionnaire consists of two factors, each comprising four items rated on a seven-point scale, where 0 indicates “Disagree,” and

6 indicates “Completely agree.” SPAQ is formed by two factors of Activity Engagement (AE) and Willingness (WIL), which were negatively correlated in its development study (r = -0.26).[18] AE reflects the persistence of normal activities despite dissatisfaction with sleep, while WIL measures the ability to relinquish attempts to fight or control sleep problems. It is important to note that this negative correlation between the two factors originates from WIL items being reverse-scored, indicating that they measure *Unwillingness*.

Despite the importance of studying acceptance in sleep problems,[24] to the best of our knowledge, there are currently no cultural adaptations or validations of the SPAQ in languages other than English. Moreover, other than the SAS, there are currently no other instruments in Brazilian-Portuguese that specifically assess acceptance or psychological flexibility in relation to sleep problems.

Given SPAQ’s relevance and uniqueness for measuring acceptance of sleep problems and the lack of a proper translation of the scale for Brazilian-Portuguese speakers, our goal was to translate the scale and analyze its psychometric properties. Specifically, using latent variable modeling, we aimed to confirm its original two-factor structure and assess its reliability. Furthermore, we sought to find convergent validity evidence by testing whether higher scores on acceptance would be negatively associated with insomnia severity, psychological inflexibility, and symptoms of anxiety and depression.

Methods

Participants and sampling

We collected data from individuals with insomnia symptoms enrolled in a randomized controlled trial to compare the effectiveness of an ACT-based protocol and CBT for insomnia in adults[23] and healthy controls (without insomnia) enrolled in a cross-sectional study about personality traits and insomnia.[25] Participants were recruited through social media and newspaper advertisements between 2021 and 2022. Interested volunteers accessed the REDCap web platform to complete a screening process to determine eligibility. The eligibility criteria included being 18 to 59 years old and able to read and write in Portuguese. Participants were classified as good sleepers if they reported not experiencing any difficulty falling or staying asleep, as outlined in the Diagnostic and Statistical Manual of Mental Disorders.[26] Additionally, they needed a total score of less than seven on the Insomnia Severity Index.

Participants who met any of these criteria were included as bad sleepers. The study received approval from the Research Ethics Committee of the University of São Paulo Medical School Hospital (HC-FMUSP, CAAE: 46284821.1.0000.0068), and all participants provided informed consent electronically.

Translation of the SPAQ

The translation of the SPAQ followed general cross-cultural adaptation recommendations.[27,28] Initially, three independent translators translated the original English items into Portuguese. An expert committee of insomnia health professionals then synthesized these versions and documented their decisions in a form.[29] Two native speakers back-translated the synthesized version into English, and we reconciled it into a single version for review by the original authors. After discussing their suggestions, we adjusted the translation accordingly. Finally, we conducted a pilot study with 15 participants (12 females) from the target population, with an average age of 43 years (19–57 years). Participants generally understood the test items and instructions well. However, those without sleep issues struggled with some ambiguous SPAQ items. For example, some disagreed with the first question, as they interpreted it as not having sleep problems despite feeling they live normally. After discussions with the original authors, we added a note in the instructions encouraging participants to consider any sleep difficulties, no matter how minor, when answering. The Brazilian-Portuguese final version of the SPAQ can be found in the supplemental materials. Intermediate instrument versions and decision criteria documentation are available at https://osf.io/av45j/.

Measures

Insomnia Severity Index (ISI)

The Insomnia Severity Index[30,31] is a retrospective measure of insomnia experience over the previous month. Participants responded to items using a 0 (no severity) to 4 (high severity) Likert scale, resulting in total scores from 0 to 28, representing varying degrees of insomnia severity (0–7: absent; 8–14: mild; 15–21: moderate; 22–28: severe). A unidimensional model fitted to our data resulted in good incremental fit indices but poor absolute fit: $\chi^2(14) = 327.56$, $p < 0.001$, RMSEA = 0.129, 90% CI

[0.117, 0.141], CFI = 0.996, TLI = 0.994, and SRMR = 0.048. We also found high reliability for the ISI, ω = 0.95 95% CI [0.95, 0.96].

Hospital anxiety and depression scale (HADS)

The HADS[32,33] measures anxiety and depression symptoms in hospital settings. It comprises 14 items divided into two subscales (Anxiety and Depression). Each subscale yields a score from 0 to 21, with higher scores indicating greater symptom severity. A common cutoff point of 9 differentiates between the presence and absence of anxiety/depression. A two-factor model corresponding to this structure demonstrated an acceptable fit to our data: $\chi^2(76) = 551.11$, $p < 0.001$, RMSEA = 0.068, 90% CI [0.063, 0.073], CFI = 0.993, TLI = 0.992, and SRMR = 0.047. Reliability for both the Anxiety (ω = 0.91, 95% CI [0.90, 0.92]) and Depression (ω = 0.88, 95% CI [0.87, 0.89]) subscales was high.

Acceptance and action questionnaire-II (AAQ-II)

The AAQ-II[34,35] is a self-report instrument to assess experiential avoidance and psychological inflexibility. Participants rate items on a 7-point scale (1 = not true to 7 = always true), with higher scores reflecting greater levels of experiential avoidance. Consistent with the literature, a unidimensional model fitted to the seven items of the scale resulted in good incremental fit indices but a poor absolute fit: $\chi^2(14) = 434.73$, $p < 0.001$, RMSEA = 0.149, 90% CI [0.147, 0.137], CFI = 0.996, TLI = 0.994, and SRMR = 0.047. The scale demonstrated high reliability (ω= 0.97, 95% CI [0.96, 0.97]).

Statistical Analyses

Because items 5, 6, 7, and 8 are reverse-scored, agreement with these items reflects *Unwillingness*. Therefore, to maintain consistency with the construct's name, we reversed scores on these items before the statistical analysis, such that higher scores reflect *Willingness*. Data and code used in the analyses are available at https://osf.io/av45j/.

We reviewed item statistics before conducting the main analyses, including variation, distribution, and inter-item correlation. We also assessed the presence of multivariate outliers using the Mahalanobis distance and identified points of influence with the generalized Cook's distance (gCD) using the R package *faoutlier*[36] version 0.7.6.

After conducting these analyses, we evaluated the SPAQ's structural validity by testing its original two-factor structure through Confirmatory Factor Analysis (CFA). This was performed using the R package *lavaan*[37] version 0.6.12 with a Diagonally Weighted Least Squares (DWLS) estimator. Due to the ordinal nature of the item response scale, DWLS is generally preferred over robust Maximum Likelihood estimators.[38] Model fit was assessed using several fit statistics, including chi-squared, Comparative Fit Index (CFI), Tucker–Lewis index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). The cutoff values for a good model fit were defined as SRMR ≤ .08, RMSEA ideally less than 0.06 but less than 0.08 also acceptable, and CFI and TLI ≥ .96.[39] The CFA plot was generated using the *semPlot* package.[40]

To evaluate the reliability of AE and WIL factors, we calculated a categorical omega (ω) point estimate along with a bias-corrected and accelerated bootstrap confidence interval (based on 1000 bootstrap samples) via the R package *MBESS,*[41] version 4.9.2. We considered reliability values above 0.70 acceptable.[42]

To ensure that the construct was measured equivalently between groups of good and poor sleepers, as well as across time (baseline assessment and a second administration 14 days later), we conducted a series of measurement invariance tests using a stepwise approach through multigroup confirmatory factor analysis (MGCFA). For group comparisons, we first assessed configural invariance to confirm that the factor structure was consistent across groups. This was followed by tests for equal slopes (metric invariance), equal threshold invariance (strong invariance), and equal unique factor variances (strict invariance).[43,44] Similarly, for longitudinal comparisons, we tested the same levels of invariance to evaluate whether the measurement properties remained stable across baseline and a second assessment 14 days later. To compare the nested models, we used the χ^2 difference test in addition to differences in approximate fit indices (CFI and RMSEA), given the high sensitivity of the χ^2 test to misspecification. There are numerous recommendations for evaluating measurement invariance and hardly an one-size-fits-all solution.[45] Based on similarities with our study, we follow a general guideline that, in addition to a non-significant chi-square difference, we judge the model does not differ from the previous model if ΔCFI ≤ 0.004 and ΔRMSEA ≤ 0.05 for slope invariance and ΔRMSEA ≤ 0.01 for threshold invariance.[46] All analyses were conducted using the R package *semTools*[47] version 0.5-6.

We also examined potential differences in item clustering between groups of good and bad sleepers using Exploratory Graph Analysis (EGA).[48] EGA is a method similar to Exploratory Factor Analysis (EFA) that identifies communities within network models. It also performs at least as well as more traditional EFA methods and offers advantages such as: not requiring a rotation method for interpreting first-order factors, and autonomously assigning items to factors.[49] Although network and latent variable models offer different perspectives on the causal mechanisms behind the observed variables, communities in networks are statistically comparable to factors in latent variable models.[50] In the latent variable framework, symptoms are seen as causal outcomes of a latent variable, while in psychometric networks, their relationships are understood as a system of causal interactions among them.[51] In the network representation, each node is an item, and the edge connecting them represents the partial correlation between any two items (i.e., the correlation between a pair of items after controlling for the effect of all the other items). We conducted the EGA using graphical lasso (glasso) for edge selection and the Walktrap algorithm for community detection. This analysis was performed with the *EGAnet*[52] R package version 2.0.7.

To assess convergent validity, we examined the relationships between the latent factors of the SPAQ (AE and WIL) and related theoretical constructs using structural equation modeling (SEM). Specifically, we estimated the latent correlations between SPAQ factors and measures of insomnia severity (ISI), depression (HADS-Depression), anxiety (HADS-Anxiety), and psychological inflexibility (AAQ-II). We anticipated negative associations with all constructs, meaning that higher levels of acceptance of sleep problems should correlate with lower levels of insomnia severity, anxiety, depression, and psychological inflexibility. These relationships were tested in a single SEM model to evaluate how well the constructs aligned with our theoretical expectations. The analyses were performed using the DWLS estimator in the *lavaan*[37] package.

Results

Since all survey items were mandatory for submission, we did not observe missing data for the SPAQ after excluding participants who did not complete the questionnaire. Using the Mahalanobis' distance, we identified 28 participants with D^2 values with probability values lower than 0.001 (considering a distribution with df = 9). These cases

were inspected individually, and their response pattern was considered normal. Therefore, none were excluded in this step. However, three highly influential cases were removed based on the visual inspection of the box plot of generalized Cook's distance values. The final sample consisted of 1352 individuals, 80.4% female and 74.8% with sleep problems. Ages ranged from 18 to 59.8 years (M = 38.54, SD = 9.79). Table 1 describes the sample, and Table 2 presents the statistics for the items.

Table 1. Demographic characteristics of study participants by sleep group.

	Bad sleepers (N = 1011)	Good sleepers (N = 341)
Age [mean(sd)]	38.99 (10.02)	37.19 (8.96)
Female (%)	794 (78.5)	293 (85.9)
Race (%)		
Asian	33 (3.3)	14 (4.1)
Black	247 (24.4)	75 (22.0)
White	719 (71.1)	251 (73.6)
Other/Not informed	12 (1.2)	1 (0.3)
Marital status = Unpartnered (%)	547 (54.1)	159 (46.6)
Education (%)		
Higher education	752 (74.4)	301 (88.3)
Secondary school	243 (24.0)	39 (11.4)
Primary school	16 (1.6)	1 (0.3)
Employment status = Working (%)	884 (87.4)	321 (94.1)

Table 2. Item-level descriptive statistics (Mean, SD, Quartiles) for SPAQ by sleep group.

	Bad sleepers				Good sleepers			
Item	Mean	SD	25%	75%	Mean	SD	25%	75%
1. Although things have changed, I am living a normal life despite my sleeping problems.	3.04	1.76	2.00	4.00	2.82	2.58	0.00	6.00
2. I lead a full life even though I have sleeping problems.	2.48	1.82	1.00	4.00	2.64	2.55	0.00	5.00
3. My life is going well, even though I have sleeping problems.	2.67	1.79	1.00	4.00	2.79	2.59	0.00	6.00
4. Despite the sleeping problems, I am now sticking to a certain course in my life.	3.01	1.85	1.00	5.00	2.91	2.62	0.00	6.00
5. Keeping my sleeping problems under control takes first priority.	4.29	1.60	3.00	6.00	1.83	2.23	0.00	4.00
6. I need to concentrate on getting rid of my sleeping problems.	4.70	1.50	4.00	6.00	1.48	2.08	0.00	3.00
7. It’s important to keep on fighting these sleeping problems.	5.15	1.32	5.00	6.00	1.78	2.30	0.00	4.00
8. My thoughts and feelings about my sleeping problems must change before I can take important steps in my life.	3.73	1.90	2.00	5.00	1.47	2.08	0.00	3.00

Confirmatory Factor Analysis and Reliability

The original two-factor model provided satisfactory fit indices: $\chi^2(28) = 170.45$, $p < 0.001$, RMSEA = 0.077, 90% CI [0.066, 0.088], CFI = 0.999, TLI = 0.998, and SRMR = 0.044. Figure 1 shows that all standardized factor loadings were equal to or greater than 0.75 across both factors. The correlation between AE and WIL was negative and weak (-0.10), and the reliability of the two factors was high (ω_{AE}= 0.95 [0.94, 0.96], ω_{WIL}= 0.90 [0.89, 0.91]).

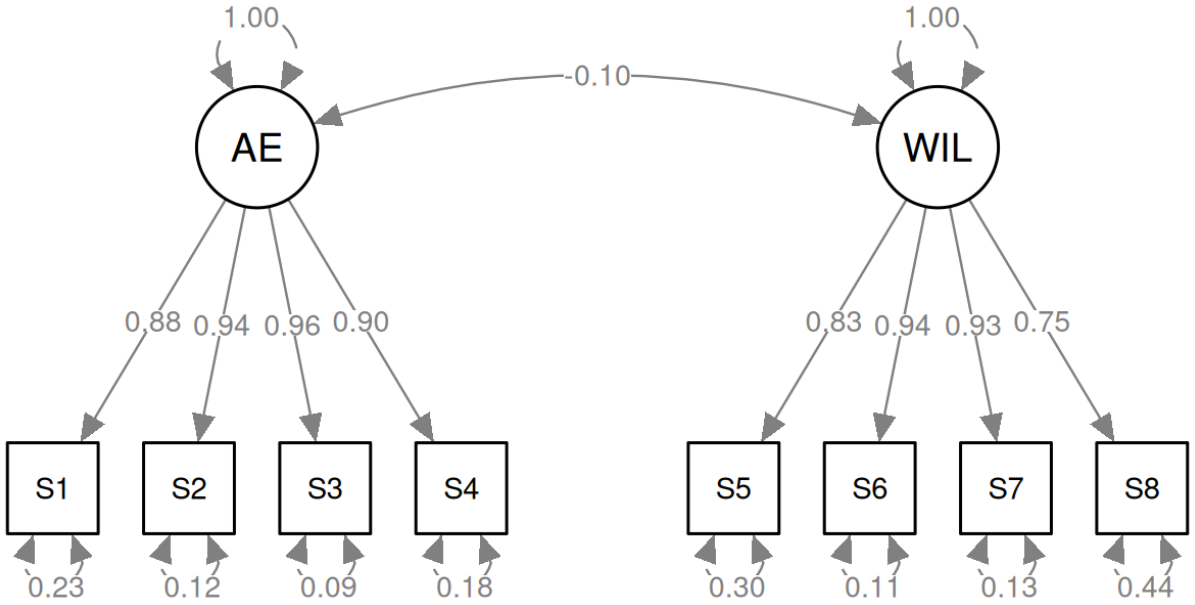

Figure 1. Two-factor confirmatory factor analysis model of the SPAQ. Circles are latent variables where AE = Activity Engagement and WIL = Willingness. Squares indicate the items identified by their ordering in the questionnaire. Numbers on single-headed arrows indicate standardized factor loadings. The number on the double-headed solid arrow indicates a latent correlation. Numbers on double-headed dashed arrows indicate residual variances.

Convergent Validity

The SEM model constructed to evaluate convergent validity demonstrated good fit: $\chi^2(579) = 3177.15$, $p < 0.001$, RMSEA = 0.058, 90% CI [0.056, 0.060], CFI = 0.995, TLI = 0.995, and SRMR = 0.041. AE showed moderate negative correlations with Psychological Inflexibility (-0.355), Anxiety (-0.310), and Depression (-0.444), as well as weak negative correlations with Insomnia severity (-0.19). Additionally, negative strong and moderate-to-strong correlations were observed between WIL and Insomnia severity (-0.737), Anxiety (-0.503), Psychological Inflexibility (-0.447), and Depression

(-0.445). These findings align with theoretical expectations, thereby supporting the convergent validity of the SPAQ factors.

Measurement Invariance

Multigroup Confirmatory Factor Analysis

When testing invariance across groups, we found no support even for the configural invariance: $\chi^2(38) = 297.57$, $p < 0.001$, RMSEA = 0.101, 90% CI [0.090, 0.111], CFI = 0.998. Based on the significant chi-square test and RMSEA > 0.10, we could assume that the equivalence of the underlying model structure across good and bad sleepers does not hold.

To better understand this dissimilarity between groups, we fitted two separate CFA models for good and bad sleepers, using the same SPAQ proposed structure. We found that the model was a “perfect” fit to good sleepers: $\chi^2(19) = 18.75$, $p = 0.473$, RMSEA ≈ 0, 90% CI [0, 0.047], CFI ≈ 1, TLI ≈ 1, and SRMR = 0.023. Despite the seemingly excellent results, they are more likely to result from convergence problems, given that indicators like items 1, 2, 3, 4, and 7 had all near-zero estimated variance. No negative variances or inadmissible parameter estimates were found. Conversely, for bad sleepers, the model fit poorly: $\chi^2(19) = 228.89$, $p < 0.001$, RMSEA = 0.105, 90% CI [0.093, 0.117], CFI = 0.993, TLI = 0.990, and SRMR = 0.068. Modification indices indicated that the discrepancy between the two groups is likely due to the need for correlations between items in the bad sleepers group, which are assumed to be zero, conditioning on the latent variable. For example, the highest modification index suggested a cross-loading between item 8 and the AE factor. Others were correlations between items 3 and 4 and items 1 and 2. Interestingly, we found that for good sleepers, the correlation between AE and WIL is negative and strong (-0.652), while for bad sleepers, it is weak and positive (0.260). That can explain the weak negative correlation between factors when examining the entire sample. These correlations likely cancel each other out.

In the test for longitudinal measurement invariance, we found better evidence for configural invariance: $\chi^2(90) = 484.71$, $p < 0.001$, RMSEA = 0.062, 90% CI [0.057, 0.068], CFI = 0.998, TLI = 0.998, and SRMR = 0.045. The fit of the metric model did not deteriorate substantially compared to the configural model, indicating that the assumption of equal factor loadings across time points holds ($\chi^2(6) = 4.41$, $p = 0.621$,

ΔCFI ≈ 0; ΔRMSEA = 0.002). When testing threshold invariance, the change in comparative fit indices were within the expected limits, but the chi-square test was significant: $\chi^2(38) = 76.88$, $p < 0.001$, ΔCFI = 0; ΔRMSEA = 0.007. Similar evidence was observed for strict invariance testing ($\chi^2(8) \approx 0$, $p \approx 1$, ΔCFI ≈ 0; ΔRMSEA ≈ 0.002). These results suggest at least moderate evidence of invariance between assessment occasions regarding the pattern of factor loadings, the value of factor loadings, and the thresholds that define the boundaries between response categories. This means that participants likely interpreted the response scale in a similar manner. Additionally, the support for strict invariance indicates that the amount of unique, item-specific variance remained stable over time, suggesting no changes in measurement error and item-specific influences.

We also evaluated if latent means were equivalent across the two 14-day assessment points. A model constraining the latent means of AE and WIL to be equal across time was compared against the model of threshold invariance. This constrain resulted in a significant worsening of model fit by means of the chi-square test ($\chi^2(2) = 13.89$, $p < 0.001$), but a negligible change in alternative fit indices with RMSEA and CFI differences all approximately zero, suggesting that the practical magnitude of this change was very small.

Exploratory Graph Analysis

In a subsequent analysis, we employed Exploratory Graph Analysis (EGA) to investigate whether items would group differently across various subgroups. Whether examining the entire sample or the individual subgroups, EGA consistently identified two communities aligned with the proposed structure of the SPAQ. Figure 2 displays the network models estimated for both subgroups and the full sample.

Before interpreting the results, several considerations must be addressed. In CFA, communities are formed by the causal effects of a latent variable, while in EGA, groups are formed based on the density of connections among nodes within the network. This explains why the graphs in Figure 2 illustrate associations between items from different groups. Additionally, the absence of edges between nodes does not indicate a lack of modeled association; instead, the glasso algorithm introduces sparsity into the graph, reducing small edge strengths to zero, simplifying the graph structure.

The EGA results align with some of our intuitions from the MGCFA analysis. The violation of configural invariance may not necessarily indicate different item groupings for good and poor sleepers. Furthermore, as shown in Figure 2 Panel A, all associations between items from different communities are positive, while for good sleepers (Panel B), these associations are negative. This discrepancy in the direction of associations is reflected in the CFA model as a difference in the signs of covariances between latent factors. Ultimately, the graph depicting the full sample exhibits fewer connections between communities, corresponding to the weak covariance between factors observed in the CFA that includes all participants.

However, it is important to note that this analysis was purely exploratory, and any conclusions drawn from the EGA results are primarily speculative. Additionally, issues arising from some items having near-zero variance will likely impact the EGA results as they do in CFA.

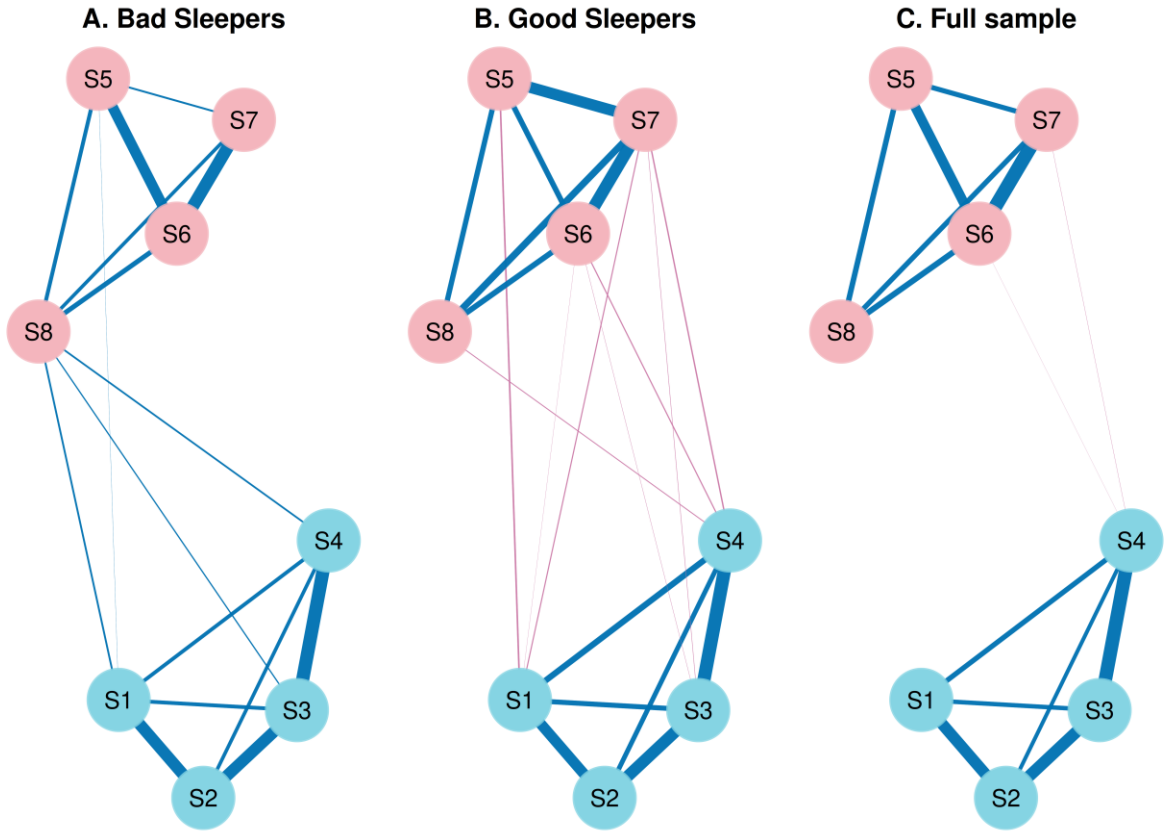

Figure 2. Weighted graph structure of the SPAQ's items obtained with EGA. Panel A is the graph obtained with the sample of bad sleepers, Panel B is the graph for good sleepers, and Panel C shows the graph obtained with all participants combined. For all graphs, the nodes represent each of the eight items, and the edges are the partial correlations between them. The strength of the partial correlations is depicted as the edge thickness, and the direction is the

edge color, where blue represents positive associations and red represents negative ones. The different node colors identify the two distinct communities identified by the Walktrap algorithm, meaning that nodes with the same color belong to the same community. For example, we observe, in general, strong positive associations between nodes within the same community, represented by thick blue lines.

Discussion

Psychological flexibility and acceptance are relevant concepts in the field of sleep health, highlighting the importance of appropriate instruments for assessing these constructs. The SPAQ was originally adapted to evaluate acceptance and engagement in activities related to sleep problems.[18] In this study, we developed a Brazilian Portuguese version of the SPAQ, demonstrating semantic and psychometric equivalence with the original version, making the instrument suitable for the Brazilian population. Consistent with the original SPAQ, we identified a two-factor structure, Active Engagement (AE) and Willingness (WIL).[18] Our findings showed that the scores on the SPAQ remained consistent over 14 days. However, there was inconclusive evidence regarding the structural invariance between groups of good and poor sleepers. To our knowledge, this is the first study to examine the psychometric properties of the SPAQ in a new sample. We build on the original findings by utilizing a larger sample that includes participants without sleep problems and investigating longitudinal and group measurement invariance.

The SPAQ consists of two structures that correspond to distinct concepts. WIL reflects an individual's acceptance of experiencing the interfering effects of sleep problems and their attempts to control sleep. In contrast, AE represents the persistence in maintaining normal, value-driven activities despite experiencing the daytime consequences of sleep disturbances. When examining the entire sample, we found a weak negative correlation between these two latent variables. The negative correlation reported by SPAQ's authors[18] represents the inverse association between Active Engagement and Unwillingness. However, examining latent correlations separately showed that the subsample of good sleepers pushed this negative association. We found a positive correlation of 0.26 between AE and WIL for bad sleepers, agreeing with the original study's direction and effect size. Given these two factors' conceptual and psychometric differences, researchers and clinicians must be mindful when

interpreting the overall SPAQ score. Rather than focusing solely on the total score, it is recommended to consider each factor separately.

It is important to consider the clinical implications of the SPAQ's two factors. Since they represent weakly correlated constructs, changes on each may reflect different effects of intervention components. While WIL refers to acceptance-related behaviors concerning sleep, AE refers to value-based engagement behaviors. As psychological flexibility is divided into the processes of Openness to Experience, Behavioral Awareness, and Valued Action (Francis et al., 2016), changes in the scores of different factors may reflect the effects of distinct processes. Accordingly, the WIL factor may be more closely related to processes of Openness to Experience and Behavioral Awareness, whereas the AE factor may be more strongly associated with processes of Valued Action.

The WIL factor assesses acceptance in the specific context of sleep, aligning with theoretical models that emphasize the role of acceptance in sleep.[24] Nevertheless, given its associations with the AAQ-II, it is possible that sleep-specific acceptance overlaps with the broader construct of general acceptance. Furthermore, it has been suggested that aspects of acceptance may represent either state- or trait-like characteristics of the individual, although evidence supporting this distinction remains limited.[54] Future studies using intensive longitudinal designs could evaluate the dynamics of acceptance to investigate whether it represents states or traits, as well as the clinical implications of such differentiation.

The good fit indices obtained with a CFA, coupled with the high reliability of both subscales, provide evidence generally associated with sound structural validity of a scale. Moreover, regarding convergent validity, the WIL factor was negatively correlated with insomnia severity, psychological inflexibility, anxiety, and depression, aligning with past findings.[12–15,18] These results suggest that individuals with lower acceptance of sleep difficulties tend to exhibit reduced psychological flexibility, worse sleep outcomes, and higher levels of anxiety and depression. Similarly, the AE factor showed negative correlations with insomnia severity, psychological inflexibility, WIL, anxiety, and depression, also consistent with prior research. This supports the idea that individuals with lower flexibility and acceptance may struggle more with engaging in meaningful daily activities, further exacerbating sleep difficulties and emotional distress. Future studies could expand these findings by also testing discriminant

validity, for example, showing that acceptance of sleep problems differs from having external locus of control (i.e., feeling powerless or fatalistic).

One particularly interesting finding is the difference in the correlation between AE and WIL across groups. While good sleepers show a strong negative association, this relationship weakens and becomes positive among bad sleepers. One possible reason for the negative association is the wording of AE items, which reference sleeping problems and may introduce ambiguity. For instance, item 2 states, “I lead a full life even though I have sleeping problems.” A participant who does not have sleeping problems might disagree with this item despite leading a full life, creating inconsistencies in responses.

Alternatively, this pattern may reflect meaningful differences in how good sleepers engage with both constructs. Good sleepers may be less likely to endorse WIL items because these items refer to fighting or controlling sleep problems, which they may not find relevant. At the same time, they might also report lower engagement in activities related to goal pursuit, leading to lower AE scores. Since WIL items are reverse-coded, this results in a strong negative correlation in this group. Regardless of the underlying cause, this pattern helps explain why the factor correlation appears weakly negative in the full sample. The opposing relationships across groups likely cancel each other out, reducing the overall association.

While these discrepancies raise concerns about measurement comparability, Exploratory Graph Analysis (EGA) indicates the SPAQ’s overall structure remains stable. The fact that the same two-factor structure emerged in both subgroups suggests that, at a broad level, the scale captures similar constructs regardless of sleep quality. However, this result should be interpreted with caution. First, our formal test of configural invariance resulted in non-invariance between good and bad sleepers, meaning that the SPAQ structure may not be equivalent for both groups, restricting the comparability of scores and conclusions regarding group differences. Second, while EGA contradicts this finding, suggesting structural consistency across groups, it is an exploratory method and does not provide definitive evidence of configural invariance. Moreover, because we conducted both exploratory and confirmatory analyses within the same sample, this may have inflated the consistency of our results, limiting their generalization. Our study does not provide conclusive evidence that the SPAQ’s factor structure is comparable across good and bad sleepers. Future studies should validate these results using independent samples.

The results of the longitudinal invariance testing suggest that the SPAQ functions consistently across the two assessment points. Configural invariance indicates that the scale measures the same underlying construct at both occasions, meaning the general factor structure remains unchanged. Metric invariance confirms that the relationships between the items and the latent factor are stable over time. Threshold invariance suggests that individuals with the same level of the underlying trait are just as likely to select a given response category at both time points, meaning that differences in responses reflect actual changes in the construct rather than changes in how participants interpret the scale. Finally, unique factor invariance provides evidence that the amount of item-specific variance and measurement error remains consistent.

While our findings provide new insights into the measurement properties of the SPAQ, several limitations should be considered. The generalizability of our findings is limited, even among the Brazilian population, because our sample was mainly composed of white, female, and highly educated participants. Given that cultural and socioeconomic factors can influence attitudes toward sleep and coping behaviors, future studies should examine whether the SPAQ functions similarly in more diverse populations.

Additionally, the bad sleepers group was composed of individuals seeking treatment for insomnia, which likely places them at the higher end of the insomnia severity spectrum. This could explain why certain items required additional correlations in this group, as individuals with significant sleep disturbances may interpret or respond to the items differently. Future research should investigate whether SPAQ functions equivalently across individuals with varying degrees of sleep problems.

A further limitation is the considerable numerical imbalance between our subsamples, with poor sleepers (N = 1011) outnumbering good sleepers (N = 341) by nearly three to one. Consequently, the psychometric properties identified in the full-sample analyses are disproportionately influenced by individuals with sleep problems.

In our invariance analysis, we identified discrepancies between groups. Some AE items explicitly reference sleep problems, which may introduce unintended response biases, particularly among good sleepers who might disagree with certain items simply because they do not identify as having sleep issues. However, we must acknowledge that the imbalance between the subsamples may also obscure meaningful comparisons between these groups, given that statistical power and precision of estimates are significantly lower for the good sleepers' group. Nonetheless, we

suggest that future research should explore differential item functioning (DIF) to assess whether individual items function differently across sleep groups, potentially distorting comparisons of latent factor scores. If some items are biased, we suggest a deeper scale refinement, replacing the malfunctioning items with others that can better reflect the underlying construct.

Regarding the longitudinal aspect of our study, we tested measurement invariance over two time points separated by 14 days, which provides preliminary evidence of stability. However, this short period may not capture longer-term changes in how individuals engage with sleep-related behaviors. Future studies should examine longitudinal invariance over extended periods, allowing for the detection of potential shifts in factor structures, response tendencies, or latent means over time. Approaches such as latent curve modeling can help identify whether changes in AE and WIL occur and how they respond to external factors, such as stress, lifestyle changes, or clinical interventions.

Conclusion

To conclude, this study's key contribution is the development of a Brazilian-Portuguese version of the SPAQ, whose scores were validated using a large sample of individuals with and without sleep problems. We provide researchers and clinicians with a Brazilian-Portuguese version of the SPAQ that is reliably equivalent to the original instrument. Despite the limitations, our study was the first to examine the SPAQ's longitudinal measurement invariance and psychometric properties in subgroups of individuals with good and poor sleep. While the model fit for the entire sample was adequate, it was not the case when analyzing only the subsample of bad sleepers. This elicits caution when interpreting the scores of this scale and possibly the need for refinement of its items.

As clinical implications, the SPAQ can be used to assess both the effectiveness and the processes of change of interventions. RCTs have shown that participants who underwent ACT for insomnia demonstrated significant improvements in SPAQ scores, whereas those in the control group did not show significant improvements.[21-23] Furthermore, the instrument can be used to evaluate the process of change in ACT for insomnia when applied at different time points in single-case experimental designs or in mediation studies.[9]

Disclosure

The authors declare no potential conflict of interest.

Author contributions: CRediT TaxonomyMarwin CarmoConceptualization-Equal, Data curation-Equal, Formal analysis-Equal, Investigation-Equal, Methodology-Equal, Software-Equal, Visualization-Equal, Writing - original draft-Equal, Writing - review & editing-EqualIlla LinaresConceptualization-Equal, Investigation-Equal, Writing - original draft-Equal, Writing - review & editing-EqualLeo Paulos-GuarnieriInvestigation-Equal, Writing - original draft-Equal, Writing - review & editing-EqualMaria PiresConceptualization-Equal, Investigation-EqualKristoffer BotheliusConceptualization-Equal, Writing - review & editing-EqualRENATHA EL RAFIHI-FERREIRAConceptualization-Equal, Formal analysis-Equal, Investigation-Equal, Project administration-Equal, Resources-Equal, Supervision-Equal, Writing - original draft-Equal, Writing - review & editing-Equal

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