General Health Questionnaire (GHQ12): new evidence of construct validity

Questionário de Saúde Geral (QSG-12): novas evidências de validade de construto

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Abstract *This study aimed to gather evidence on the adequacy of the General Health Questionnaire (GHQ-12) in Brazil, considering a random sample of Brazilian physicians. Specifically aimed: (1) to test the GHQ-12 bifactor structure compared to alternative models, (2) to check its factorial invariance regarding to gender and the diagnosis of mental and behavioral disorders, and (3) to know the association of this measure with indicators of poor health (e.g., suicidal thoughts, decreased libido, medication use). The study included 1,085 physicians with a mean age of 45.7 (SD = 10.6), mostly male (61.5%), married (72.6%) and Catholic (59.2%). They answered the GHQ-12, the Positive and Negative Suicidal Ideation Inventory, and demographic questions. The best fit model was the bifactor structure composed of anxiety and depression, in addition to a general dimension, which presented Cronbach's alpha, McDonald's ω and composite reliability higher than 0.70 just for a general fact. Psychological distress scores correlated with suicidal ideation and indicators of health and sexual satisfaction. This is a psychometrically suitable instrument that can be used in terms of its total, but its specific factors need to be used with caution.*

Key words *Physicians, Health, Psychological distress, Anxiety, Depression*

Resumo *Este estudo teve como objetivo reunir evidências sobre a adequação do Questionário de Saúde Geral (QSG-12) no Brasil, considerando uma amostra aleatória de médicos brasileiros. Especificamente, objetivou-se: (1) testar uma estrutura bifactor em comparação com modelos alternativos, (2) verificar invariância fatorial em relação ao gênero e ao diagnóstico de transtornos mentais e comportamentais, e (3) conhecer a associação com indicadores de saúde precária (por exemplo: pensamentos suicidas, diminuição da libido e uso de medicamentos). Participaram do estudo 1.085 médicos, com média de idade de 45,7 (DP = 10,6), maioria de sexo masculino (61,5%), casados (72,6%) e católicos (59,2%). Eles responderam ao QSG-12, ao Inventário de Ideação Suicida Positiva e Negativa e a questões demográficas. O modelo de melhor ajuste foi a estrutura bifactor (composta por ansiedade, depressão e uma dimensão geral), que apresentou alfa de Cronbach, ômega de McDonald e confiabilidade composta superior a 0,70 apenas o fato geral. Pontuações de sofrimento psicológico se correlacionaram a ideação suicida e indicadores negativos de saúde e satisfação sexual. O instrumento foi psicometricamente adequado e pode ser utilizado em termos de sua pontuação total, mas seus fatores específicos precisam ser utilizados com cautela.*

Palavras-chave *Médicos, Saúde, Sofrimento psíquico, Ansiedade, Depressão*

Introduction

The General Health Questionnaire (GHQ) is a response to a recurring problem in health care, the correct diagnosis of mental disorders enabling immediate and appropriate treatment. The full version of this self-administered measure, containing 60 items, was proposed by Goldberg in 1972[1]. Shorter versions were later published, including the 12-item version (GHQ-12), which is the object of interest in this study[2]. This shorter version is easy to administer and contains evenly distributed items written as positive (e.g., "*Have you felt capable of making decisions*?") and negative (e.g., "*Have you been thinking of yourself as a worthless person*?")[2]. Thus, some studies have investigated the psychometric adequacy of GHQ-12 at the national and international levels, considering the general population, young people, elderly people, and groups of professionals.

In Brazil, some studies have already been conducted on this measure. For example, authors[3] analyzed a sample of 446 people (158 unemployed and 288 employed) and reported exploratory factor analysis of two items: self-efficacy (α = 0.85), and depression and emotional exhaustion (α = 0.75). Gouveia et al.[4] examined a general population sample of 306 people with confirmatory factor analysis. Their findings showed that a bifactor model was more appropriate [depression (α = 0.81) and anxiety (α = 0.66)] than a unifactorial model (psychological distress, α = 0.84). Gouveia, Barbosa, and Andrade[5] analyzed a sample of 7,512 physicians and tested their factorial structure with one and two factors [depression (α = 0.85) and social dysfunction (α = 0.82)]. They reported that the latter emerged in exploratory factor analysis and showed the best fit indicators in confirmatory factor analysis. Nevertheless, Gouveia and colleagues[2] analyzed a sample of 1,180 people (university students, elementary school teachers, military police officers, and people from the general population) and, controlling the effect of negative items, observed that a general factor structure could be more appropriate, which they named psychological distress ($M_\alpha = 0.84$).

At the international level, over a hundred studies have been conducted to explore or prove the GHQ-12 factorial structure[6,7] in countries as diverse as Germany[8], Saudi Arabia[9], Austria[10], China[11], Colombia[12], Spain[13], India[14], Iran[15] and Japan[16]. Meta-analyses conducted by Gnambs and Staufenbie[6] address the factorial structure

of this measure. For example, exploratory factor analysis (K = 38, N = 76,473) identified two factors that showed clusters of negative and positive items. A second study (K = 84, N = 410,640) using confirmatory factor analysis identified a bifactorial structure, with the most of the variance was explained by the general factor.

Despite the evidence on the GHQ-12 factorial structure, multiple factors can recognizably affect it, including translation bias, how items were written, and cultural and even clinical biases[7]. In this sense, some studies have been developed to prove the measure invariance of this instrument. For example, using an eight-item version in Brazil, Fernandes and Vasconcelos-Raposo[17] noted that the unifactorial solution was invariant in clinical and nonclinical samples. Romppel et al.[18] used the German and Spanish versions of the full GHQ-12 with a unifactorial solution and reported a configurational invariance between Germany and Colombia, but no metric and scalar invariance. However, little is known about the invariance of this measure in Brazil regarding the sex of the participants5. The absence of studies with this objective weakens the security of GHQ-12 comparisons between sex in Brazil, a variable that can affect mental health indicators[9].

Even though there is still no consensus on the GHQ-12 structure, and despite little evidence of its factorial invariance, there is evidence of its suitability as a screening tool[19]. Also, as the scores of this measure correlate with or are good explainers of subjective well-being[20], quality of life[21], burnout[22], suicidal ideation and suicide attempted[23], and general health[24], it is a useful measure in the context of mental health, even helping to identify mental disorders in workers seeking outpatient medical care[25].

Hence, it seems justifiable to analyze additional evidence about the GHQ-12's psychometric adequacy. The specific objective of the present study is to test the presumably more suitable bifactor structure[6] by comparing it with a simple one-factor model, a one-factor model but with control for the effects of negative items, and a two-factor model. Furthermore, we aim to verify GHQ-12 measure invariance in relation to sex and to the presence (or not) of a diagnosis of mental and behavioral disorders. Finally, we aim to understand to what extent its scores correlate with indicators of sexual satisfaction, general health, and suicidal ideation, which are critical mental health elements[20].

Method

Procedure

This was a survey research with an *ex post facto* design. It was a random sample drawn from the universe of physicians registered in the Medical Council system. The questionnaires were sent via regular mail to the addresses of the randomly chosen doctors, and all physicians participated voluntarily with no material reward and had the anonymous nature of their collaboration ensured according to the ethical principles of human subject research. The sample was composed exclusively of physicians, as this study is part of a larger survey to assess the Health of Brazilian Doctors. A minimum sample of 1,065 physicians was estimated for a population of 500,000 physicians (available on the Federal Council of Medicine website), an error (e) of 3%, a confidence margin of 95% and a z-score of 1.96. Only completely filled in were accepted for this research. Of the 1,115, 2.33% were excluded for this reason, resulting in 1,084 participants.

Sample calculation. Sample size = {[z2 * p(1-p)]/e2}/1+[z2 * p(1-p)/e2N]. N = population size; e = margin of error (percentage in decimal format); z = z score.

Instruments

The participants answered a booklet consisting of demographic questions (e.g., age, sex, marital status, religion, and employment status), whether they used any prescription drugs, whether they experienced decreased libido, and whether they considered their sex life satisfactory (the answers for these three questions were classified as 0 = *No* or 1 = *Yes*). In addition, all participants answered the following instruments:

General Health Questionnaire. Proposed by Goldberg[1], the shorter version (GHQ-12) considered here has been widely used as a screening tool to detect non-severe (non-psychotic) psychiatric disorders. Although different factor structures and internal consistency coefficients are used in Brazil, their psychometric indicators are often acceptable[2-4,26]. The 12 items are scored in terms of how much the person has experienced a given symptom on a four-point scale. The alternative answers for negative items regarding mental health (e.g., *Have you lost much sleep due to worrying?*) range from 1 (*Absolutely not*) to 4 (*Much more than usual*), while the alternative answers for positive affirmative items (e.g., *Have you felt*

capable of making decisions?*) range from 1 (*More than usual*) to 4 (*Much less than usual*). The scoring system used by Goldberg (1972) implies that each of these items is recoded as 0 (*Absence of psychiatric disorder*; scores 1 and 2) or 1 (*Presence of psychiatric disorder*; scores 3 and 4). Therefore, the higher the total score of this measure, the higher the level of psychological distress.

Positive and Negative Suicidal Ideation Inventory. This version was initially proposed by Osman et al.[27] and includes 14 items that measure two main oblique factors ($r = -0.49$, $p < 0.001$): *negative suicidal ideation* (eight items, e.g., seriously considering the possibility of ending your life for not being able to meet the expectations of others; feeling hopeless about the future and considering the possibility of ending your life), and *positive suicidal ideation* (six items, e.g., feeling enthusiastic about your success at school and/or work; feeling confident about being able to deal with most problems in your life). The authors demonstrated that this factorial structure best fit the data (Robust comparative fit index = 0.96, non-normed fit index = 0.95, and root mean square error of approximation = 0.03), with each factor showing Cronbach's alpha above 0.80.

Data analysis

The data were tabulated and analyzed using SPSS (version 21). First, descriptive statistics (mean, standard deviation, frequency) were calculated for sample characterization. The Cronbach's alpha and McDonald's ω were calculated to evaluate the internal consistency of the GHQ-12 dimensions. AMOS software (version 21) was then used for confirmatory factor analyses (CFA) to prove the best factor structure of this instrument. In this case, the covariance matrix was considered as input using Maximum Likelihood (ML) estimation and the following adjustment indicators: GFI (Goodness-of-Fit Index), AGFI (Adjusted Goodness-of-Fit Index), and TLI (Tucker-Lewis Index), with values equal to or above 0.90 taken as acceptable, and RMSEA (Root Mean Square Error of Approximation) with recommended values close to 0.05 and accepting up to 0.10. Three indicators were also used to compare the models (ECVI, CAIC, and $\Delta\chi^2$). Finally, Pearson correlations were calculated to determine the adequacy of GHQ-12 to explain physical health variables and suicidal ideation.

The R software (version 3.3.2)[28] was used to confirm the factorial invariance of GHQ-12 with

a multigroup confirmatory factor analysis (MG-CFA)[29]. Hierarchical models were tested for the invariance types: (1) *configural*: the same factorial (two-dimensional) model for the groups; (2) *metric*: equivalent structure and factor loadings (λ); and (3) *scalar*: in addition to the other equivalent parameters, it considers equivalent thresholds. For interpretative purposes, the invariance was evaluated based on the difference between ΔCFI (if lower than 0.01, invariant model)[30] and ΔRMSEA indicators (if lower than or equal to 0.015, invariant model)[31].

Results

Description of participants

Of a total of 1,089 physicians, 547 reported having been diagnosed with mental and behavioral disorders and 542 reported not having been diagnosed. Most respondents were male (61.5%), married (72.2%), Catholic (59.2%) and employed (88.8%), with a mean age of 45.7 years (SD = 10.6).

GHQ-12 factorial structure evidence

Confirmatory factor analyses were used to test the GHQ-12 factorial structure in the group studied. Four models were tested: the unifactorial model (M1), in which a general factor of psychological distress was explained by the 12 items of the measure; the bifactorial model (M2), which combined one depression and one anxiety factor; a general factor with control of negative items (M3); and finally the bifactor model (M4), whose items are saturated in both specific components and which represents psychological distress in the general factor. The results of these analyses are shown in Table 1.

The findings for the unifactorial model (M1) showed unsatisfactory adjustment indicators (GFI = 0.89, CFI = 0.89, TLI = 0.87, and RMSEA = 0.11). The most promising indicators were seen for the model (M2) (GFI = 0.90, CFI = 0.91, TLI = 0.89, and RMSEA = 0.10) and for model 03 (M3) (GFI = 0.91, CFI = 0.92, TLI = 0.89, and RMSEA = 0.10), but they were even better for the bifactor model (M3) (GFI = 0.95, CFI = 0.95, TLI = 0.92, and RMSEA = 0.08). Direct comparison of these models showed the M_3 model to be superior to M_2 [$\Delta\chi^2$ (5) = 59.00, $p < 0.001$] and, although the M_3 and M_4 models were both satisfactory, the latter was statistically more appropriate [$\Delta\chi^2$ (7) = 352.95, $p < 0.001$].

Table 2 shows that the depression and anxiety factors had lower factor loadings when compared to the general factor.

Cronbach's alphas, McDonald's ω, composite reliability (CR) and average variance extracted (AVE) were calculated specifically for the general factor (α = 0.92, ω = 0.92, CR = 0.92, AVE = 0.53), but also for the factors of depression (α = 0.89; ω = 0.82, CR = 0.27, AVE = 0.07) and anxiety (α = 0.80; ω = 0.81, CR = 0.23, AVE = 0.06). Therefore, this psychometric parameter seems to confirm the adequacy of the general factor only.

Factorial invariance

Table 3 shows that the GHQ-12 configural, metric, and scalar invariance parameters were corroborated regarding participants' sex and presence/absence of diagnosis of mental and behavioral disorders considering the previously described criteria (ΔCFI < 0.01 and ΔRMSEA ≤ 0.015).

Thus, this instrument has full factorial invariance and can be used to compare men and women, as well as clinical and nonclinical groups (general population).

Table 1. Comparison of General Health Questionnaire Models (GHQ-12).

Models	χ^2	df	χ^2/df	GFI	CFI	TLI	RMSEA (CI95%)	CAIC	ECVI	$\Delta\chi^2$(df)
M_1	781.85	54	14.47	0.89	0.89	0.87	0.11 (0.10-0.12)	973.68	0.76	-
M_2	653.07	53	12.32	0.90	0.91	0.89	0.10 (0.09-0.11)	852.90	0.64	128.77(1)*
M_3	594.07	48	12.38	0.91	0.92	0.89	0.10 (0.09-0.11)	833.86	0.60	59(5)*
M_4	352.95	41	8.61	0.95	0.95	0.92	0.08 (0.07-0.09)	658.69	0.39	241.12(7)*

p < 0.001, M_1 (Model 1): unifactorial, M_2 (Model 2): bifactorial, M_3 (Model 3): control of negative items, M_4 (Model 4): bifactor; GFI = Goodness of fit index, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error of Approximation, CI90% = 90% confidence interval, ECVI = Expected Cross Validation Index, CAIC = Consistent Akaike Information Criterion, and $\Delta\chi^2$(df) = difference between χ^2 and the degrees of freedom of the current and previous models.

Source: Authors.

Correlational validity

After demonstrating the adequacy of the GHQ-12 structure and factorial invariance, we tried to validate its usefulness to understand other constructs. In this case, general and specific scores for anxiety and depression were calculated and correlated with suicidal ideation factors and sexual satisfaction and general health indicators (prescription drug use). The results can be seen in Table 4.

This table shows that the general factor (psychological distress) correlates with the general dimension of suicidal ideation ($r = 0.71$, $p < 0.001$) and their specific negative ideation factors ($r = 0.46$, $p < 0.001$), but most importantly with positive ideation ($r = -0.77$, $p < 0.001$). There was also a correlation between psychological distress and decreased libido ($r = 0.38$, $p < 0.001$), satisfaction with sexual life ($r = -0.37$, $p < 0.001$), and continuous use of some type of prescription drug ($r = 0.20$, $p < 0.001$).

Table 2. Description of the factor loadings of the bifactor model

	General factor General health	Factor I Depression	Factor II Anxiety
GHQ1	0.68	0.15	---
GHQ2	0.66	0.28	---
GHQ3	0.60	---	0.36
GHQ4	0.40	---	0.34
GHQ5	0.87	0.45	---
GHQ6	0.80	0.08	---
GHQ7	0.71	0.23	---
GHQ8	0.76	---	0.04
GHQ9	0.87	0.26	---
GHQ10	0.78	---	0.11
GHQ11	0.68	---	0.28
GHQ12	0.76	---	0.15

Source: Authors.

Discussion

The main objective of this study was to test the bifactor structure of the GHQ-12, which proved to be more adequate in studies outside Brazil[6], comparing it with the unifactorial and bifactorial models. We also aimed to verify the measure invariance of this instrument regarding sex and the presence (or not) of a diagnosis of mental and

Table 3. Evidence of GHQ-12 measure invariance.

		Adjustment Indices			Invariance test	
		χ^2(df)	CFI	RMSEA	ΔCFI	ΔRMSEA
Sex	Configural invariance	246.78(82)	0.97	0.052	—	—
	Metric Invariance	266.29(103)	0.97	0.045	0.001	0.006
	Scalar invariance	286.17(112)	0.96	0.046	0.004	0.001
Diagnosis	Configural invariance	240.31(82)	0.97	0.047	—	—
	Metric Invariance	279.31(103)	0.97	0.043	0.002	0.004
	Scalar invariance	296.17(112)	0.96	0.042	0.002	0.001

Source: Authors.

Table 4. Evidence of GHQ-12 construct validity.

	1	2	3	4	5	6	7	8
1. Psychological distress								
2. Depression	0.97							
3. Anxiety	0.87	0.74						
4. Suicidal ideation	0.71	0.74	0.53					
5. Negative ideation	0.46	0.50	0.31	0.86				
6. Positive ideation	-0.77	−0.79	-0.61	-0.89	-0.54			
7. Decreased libido	0.38	0.37	0.33	0.31	0.21	-0.34		
8. Satisfactory sex life	-0.37	-0.37	-0.30	-0.39	-0.27	0.41	-0.48	
9. Continued use of any prescription drugs.	0.20	0.21	0.17	0.24	0.18	-0.25	0.17	-0.15

$p < 0.001$.

Source: Authors.

behavioral disorders and to find evidence of a correlational validity of this measure, correlating it with indicators of sexual satisfaction, general health, and suicidal ideation.

Of the main findings, multiple confirmatory factor analyses evidenced that the best fit was the bifactor model with two specific factors (anxiety and depression) and a general dimension of psychological distress. This finding corroborates reports of participants from several countries and samples[6,32] This elucidates divergences found in the national literature regarding the factorial structure of the GHQ-12[2,3,26,33].

The bifactor structure is commonly used when there are factor models in the literature, which assume acceptable adjustments and, therefore, can compete with each other. The results of this study showed this competition between two structures (general factor versus specific factors), but point to a solution between the divergences of the general and specific structure when it presents factor loadings and better reliability indicators for the general factor.

The emphasis on the general dimension of the GHQ is in line with the original objective of the scale, which aims to make a pre-clinical assessment of people's general mental health status[6]. After that, a professional would more specifically assess dimensions such as depression and anxiety. Possibly due to the complexity and the various aspects that make up mental health, dimensions such as depression and anxiety emerge from the structure of the scale, but as the data show, these specific factors are not reliable. Thus, as highlighted in international meta-analysis studies, specific factor scores reflect a very limited variation, demonstrating that the GHQ-12 is essentially one-dimensional[6].

Regarding the adjustment of the Bifactor model, we would like to highlight the value of the RMSEA, as it was within the acceptable limit. The discussion in the literature about these reference points is wide and complex, for this reason it is highly recommended to use more than one index. This happens because the indices are affected by different elements that vary between studies, such as model complexity, sample size, number of latent and observable variables, degrees of freedom, among others. Specifically, the RMSEA tends to increase with the addition of more variables to the model. The use of this or other types of reference to interpret the RMSEA depends on model specifications, degrees of freedom and sample value and not on a single analysis criterion. For this reason, the interpretation

of the model fit needs to be done in a way that considers the other indicators together[34].

The bifactor structure also showed full measure invariance for sex and diagnosis (presence or absence of mental and behavioral disorders). These findings are even more encouraging than those reported in previous studies[17,18]. The relevance of these two variables must be shown and the measure has to demonstrate invariance. The sex of the participants explains significant variations in the level of psychological distress experienced, evidencing that females are more negatively affected[9,35,36]. On the other hand, the condition of being part of a clinical group or the general population may be relevant because different types of symptoms and magnitude levels may be experienced. Thus, measure invariance should be demonstrated under these conditions, corroborating a previous study that used a shorter GHQ-12 version[17].

As for the correlation between psychological distress and its specific anxiety and depression factors and external variables, our results corroborate what has been theoretically expected and verified in previous studies[23,24,37-39]. Psychological distress and suicidal ideation are directly correlated, such that participants with greater distress experience an inability to participate in pleasurable activities and feelings of sadness, apprehension, irritability, and tension[40]. Thus, mental disorders seem to be a risk factor for suicidal ideation and even suicide[41].

The association between psychological distress and continuous use of prescription drugs reinforces the finding that the prevalence of symptoms of non-severe mental health disorders may be related to dysfunctional behavioral indicators[38]. Finally, the indicators of sexual satisfaction and decreased libido were correlated with psychological distress as well as anxiety and depression, corroborating the findings by De Ryck et al.[37] These results are potentially applicable by showing the negative impact of mental disorder on sexuality and may serve to guide effective communication about sexual concerns and expectations for partners experiencing psychological distress[35].

To summarize, these findings confirm the psychometric adequacy of GHQ-12 to the Brazilian reality, corroborating previous studies[3-5]. They also show the factorial invariance of this measure as reported by Gouveia et al.[5], as well as the association of psychological distress with central variables in the context of intimate interpersonal relationships, such as libido and sexu-

al satisfaction. Although this study has positive points, such as the survey of a random sample of a professional category at the national level and being able to indicate a structural solution for a health scale widely used in the national and international context, it is necessary to emphasize that this study cannot offer a generalization to other populations of professionals, demanding attention regarding its use. Future studies are necessary to present more evidence about the predictive power of this measure, including aspects such as work performance or wish to leave the profession. Within the scope of parameters, it is important to present evidence of the temporal stability of GHQ-12 and its adequacy to understand the progress of a given clinical condition.

Collaborations

TAA Oliveira worked on the design, analysis and general writing of the manuscript. VV Gouveia worked in the elaboration of the research project, data collection, supervision of the analysis and guidance of the writing. MGC Ribeiro worked on data analysis and discussion of results. KG Oliveira participated in the design and writing of the manuscript. RLP Melo complementation of analysis and writing. E Montagna worked on the design, supervision and guidance of the manuscript.

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