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Factor structure, measurement invariance and psychometric properties of the Quality of Life Scale WHOQOL-BREF in the Ecuadorian context

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Abstract

Background: The short version of the World Health Organization Quality of Life questionnaire (WHOQOL-BREF) is a popular instrument used to assess quality of life. The objective of this study was to evaluate the following psychometric properties: structural validity, convergent validity, internal consistency, and measurement invariance across sex of the WHOQOL-BREF in a sample of Ecuadorian adults.

Methods: We used a sample of undergraduates ($n = 987$) to assess the WHOQOL-BREF original four-factor structure, a model with correlated factors, a hierarchical model, and two models resulting from the exploratory factor analysis and exploratory graph analysis. All the models were evaluated using confirmatory factor analysis.

Results: The results of the exploratory factor analysis and exploratory graph analysis suggest that the items are organized into four factors, although differently from the original version and the orthogonality assumption is not maintained. The confirmatory factor analysis shows that the original WHOQOL-BREF structure with correlated factors presents adequate psychometric properties. However, we propose a four-factor structure that has the best psychometric properties and adequate internal consistency. The results of the measurement invariance show that strict and strong invariance is achieved between men and women. Convergent validity analysis reveals moderate correlations with self-esteem, resilience, and social support.

Conclusions: Despite the original version of the WHOQOL-BREF with correlated factors has acceptable psychometric properties in the Ecuadorian context, we propose a version with a different organization of its items, which is consistent with the findings of other investigations.

Keywords: Quality of life, WHOQOL-BREF, Factor analysis, Measurement invariance, Psychometric properties, Ecuador

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Introduction

The Quality of Life (QOL) evaluation is a research line that has been promoted with emphasis from different fields: economics, medical, and social sciences (Cummins & Lau, 2006). In recent decades, it has become an essential element in the health field since it has been used to improve results and increase standards to treat and intervene in chronic diseases, disabilities, and medical conditions (Barneveld et al., 2014; Burgess & Gutstein, 2007; Oliveira et al., 2016; Sosnowski et al., 2017); yet, its study constitutes a challenge for research due to the dispersion and diversity of its conceptions, the dimensions that comprise it, challenges in its measurement, and the factors that influence it (Taillefer et al., 2003). Based on cross-cultural studies and with the objective of unifying criteria, the World Health Organization (WHO) proposed the following definition of quality of life: “the perception that an individual has of his situation in life within the cultural context and value system in which he lives and in relation to his objectives, expectations, norms and interests” (The WHOQOL Group, 1996). This definition denotes the subjective, cultural, and multidimensional nature of the QOL. From this definition, the World Health Organization Quality of Life questionnaire (WHOQOL-BREF) was developed. The instrument of generic evaluation of the quality of life stands out for its rigor in the process of translation and intercultural adaptation, allowing to obtain reliable conclusions about its equivalence in 15 cultures (Bowden & Fox-Rushby, 2003; Crocker et al., 2015). In addition, the WHOQOL-BREF questionnaire stands out among the most popular generic measurement instruments of quality of life used in clinical and epidemiological research because it allows collecting information on four domains through 26 items: physical and psychological (commonly evaluated in the clinical field), social relations, and environment. It transcends its application to other areas beyond public health (Skevington & Epton, 2018). In cross-cultural studies, it shows excellent internal consistency, good test–retest reliability, discriminant validity, and construct validity in the general population and in different groups of patients with different diseases that cause disability (Harper et al., 1998; Jang et al., 2004; Min et al., 2002; Skevington et al., 2004). Factor invariance through gender has been reported as well (Perera et al., 2018).

The international use of WHOQOL-BREF continues to expand, but the structure evaluation is required because there are conflicting results. For instance, there is research that supports the original WHO four-domain model such as a recent study in Singapore involving 3400 adults with a wide range of age and health conditions, reported an acceptable fit of the data with the original four domain model (Suárez et al., 2018), whereas in Taiwan, a sample of 1068 healthy and unhealthy

adults was used, and the exploratory and confirmatory factor analysis suggested a four-domain model (Yao et al., 2002). However, other investigations could not replicate the original structure of the WHOQOL-BREF (Benitez-Borrego et al., 2014; Benítez-Borrego et al., 2016; Moreno et al., 2006; Ohaeri et al., 2007; Oliveira et al., 2016). In short, the importance of clarifying the structural factor of the questionnaire in different contexts is evident (Ohaeri et al., 2007; Perera et al., 2018; Snell et al., 2016), given the linguistic and cultural differences that can be detected even when the language is the same (Benítez-Borrego et al., 2016; Hambleton et al., 2004).

Besides, in the study of quality of life, it is essential to recognize that there are many different factors correlated with quality of life in general population and clinical samples. For example, previous researches recommended to put attention to self-esteem, as an important factor influencing the promotion of quality of life of patients with chronic disease, depression and the elderly (Hemati & Kiani, 2016; Kuehner & Bueger, 2005; Tavares et al., 2016). Other protective factors like resilience were found to be an important predictor of high levels of quality of life in cancer patients (Ristevska-Dimitrovska et al., 2015) and people suffering from chronic pain (Yazdi-Ravandi et al., 2013). The literature also reveals that social support is beneficial to QOL in depressed patients (Kuehner & Bueger, 2005), elderly people (Unalan et al., 2015; Wang et al., 2020), patients with multiple sclerosis (Dębska et al., 2020; Glanz et al., 2020), and the general population (Helgeson, 2003).

Despite the importance of the subject, there is no previous research about the psychometric characteristics of the Spanish version of WHOQOL-BREF questionnaire in the Ecuadorian context. Therefore, the objective of this paper was to evaluate the structural validity, convergent validity, internal consistency, and measurement invariance properties of the WHOQOL-BREF in a sample of Ecuadorians.

Method

Sample and procedure

An incidental non-probabilistic technique was used to sample the population. The adequate size of the sample for factor analysis will depend on the number of factors, the magnitude of population correlations, and the desired reliability of the correlation coefficients; Tabachnick and Fidell (2012) recommend larger sample sizes. Given that the WHOQOL-BREF is a widely popular tool, we selected 1000 participants from two universities in Cuenca, Ecuador; 13 of them did not complete the questionnaire and were not considered in the analysis. In the University of Cuenca, we recruited students from the Faculty of Medical Sciences which includes the Nursing School and the Medicine School ($n = 688$, 21%

were men, average age was 21.26, standard deviation was 2.57) and Faculty of Psychology ($n = 258$, 30% were men, average age was 23.4, standard deviation was 2.2). In the University of Azuay, we recruited students from the Faculty of Economics and Business ($n = 41$, 18% were men, average age and standard deviation were 21.6 and 2.25, respectively). All of them were reached in their classrooms after permission from the authorities was granted. Once an informed consent was obtained, in which the objectives of the investigation were explained, the instruments were handed along with a sociodemographic survey. The application lasted approximately 30 min and was carried out by three psychologists who had practical experience of at least 200 h in psychological evaluation and were trained by the principal investigator for 24 h through instructional classes and role play. The participation of the subjects was anonymous and voluntary without economic or other incentives. Regarding exclusion criteria, we did not consider participants with any severe difficulty in communication (e.g., not being able to read or write) with significant cognitive impairment or suffering from severe visual impairment. Data was collected during December 2017.

The descriptive statistical results of the sample are presented in Table 1. The average age of participants was 21.3 years ($SD = 2.5$, range = 18–33).

Instruments

Questionnaire of sociodemographic characteristics of the participants

An ad hoc questionnaire was developed to characterize the sample based on sociodemographic characteristics: gender, age, marital status, employment status, income, and disability.

Spanish version of the Quality of Life Questionnaire (The WHOQOL Group, 1996)

It consists of a total of 26 questions, two general questions about quality of life and satisfaction with the state

Table 1 Sociodemographic characteristics of the sample

Variable		($n = 987$)	Percentage (%)
Sex	Men	256	25.94%
	Women	731	74.06%
Civil status	Single	877	88.86%
	Married	65	6.59%
	Divorced	2	0.20%
	Common law union	43	4.36%
	Ethnic group	Mestizo	955
	White	20	2.03%
	Afro-Ecuadorian	4	0.41%
	Indigenous	8	0.81%

of health and 24 questions that evaluate four domains: physical health, psychological health, social relations, and environment. The response scales are Likert type with five points. Domain scores can be converted according to a score correction table. Permission for use was requested on the World Health Organization website (http://www.who.int/substance_abuse/research_tools/whoqolbref/en/). The Spanish version of the WHOQOL-BREF has been validated in another study (Lucas-Carasco, 2012). Cultural adaptation could be necessary not only when the questionnaire is used in a different language, but also in this case due to the cultural diversity of Spanish (Lenz et al., 2017; Sousa & Rojjanasrirat, 2011). A panel of experts reviewed the wording of the questions and analyzed whether the questions were understandable to Ecuadorian culture. No changes were suggested. With this version, a pilot test was carried out with 30 adult residents in Cuenca (Ecuador), to ensure understanding of the questionnaire, each participant was asked to report any difficulties they encountered in understanding each of the questions and possible suggestions. No additional modifications were necessary. The sample used in this stage was not included in the data analysis.

Rosenberg self-esteem scale (RSE) (Atienza et al., 2000; Rosenberg, 2015)

It consists of 10 items in a 4-point Likert response format (strongly disagree, disagree, agree, strongly agree). Five of the items are presented positively worded and five negatively worded. This instrument has been evaluated and it is appropriate for its use in the Ecuadorian context (Bueno-Pacheco et al., 2020). The internal consistency achieved in this study was a Cronbach's alpha value of $\alpha = 0.86$.

Brief resilience scale (BRS) (Rodríguez-Rey et al., 2016; Smith et al., 2008)

It is a Likert-type scale with six items in a range from 1 (strongly disagree) to 5 (strongly agree). Previous findings support the validity and reliability of this version. This instrument has been evaluated, and it is appropriate for its use in the Ecuadorian context (Peña et al., 2020). The internal consistency obtained in this study showed a Cronbach's alpha value of $\alpha = 0.72$.

Functional Social Support questionnaire (Duke-UNC-11) (Bellón Saameño et al., 1996; Broadhead et al., 1988)

It quantitatively evaluates perceived social support and includes two dimensions: confidential social support and affective social support. The 11 items have a Likert response format with scores from 1 to 5 (much less than desired, less than desired, neither much nor less, almost as desired, as much as desired). The range of the total

scale goes from 11 to 55 where the higher the score, the greater the perceived social support. This instrument has been evaluated and is appropriate for its use in the Ecuadorian context (Aguilar-Sizer et al., 2021). The internal consistency achieved in this study was a Cronbach's alpha value of $\alpha = 0.92$

Data analysis

A descriptive analysis of the WHOQOL-BREF items (average score, standard deviation, skewness, kurtosis, item-total correlation, and Mardia's multivariate normality test) was used to determine the type of estimator and the type of correlation matrices to be used.

To avoid overfitting problems in factor analysis, the sample was randomly divided into two: the first subsample ($n = 494$) was used to perform exploratory factor analysis (EFA) and exploratory graph analysis (EGA). Confirmatory factor analysis (CFA) was performed in the second subsample ($n = 493$).

In exploratory factor analysis, to determine whether the data matrix can be factored, the Kaiser-Meyer-Olkin coefficient (KMO) was calculated, and the Bartlett sphericity test was performed. If the coefficient is greater than 0.85 and the Bartlett's null hypothesis is rejected, then factor analysis is carried out. There is no agreement regarding the best way to determine the number of factors to extract; thus, we relied on several criteria that included parallel analysis, very simple structure (VSS), Velicer's minimum average partial (MAP), and EGA (Golino & Christensen, 2019; Golino & Epskamp, 2017; Horn, 1965; Revelle, 2020). EGA focuses on the estimation of direct relationships between observed variables rather than modeling observed variables as functions of latent common causes. Recent evidence reveals that EGA outperforms other factor extraction methods (H. F. Golino & Epskamp, 2017) and shows promising applications in quality of life research (Kossakowski et al., 2016). Finally, we looked for consistency among the obtained results.

Two options were tested to determine the type of rotation. First, orthogonal rotation was considered as suggested in the original version of WHOQOL-BREF. This option is questioned due to evidence that the orthogonal solution does not fit well in a population whose native language is Spanish (Benitez-Borrego et al., 2014). Second, we used oblimin rotation and checked whether the correlation between factors was at least 0.32 which would reveal an overlap in the variance of the variance between factors of at least 10% (Tabachnick and Fidell (2012). Factor loadings were expected to be at least 0.30, although other scholars consider a value above 0.45 as adequate (Comrey, 2013).

The confirmatory factor analysis (CFA) is performed using diagonally weighted least squares (DWLS) estimator. The goodness of fit of the model was evaluated with

different indices such as chi-square, comparative fit index (CFI), Tucker-Lewis index (TLI), standardized root mean squared residual (SRMSR), and root mean square error of approximation (RMSEA). For CFI and TLI, values between 0.90 and 0.95 were considered to indicate acceptable goodness of fit of a model, while values greater than 0.95 reveal excellent goodness of fit (Hu & Bentler, 1999). For SRMR and RMSEA, it is considered acceptable when it is below 0.08 and very good when it is less than 0.05 (Steiger & Lind, 1980). Given that we evaluate several models, we also report the Parsimony Normed Fit Index (PNFI) and the Parsimony Global Fit Index (PGFI).

To assess the convergent validity of the questionnaire, the dissaturated Spearman correlation coefficients were calculated and presented in a correlogram. We hypothesize positive, significant, and moderate correlations (at least 0.4) between the domains of quality of life and self-esteem, confidential social support, affective social support, and the positive dimension of resilience. Likewise, we expect the domains of quality of life to be negatively correlated with the negative dimension of resilience.

The internal consistency of the instrument was evaluated through Cronbach's alpha (α), McDonald's omega (ω) as calculated by Raykov (2001), and hierarchical omega. Scores between 0.7 and 0.8 are considered acceptable, values greater than 0.8 show high consistency, and values greater than 0.9 may indicate redundancy in the questions (Cicchetti, 1994; Tavakol & Dennick, 2011). We also analyze the average extracted variance of each dimension (AVE) which value should be 0.5 or higher (Hair et al., 2010).

The invariance of the measurement between men and women was verified using the version of the questionnaire that presents the best validity and internal consistency results. The invariance analysis of measures aims to test the equivalence between the groups. For this, we start testing the equality of population covariance, then we evaluate the configural, metric, residual, scalar, strong means, strict residual, and strict means invariance using Equivalence testing as proposed by Jiang et al. (2017).

All the analysis was conducted in the R software (R Core Team, 2021) using the packages summarytools (Comtois, 2021), polycor (Fox, 2019), GGally (Schloerke et al., 2021), CTT (Willse, 2018), lavaan (Rosseel, 2012), nFactors (Raiche & Magis, 2020), psych (Revelle, 2020), sjPlot (Lüdtke, 2021), REdaS (Maier, 2015), MVN (Korkmaz et al., 2014), EGAnet (Golino & Christensen, 2019), semTools (Jorgensen et al., 2021), semPlot (Epskamp, 2019), and equaltestMI (Jiang et al., 2021)

Results

The significance of the Mardia's coefficient ($p < .01$) revealed a non-normal multivariate distribution of the

data. Items 26, 3, and 4 presented relatively low discrimination coefficients, and items 3 and 4 have the highest kurtosis coefficients among the items with values of 0.98 and 0.8, respectively. See Table 2 for detailed item statistics.

Exploratory factor analysis

Bartlett's sphericity test ($p < 0.01$) and the KMO criterion (0.91) revealed that the correlation matrix could be factored.

Parallel analysis suggests that the number of factors to be extracted is 8, 3 according to VSS, 2 according to MAP, and 4 according to EGA. Exploratory hierarchical analysis suggests 3 first-order factors and 1 second-order factor. The lack of consistency of these results led us to perform a factor extraction with oblimin rotation and minimum residual estimator extracting 2, 3, 4, and 8 factors. Depending on the number of factors to be extracted, the results show that several items do not discriminate well between the dimensions or have a

relatively low factor scoring. For instance, when 8 factors are extracted, we observed that items 15, 21, 22, and 26 score above .30 but below .45. This loading behavior is observed when extracting 4 factors (items 9, 14, 21, 22, 26), 3 factors (items 9, 14, 16, 22), and 2 factors (items 9, 16, 22, 26). The explained variance of these solutions was 62%, 51%, 47%, and 41%, respectively. In the case of the solution of 4 factors, and consistent with other research, we observe that several factor loadings fall under a different factor than those originally suggested by the WHO (see Table 3). A common pattern observed in all the solutions, except the two-factor model, is that items 3 and 4 load into one factor. The problem with a factor that only includes two items is that it merely reflects a correlation between those; however, it is possible to retain such factor if the two items are highly correlated, and the correlation with the other items is relatively low (Worthington & Whittaker, 2006). We explored the polychoric correlation matrix and found that among all the questions, items 3 and 4 have the highest correlation,

Table 2 Descriptive statistics of the items of WHOQOL-BREF

Item	Mean	SD	Skew	Kurtosis	Item discrimination
3. To what extent do you feel that physical pain prevents you from doing what you need to do?	3.32	1.19	- 0.18	- 0.98	0.27
4. How much do you need any medical treatment to function in your daily life?	3.65	1.33	- 0.62	- 0.8	0.22
5. How much do you enjoy life?	3.7	0.85	-0.39	- 0.01	0.63
6. To what extent do you feel your life to be meaningful?	3.86	0.9	- 0.51	- 0.12	0.61
7. How well are you able to concentrate?	3.29	0.76	0.12	0.1	0.48
8. How safe do you feel in your daily life?	3.47	0.8	- 0.07	- 0.11	0.65
9. How healthy is your physical environment?	3.4	0.79	0.01	0.01	0.55
10. Do you have enough energy for everyday life?	3.46	0.86	0.16	- 0.29	0.57
11. Are you able to accept your bodily appearance?	3.76	1.04	- 0.51	- 0.52	0.51
12. Have you enough money to meet your needs?	3	0.91	0.3	0	0.55
13. How available to you is the information that you need in your day-to-day life?	3.53	0.87	0.03	- 0.38	0.59
14. To what extent do you have the opportunity for leisure activities?	2.88	0.91	0.15	- 0.1	0.42
15. How well are you able to get around?	3.73	0.94	- 0.27	- 0.56	0.46
16. How satisfied are you with your sleep?	3.03	0.92	0.26	- 0.06	0.46
17. How satisfied are you with your ability to perform your daily living activities?	3.44	0.84	0.04	0.07	0.61
18. How satisfied are you with your capacity for work?	3.44	0.87	0.02	0	0.59
19. How satisfied are you with yourself?	3.67	0.92	- 0.33	- 0.08	0.66
20. How satisfied are you with your personal relationships?	3.52	0.9	- 0.18	- 0.04	0.61
21. How satisfied are you with your sex life?	3.35	0.98	- 0.04	0.07	0.46
22. How satisfied are you with the support you get from your friends?	3.53	0.92	- 0.31	0.18	0.48
23. How satisfied are you with the conditions of your living place?	3.77	0.95	- 0.31	- 0.44	0.57
24. How satisfied are you with your access to health services?	3.94	0.97	- 0.54	- 0.36	0.5
25. How satisfied are you with your transport?	3.44	1.03	- 0.02	- 0.65	0.47
26. How often do you have negative feelings such as blue mood, despair, anxiety, depression?	3.04	0.93	- 0.11	- 0.43	0.31

Table 3 Factor loadings for the four-factor solution obtained with EFA

Item	Factor 1	Factor 2	Factor 3	Factor 4
Q3	- 0.01	- 0.01	0.12	0.71
Q4	0	0.01	- 0.05	0.92
Q5	0.7	0.13	- 0.08	0.1
Q6	0.72	0.13	- 0.07	0.01
Q7	0.52	0.02	0.09	0.02
Q8	0.74	0.09	0.01	- 0.02
Q9	0.41	0.25	0.02	0.03
Q10	0.48	- 0.02	0.32	- 0.05
Q11	0.76	- 0.16	0.01	0
Q12	0.03	0.46	0.22	0.17
Q13	0.16	0.52	0.13	0.12
Q14	- 0.04	0.34	0.24	0.13
Q15	0.07	0.46	0.11	0.09
Q16	- 0.09	0.11	0.69	0
Q17	0.06	0.05	0.79	0.05
Q18	0.28	- 0.03	0.58	- 0.06
Q19	0.64	- 0.02	0.23	- 0.01
Q20	0.57	0.16	0.1	- 0.06
Q21	0.38	0.15	0.15	- 0.09
Q22	0.29	0.36	0.01	0.03
Q23	0.14	0.66	- 0.02	0.01
Q24	0.02	0.74	- 0.05	0.02
Q25	- 0.06	0.64	0.12	- 0.09
Q26	0.38	- 0.22	0.08	0.22

while they are not strongly correlated with the other questions; therefore, we kept the factor (see Fig. 1).

Figure 2 displays the results obtained using exploratory graph analysis.

Confirmatory factor analysis and internal consistency

Table 4 displays goodness of fit and internal consistency statistics of the original WHOQOL-BREF model (model 1) and its version with correlated dimensions (model 2), a hierarchical version of the original structure (model 3), a 3-factor model (model 4), and the 4-factor model built upon the results of EFA which matched the pattern obtained in the EGA (model 5). The solution of 8 factors is discarded because 2 factors included only two items that did load in more than one factor. Each but model 1 showed adequate values of *CFI* and *TLI*, but only models 4 and 5 presented acceptable values of *RMSEA* and *SRMR*. Additionally, these two models had the lowest chi-squared statistic and the highest *PNFI* and *PGFI*.

Cronbach's alpha and McDonald's omega coefficients are fairly similar in model 4 and model 5, but the AVE is slightly higher.

Overall, we conclude that model 5 presents the best results. Figure 3 displays its structure and factor loadings.

Measurement invariance

See Table 5 for measurement invariance results. The equivalence analysis was performed with several groups using the four correlated first-order model obtained in EGA that had the best structural validity and internal consistency (model 5). Results should be interpreted by comparing the value of $RMSEA_t$ (the T size value of the Wald statistic) with different *RMSEA* adjusted cutoffs. Measurement invariance of the covariance structure is achieved since the values of $RMSEA_t$ of equality of population covariance, configural, metric, residual, and factor variance-covariance models are, most of them, below an adjusted *RMSEA* of 0.08 with the sole exception of the configural model of group 2 whose $RMSEA_t$ is higher than the 0.08 threshold but lower than 0.1. Strong invariance is achieved since the $RMSEA_t$ values are acceptable for the equality of population covariance, configural, metric and scalar models. For strict invariance, it is the $RMSEA_t$ of the strict means model that overpasses the maximum threshold.

Convergent validity.

A total of three instruments and five dimensions were used to determine the convergent validity of the four dimensions of the WHOQOL-BREF (see Fig. 4). All correlations were statistically significant ($p < .001$) except one factor that did not correlate with social support.

Discussion

The psychometric analysis does not allow us to support the original uncorrelated structure of the WHOQOL-BREF. Despite a great improvement and good psychometric properties are observed when factors are allowed to correlate, an alternative four-factor structure is proposed for it presents better psychometric properties.

The results of other investigations revealed that the instrument could have a factor structure different from the one originally proposed. Variations have also been identified in relation to the original four-domain model in Spanish-speaking populations from the following countries: Costa Rica, Peru, Mexico, Cuba, Paraguay, Argentina, Colombia, Spain, and Chile (Benitez-Borrego et al., 2014; Benítez-Borrego et al., 2016; Huerta et al., 2017; Urzúa, & A., & Caqueo-Urizar, A., 2013). In other non-Spanish-speaking countries, for example, in Brazil, the original structure of the WHOQOL-BREF could not be replicated. The discrepancies observed could be due to the following characteristics of the population involved in the study: active working age and being relatively healthy (Moreno et al., 2006). Another study in

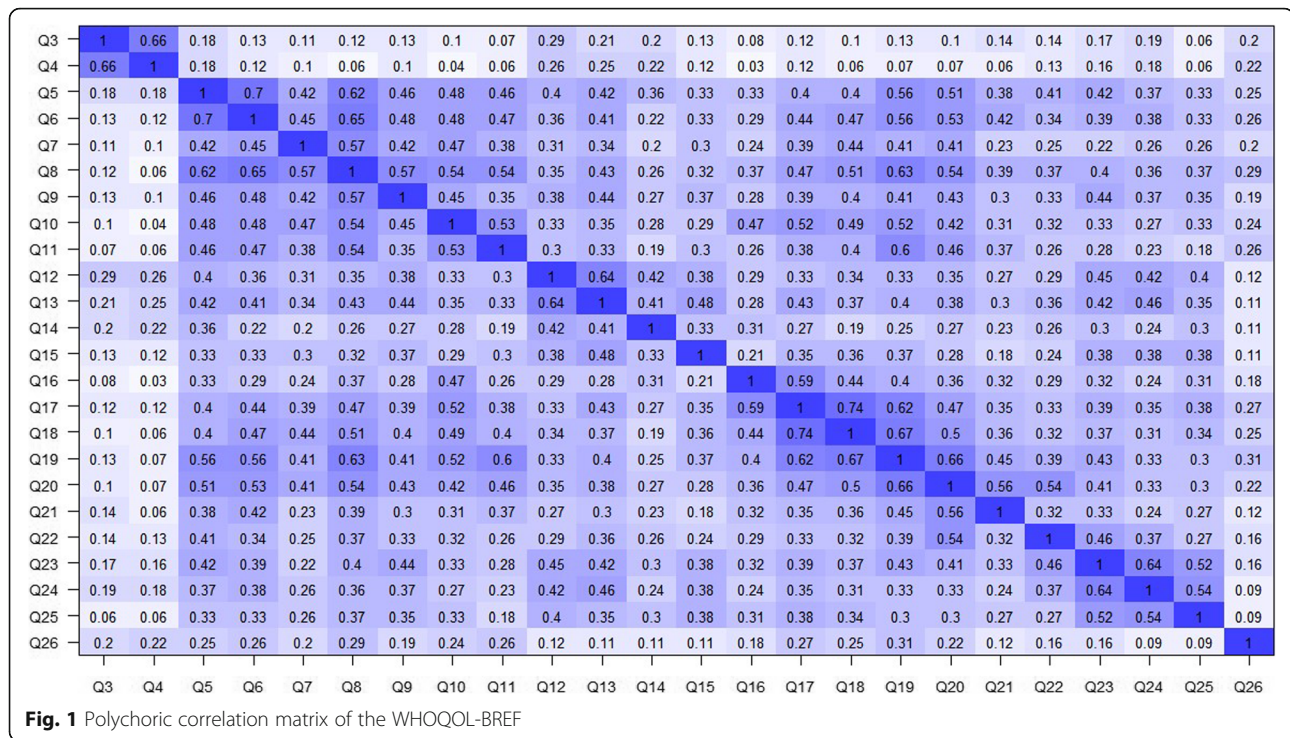


Fig. 1 Polychoric correlation matrix of the WHOQOL-BREF

Portugal involved 403 participants recruited from mental health centers could not confirm the structure of four factors of the instrument (Oliveira et al., 2016). In Nigeria, a study involving 118 recently recovered psychotic patients found that eight domains have better structural integrity indices in the confirmatory factor analysis than the WHO four-domain model (Ohaeri et al., 2004). Besides, the absence of psychometric equivalence between the Iranian and Belgian population would signal that there could be different ways of perceiving the quality of life (Theuns et al., 2010). Another study with culturally heterogeneous samples compared the English, Malay, and Chinese versions of the WHOQOL-BREF, finding partial psychometric equivalence. Although the English and Malay versions were equivalent in all domains, the English and Chinese versions were equal only in the physical and environmental domains but not for the psychological and social domains (Cheung et al., 2019).

These findings could be explained, in the first place, by the fact that the original structure of the WHOQOL-BREF fits better in samples that contain a wide range of age and health status, since this questionnaire was initially developed and validated using large clinical and nonclinical populations (Suárez et al., 2018). Second, these findings could be explained by the nationality of the participants since, despite using a common language, there are differences in cultural, historical, and social variables between Spanish-speaking countries that could be influencing the individual's perception of the different

domains of the quality of life (Benítez-Borrego et al., 2016). Third, young people's conceptions about quality of life give importance to positive expectations for the future, social relationships, and finding an interesting job, whereas adults prioritize other aspects (Saxena et al., 2001).

Considering these results and the approaches of Nisbett (2004) who recognizes that members of different cultures differ in their fundamental beliefs about the nature of the world, the western way of seeing the world can be related to ancient Greek philosophy whose concepts are strange in other cultures. Conceptually, it is conceivable to consider the people of a culture to have a holistic sense of quality of life, while in other cultures, there are more differentiated subjective evaluations of the quality of life and well-being in terms of domains. Although Nisbett's work focuses on the comparison between western (mainly American) and Asian populations, it is reasonable to think that instruments designed in the West need a careful review of content before being applied to other nations, including Latin American countries. This is reflected both in the exploratory factor analysis and in the confirmatory factor analysis.

In exploratory factor analysis, the techniques used to extract factors offered different results. Furthermore, like other research, the analysis reveals that the dimensions are correlated, which suggests a high degree of overlap between domains or even the presence of a general dimension of quality of life. In this paper, we found out that the dimensions are correlated as well, and in addition, we

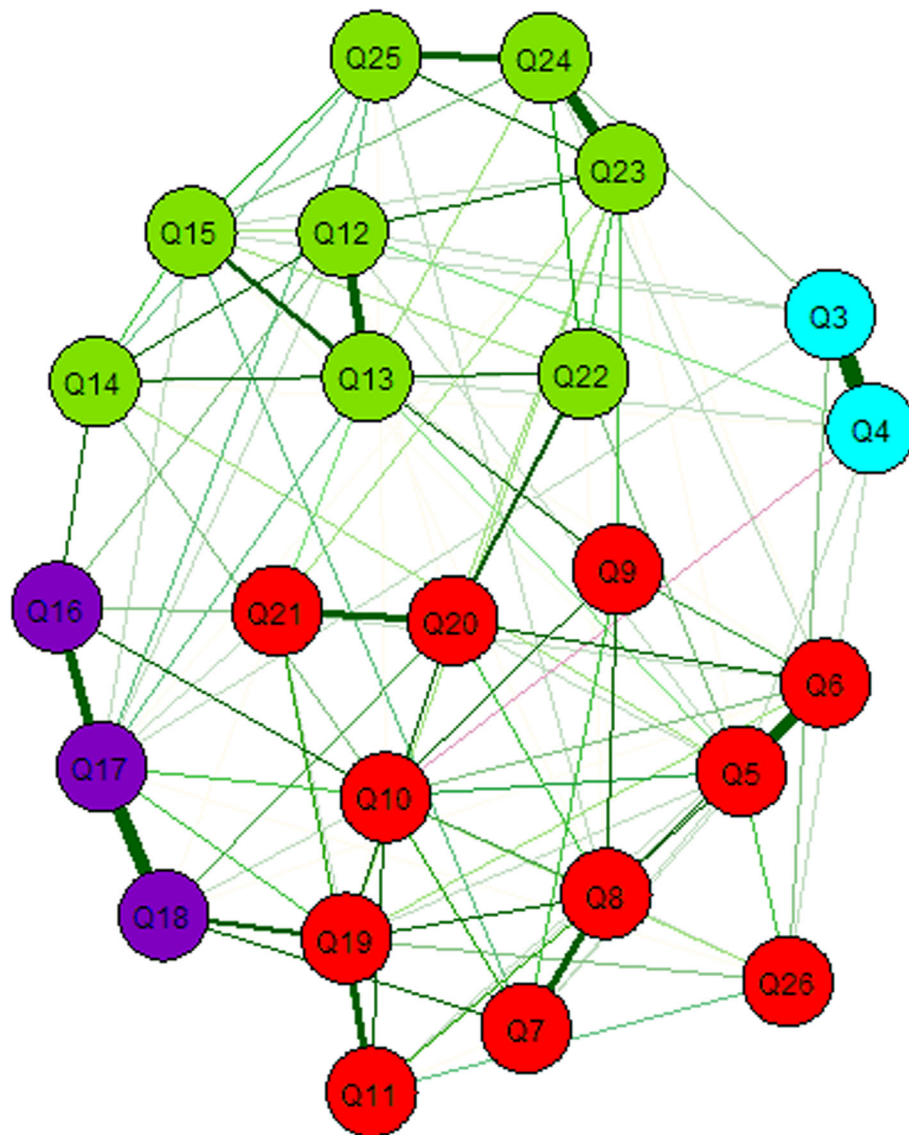


Fig. 2 Exploratory graph analysis output

explored a possible hierarchical model with a second-order factor that represent a general dimension. The finding of a one-dimensional solution of WHOQOL-BREF is found in the literature, although it is based on data from a shorter version of eight items (Snell et al., 2016).

In confirmatory factor analysis, we evaluated the structural validity of five different models of the WHOQOL-BREF. Only the version of orthogonal factors showed undisputable poor goodness of fit indices that improved after allowing factors to correlate (model 2). In models 2 and 3, the values of *CFI*, *TLI*, and *SRMR* revealed good fit, but the *RMSEA* did not ($RMSEA > 0.08$). The two models derived from exploratory factor analysis (models 4 and 5) had good fit, with the latter having slightly better outputs. More importantly, two different strategies,

EFA and EGA, lead to the same factor structure presented in model 5; this model, displayed in Fig. 3, presented the best psychometric properties and includes a 2-item factor (items 3 and 4). Other projects undertaken in Thailand, New Zealand, and China informed that the items 3 and 4 were not considered as relevant or appropriate for samples of young university students with a low proportion of self-reported health problems (Krägeloh et al., 2011; Li et al., 2009; Zhang et al., 2012). Consequently, we adhere to the recommendation that these items should be carefully interpreted with samples of young individuals that are less likely to have physical health problems.

The model we propose includes four dimensions that account for psychological (items 5, 6, 7, 8, 9, 10, 11, 19,

Table 4 Goodness of fit and internal consistency indices of the five models

Model		<i>A</i>	ω	ω_H	<i>AVE</i>	χ^2	<i>df</i>	<i>p</i> value	<i>CFI</i>	<i>TLI</i>	<i>SRMR</i>	<i>RMSEA</i>	<i>RMSEA</i> 90% CI	<i>PNFI</i>	<i>PGFI</i>	
Model 1	Factor 1	0.724	0.662	0.651	0.651	19332.150	252	< .001	0.352	0.290	0.292	0.392	0.388	0.397	0.319	0.394
	Factor 2	0.805	0.785	0.790	0.790											
	Factor 3	0.723	0.703	0.703	0.703											
	Factor 4	0.848	0.832	0.857	0.857											
Model 2	Factor 1	0.724	0.687	0.717	0.364	1319.750	246	< .001	0.964	0.959	0.075	0.094	0.089	0.099	0.852	0.642
	Factor 2	0.805	0.788	0.800	0.451											
	Factor 3	0.723	0.689	0.697	0.497											
	Factor 4	0.848	0.827	0.843	0.440											
Model 3	Factor 1	0.724	0.687	0.717	0.364	1330.290	248	< .001	0.963	0.959	0.076	0.094	0.089	0.099	0.858	0.647
	Factor 2	0.805	0.788	0.800	0.451											
	Factor 3	0.723	0.689	0.697	0.497											
	Factor 4	0.848	0.827	0.843	0.440											
Model 4	Factor 1	0.829	0.812	0.835	0.435	802.120	249	< .001	0.981	0.979	0.060	0.067	0.062	0.072	0.878	0.658
	Factor 2	0.915	0.901	0.924	0.447											
	Factor 3	0.773	0.726	0.726	0.631											
Model 5	Factor 1	0.893	0.874	0.888	0.460	702.710	246	< .001	0.984	0.983	0.058	0.061	0.056	0.067	0.870	0.651
	Factor 2	0.773	0.725	0.725	0.632											
	Factor 3	0.831	0.818	0.851	0.411											
	Factor 4	0.804	0.769	0.780	0.612											

a, Cronbach's alpha; ω , omega; ω_H , hierarchical omega; *AVE*, average variance extracted

20, 21, 26), a dimension with two items (items 3 and 4), environmental (items 12, 13, 14, 15, 22, 23, 24, 25), and physical health (items 16, 17, 18). In the case of the first domain, the clustering of items, may be the result of the influence of certain sociocultural variables not analyzed in this study, such as the importance that the participants in this region may attribute to relationships and ties for psychological health.

A research study involving 4804 respondents from 15 places, from 14 developed and developing countries and 12 languages found that younger adults rated more items as significantly more important to them than the older adults. These items included psychological aspects (e.g., to think clearly, to feel hopeful) and social/work aspects (e.g., relationship with other people, to be able to work) (Saxena et al., 2001). Therefore, for a comparative and international perspective research, the information on the gender- and age-specific items for WHOQOL-BREF is likely to be useful not only in clarifying the concept of quality of life but also in paying attention to these aspects in interpreting the results obtained using generic measures of quality of life (Saxena et al., 2001).

Regarding measurement invariance, we evaluated different models by adding constraints. First, we perform a hypothesis test to determine whether the population variance matrices are equal. A result of *RMSEA_t* lower than the lowest cutoff would support

the overall invariance of the instrument. In this case, the obtained value is higher than the 0.01 but lower than the 0.05 cutoff which leads us to further add constraints to evaluate the invariance of the instrument. Second, we examine the configural invariance and find that the goodness of fit is fair in group 1 but mediocre in group 2. The models with additional constraints show fair goodness of fit, except for strong means invariance and strict means invariance unless we are willing to tolerate a large *RMSEA*. We can conclude that strong invariance (configural, metric, and scalar) and strict (configural, metric, scalar, and residual) invariance are achieved. The high values of *RMSEA_t* for strict and strong means invariance demand a more detailed examination on the source of the lack of invariance.

The convergent validity analysis reveals moderate and significant correlations between the four dimensions proposed related to quality of life: self-esteem (van Leeuwen et al., 2012), resilience (Aranguren, 2017), and social support (Yamout et al., 2013). The magnitude of the correlation is lower than expected for the second factor that groups items 3 and 4. However, as noted before, we recommend caution with the interpretation of this factor.

All the evaluated models present good internal consistency in each of its dimensions. Nevertheless, model 5 has the highest coefficients and highest values of *AVE*.

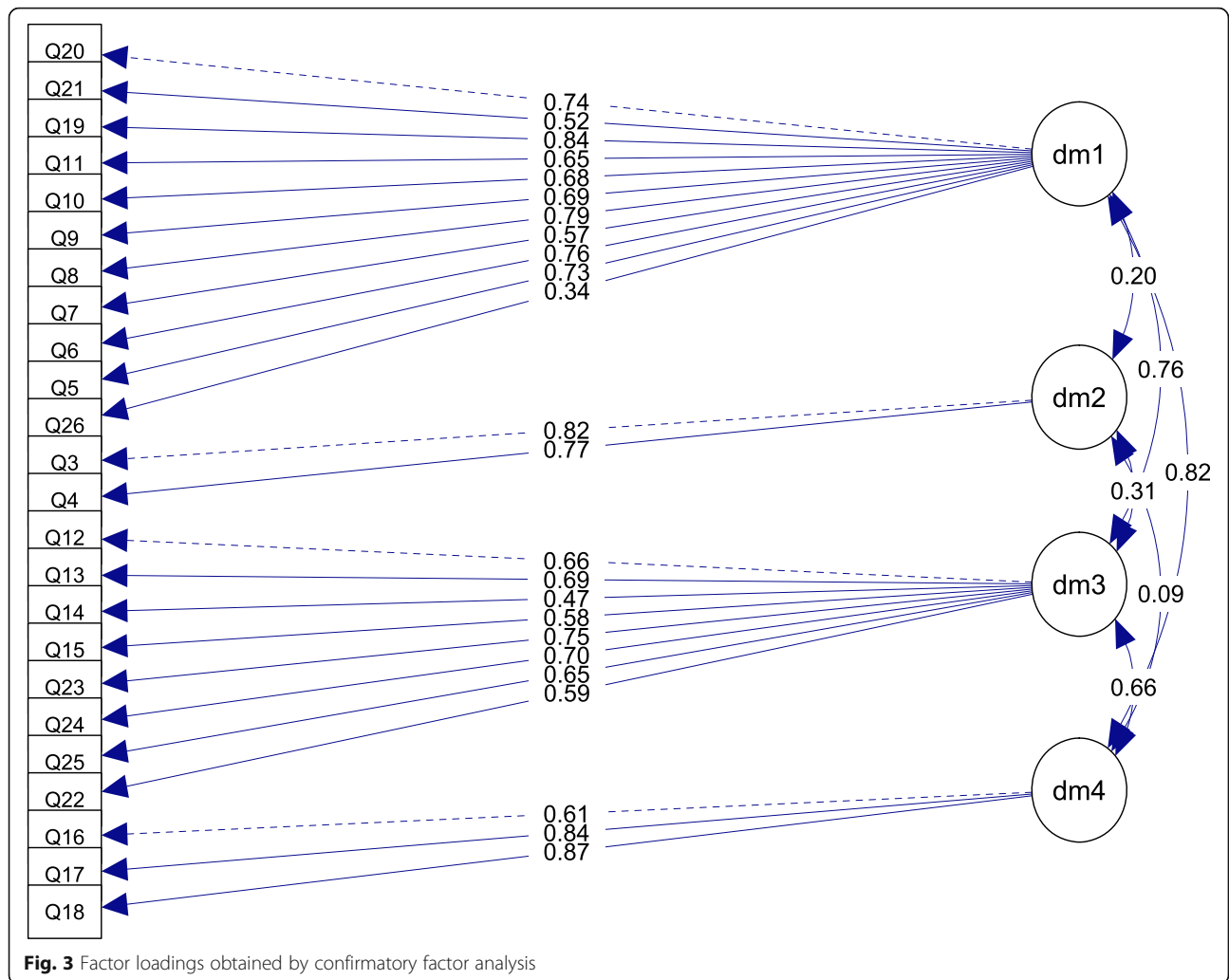
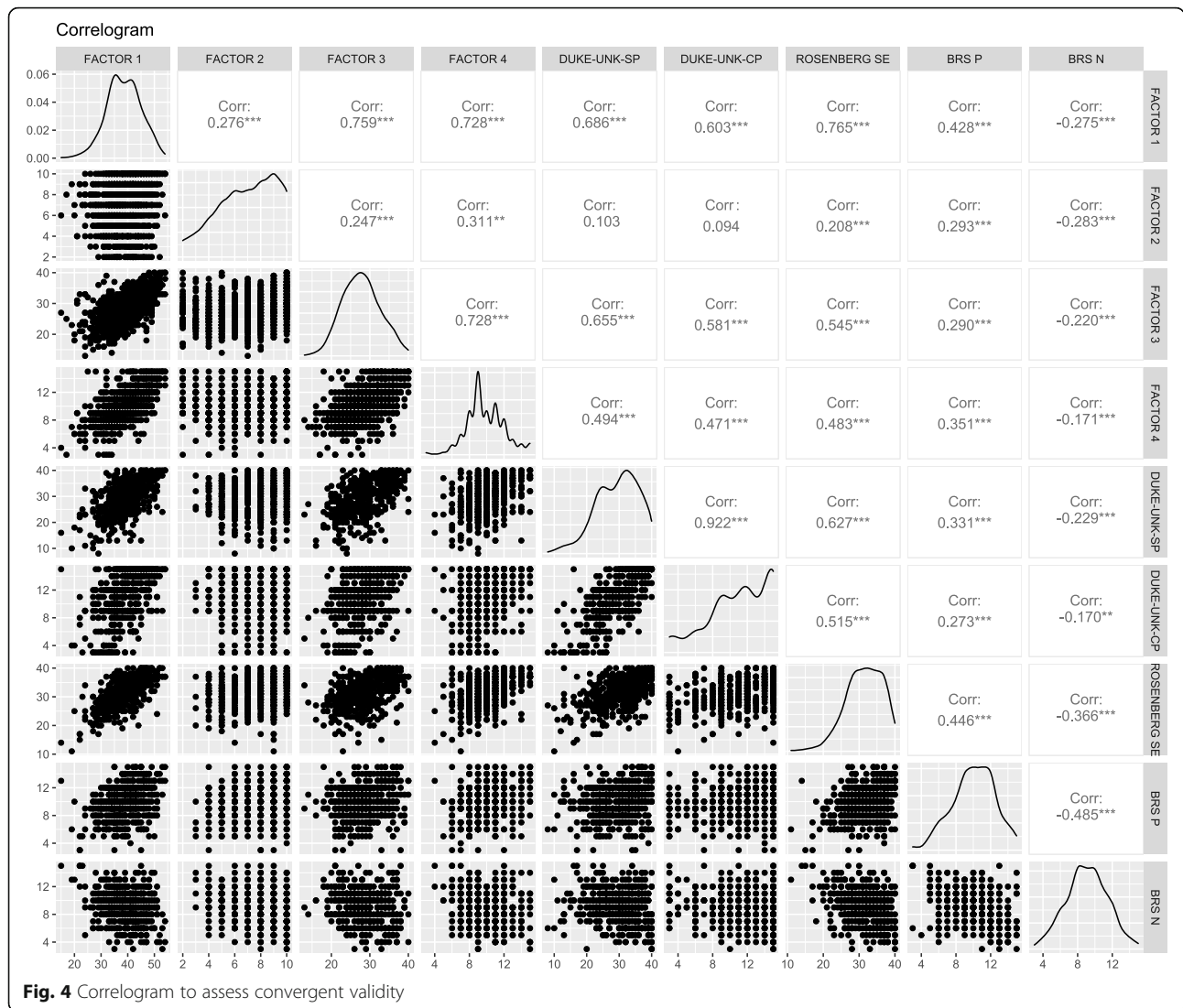


Table 5 Measurement invariance of the WHOQOL-BREF

Model	RMSEA _t	RMSEA cutoff values			
		0.01	0.05	0.08	0.1
Equality of population covariance	0.046	0.020	0.056	0.089	0.111
Configural model (group 1: men)	0.057	0.021	0.056	0.088	0.11
Configural model (group 2: women)	0.089	0.021	0.056	0.088	0.11
Metric invariance	0.061	0.04	0.07	0.098	0.117
Residual invariance	0.072	0.038	0.068	0.096	0.116
Factor variance–covariance	0.068	0.05	0.078	0.107	0.126
Scalar invariance	0.075	0.04	0.07	0.098	0.117
Strong means invariance	0.146	0.069	0.095	0.124	0.143
Strict residual invariance	0.073	0.038	0.068	0.096	0.116
Strict means invariance	0.146	0.069	0.095	0.124	0.143



For practical purposes, the original version of the WHOQOL-BREF can be used until more evidence of the alternative model is provided. When young healthy adults are being screened, items 3 and 4 should be interpreted with caution.

Some limitations of this research deserve attention as they guide the proper interpretation of the results. First, the cross-sectional design of this research should be considered, so the predictive or test-retest validity of this questionnaire is not analyzed. Second, the sample was drawn from two universities; the population surveyed is not demographically diverse enough to be representative of all Ecuadorian population, rather, representative of young adults.

Conclusion

We find that the original uncorrelated factor structure of the WHOQOL-BREF does not present adequate

psychometric properties; however, when factors are allowed to correlate, we observe good structural validity and internal consistency. Given the lack of consensus on the cross-cultural replicability of the original internal structure in other types of samples of young people or general population with different socioeconomic and health conditions, we propose a factor structure obtained by two strategies, EFA and EGA, that shows good structural validity, internal consistency, and invariance. The factor structure we propose contributes to improve the results of professional assessment and to the scarce assessment literature in the Ecuadorian context. For practical purposes, researchers may use the original four-factor with correlated factors because the model proposed in this paper needs to be examined in samples with other sociodemographic characteristics to further assure its external validity.

Abbreviations

QOL: Quality of life; WHO: World Health Organization; WHOQOL-BREF: The World Health Organization Quality of Life questionnaire, short version; RSE: Rosenberg self-esteem scale; BRS: Brief resilience scale; Duke-UNC-11: Functional Social Support questionnaire; KMO: Kaiser-Meyer-Olkin; VSS: Very simple structure; MAP: Veliger's minimum average partial; EGA: Exploratory graph analysis; DWLS: Diagonally weighted least squares; CFI: Comparative fit index; TLI: Tucker-Lewis index; SRMSR: Standardized root mean squared residual; RMSEA: Root mean square error of approximation; EFA: Exploratory factor analysis; CFA: Confirmatory factor analysis; AVE: Average extracted variance

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Authors' contributions

Conceptualization was done by SLC and PA-M. Methodology was done by PA-M and SLC. Research protocol and data collection were done by SLC, PA-M, AB, EP, and MAyMC. Drafting of the manuscript was done by SLC and PA-M. Critical review and editing of the text were done by AB, EP, MAyMC. The authors have approved the final article.

Availability of data and materials

Available upon request

Declarations

Ethics approval and consent to participate

This work complies with the national guidelines for research. At the time this grant was approved and received by the Research Department of the University of Cuenca, an ethics committee approval was not needed. Authorization was requested from the institutions to access the participants. The participation of the subjects was anonymous and voluntary without economic or other incentives.

Consent for publication

All the authors agree to the submission to *Psicología: Reflexão e Crítica* and, if approved, the publication of the manuscript.

Competing interests

The authors declare that they have no competing interests.

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