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Invariance of the COV19 - Impact on Quality of Life (COV19-QoL) Measurement in People who Lost a Loved One During the COVID-19 Pandemic from Four South American Countries*

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Data Availability. The data are available in the open access repository OSF: https://osf.io/abwfn/

Conflict of Interest. The authors declare that they have no conflict of interest.

Ethics approval. The data from the study are part of a larger project "Study of mental health and COVID-19 in a post-pandemic context in Latin America and the Caribbean" that was reviewed and approved by the Institutional Committee for the Protection of Human Subjects in Research (CIPSHI) of the University of Puerto Rico (No. 2223-006).

Consent to participate. Informed consent was obtained from all individual participants included in the study.

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The COV19 - Impact on Quality of Life (COV19-QoL) has been used as a measure of the perceived impact of COVID-19 on quality of life; however, little is known about its cross-cultural utility. The present study evaluated the measurement invariance of COV19-QoL in adult samples (N = 1034; M_{age} = 35.7 years; SD = 13.3 years; 68.3% women) from four South America countries (Ecuador, Colombia, Perú y Bolivia). The COV19-QoL unidimensional model fit indices were adequate in all the countries (CFI = 1.00, TLI = 0.99, SRMR = 0.02, RMSEA = 0.10). Both the alpha and omega indices had acceptable values ranging from 0.91 to 0.94 in all countries. Factorial invariance was evaluated using the alignment method, and invariance was obtained for the factorial weights (R^2 = 1.00) and intercepts (R^2 = 1.00), admitting the approximate invariance of COV19-QoL. The COV19-QoL can be recommended to meaningfully compare relationships between variables between groups and to compare latent means in four South American populations.

Keywords: alignment, invariance, death, quality of life, South America

Highlights:

- This study provides the first analysis of COV19-QoL in samples from South American countries using a novel statistical method, the alignment method.
- This study contributes significantly to the literature on the perceived impact of COVID-19 on quality of life, especially on the measurement of the quality of life construct.
- These findings are useful for conducting cross-cultural comparisons in both basic research and transnational epidemiological research on the effects of COVID-19 on quality of life.

The COVID-19 pandemic has caused rapid and unprecedented changes in the lives of billions of people worldwide (Ravens-Sieberer et al., 2022), affecting different areas of people's lives, especially physical health, mental health, and quality of life (Liu et al., 2021). During the pandemic, greater emphasis was placed on the deceased and less attention was paid to their loved ones and/or family members who experienced these losses. The characteristics of death during the pandemic associated with care during illness, funeral rituals, and burials, along with norms of physical distancing and social isolation that limited social contacts, made this experience particularly devastating for family members or loved ones (Stroebe & Schut, 2021). The impact of the pandemic may be greater in people who have experienced the death of a family member or loved one from COVID 19 due to the psychological consequences they may have, such as depression, suicidal ideation, anxiety, sleep disorders, and an increased risk of having physical illnesses (Joaquim et al., 2021; Lee & Neimeyer, 2022; Thimm et al., 2020). Grief may have been aggravated by a lack of emotional support and situations that affect quality of life, such as financial precariousness, home confinement, and concern for their own health and that of other family members (Carr et al., 2020). This has resulted in a deterioration in the quality of life of people who have experienced the death of a family member or loved one due to COVID-19 (Park & Cha, 2023).

Quality of life can be understood as a person's perception of well-being with respect to his or her physical, psychological, and social health as well as the expectations he or she has in relation to it (Urzua, 2010). A good quality of life means having good physical, material, and psychological conditions that allow a person to be or feel well; that is, to experience personal well-being, which is an important factor in mental health. From a psychological point of view, measurement is related to people's perceptions and expectations that their needs are being met and that they are not denied opportunities to achieve a state of happiness and personal fulfillment (Ruidiaz-Gómez & Cacante-Caballero, 2021).

Quarantine, imposed to mitigate the spread of COVID-19, has been suggested to contribute to heightened anxiety and fear of the disease, and therefore, to a reduction in quality of life (Ferreira et al., 2021). Other studies have also reported the impact of COVID-19 on quality of life (Nguyen et al., 2020; Zhang & Ma, 2020) as well as on the mental health and psychological state of people (Qiu et al., 2020; Wang et al., 2021). Recently, it has also been reported that quality of life was significantly lower in people who experienced the death of a loved one from the pandemic, where being female, experiencing the death of a partner, and being the full-time caregiver of the deceased were risk factors; whereas, time since death and cause of death were not associated with quality of life (Engel et al., 2023). However, few studies have adequately addressed the impact of the COVID-19 pandemic on the quality of life of people living in regions most affected by COVID-19, such as Latin America (Burki, 2020; Garcia et al., 2020). For example, in Latin America, it has been reported that the increased risk of poor quality of life during the COVID-19 pandemic is associated with gender, lifestyle, physical inactivity, lack of sleep, tobacco use,

and junk food intake (Guzmán-Muñoz et al., 2020). Similarly, a decrease was observed in vitality, social function, emotional role, mental health, and general health, as dimensions of quality of life, where the dimensions that decreased the most were emotional role and general health, which decreased by 39.5% and 21.0%, respectively (Guzmán Muñoz et al., 2021). Other studies have also shown that the pandemic has a negative impact on quality of life in different Latin American countries (Figueroa-Quiñones et al., 2022; García-Garro et al., 2022; Huarcaya-Victoria et al., 2022). This requires the use of appropriate measures to assess the impact of the pandemic on the quality of life within the Latin American context.

Throughout the pandemic, different instruments that measure the perceived quality of life have been used in different languages. However, the above instruments have not been developed to assess how people perceive the impact of the COVID-19 pandemic on their quality of life. It has been noted that, during the pandemic, the use of general measures of quality of life and mental health could lead to under- or over-diagnosis (Ransing et al., 2020). Similarly, the above instruments do not provide information on changes in quality of life throughout the pandemic. To measure the perception of the impact of COVID-19 on quality of life, we developed the COV19 – Impact on Quality of Life (COV19-QoL; Repišti et al., 2020). COV19-QoL comprises six items that measure different areas of quality of life affected by the pandemic. The first item measures the general impact of the pandemic on quality of life, while the other items measure the perception of deterioration of mental and physical health due to COVID-19, variations in anxiety and depression, and the perception of personal safety (Repišti et al., 2020).

Previous psychometric studies of COV19-QoL have been conducted in Bosnia and Herzegovina, Montenegro, North Macedonia, Serbia (Repišti et al., 2020), Turkey (Sümen & Adibelli, 2021), and Irán (Dehkordi et al., 2021), providing evidence of a unidimensional model with adequate reliability. However, in Latin American countries, the psychometric properties of COV19-QoL have not been evaluated. Similarly, none of the previous studies evaluated the invariance of the measurement between different groups, let alone between country groups (Dehkordi et al., 2021; Repišti et al., 2020; Sümen & Adibelli, 2021). To use a self-report scale developed in one particular context in another, it is necessary to ensure that the scale measures the original construct in the same manner (Boateng et al., 2018). Different factors, such as cultural and socioeconomic, can affect the psychometric properties of a measure. This has created a need for transnational validation studies on measures of well-being and quality of life (Sischka et al., 2020). Cross-country comparison studies are needed to ensure the comparability of measurements to obtain reliable conclusions (Boer et al., 2018). In this sense, in order to significantly compare the scores of the latent variables between countries, it is necessary that the structures underlying them are stable or invariant between countries (Davidov et al., 2014; Davidov et al., 2018). Measurement invariance (MI) provides evidence that a scale measures a latent construct in the same way across different groups, which is an important requirement before

making comparisons between groups (Brown, 2015). On the other hand, the lack of MI would generate interpretation bias, where the differences observed between the groups could be the result of technical problems and not the true differences between the constructs. In this scenario, it is not advisable to make group comparisons (Van de Schoot et al., 2012).

The main objective of the present study was to evaluate the cross-national measurement invariance (MI) of COV19-QoL among people who have experienced the death of a family member or loved one due to COVID-19 in four South American countries. For this purpose, the factor structure and reliability of the COV19-QoL in each country were initially evaluated, and the research hypotheses were tested. First, it was hypothesized that COV19-QoL would have a good fit for a unidimensional model based on previous studies (Dehkordi et al., 2021; Repišti et al., 2020; Sümen & Adibelli, 2021). Second, it was hypothesized that COV19-QoL would have adequate internal consistency reliability, with reliability coefficients greater than 0.75, as previously reported (Dehkordi et al., 2021; Repišti et al., 2020; Sümen & Adibelli, 2021). As mentioned above, no study has examined the effect of MI on COV19-QoL. However, as studies in different countries have demonstrated the presence of a unidimensional structure of COV19-QoL (Caycho-Rodríguez et al., 2023; Dehkordi et al., 2021; Repišti et al., 2020; Sümen & Adibelli, 2021), it is expected that this same unidimensional structure will be invariant across countries.

Therefore, it is necessary to develop effective, valid, and reliable measurement instruments that allow for an accurate diagnosis of the impact of COVID-19 on the perception of quality of life. Various studies have reported the impact of the pandemic on quality of life in South American countries participating in this study, revealing certain differences and similarities. In Peru, it has been reported that the quality of life of a sample of Peruvians declined during periods of high mortality and the incidence of COVID-19, specifically in the domains of physical, mental, and environmental health (Moya-Salazar et al., 2023). Furthermore, it has been indicated that one year after hospital discharge from COVID-19, patients who survived the disease reported low quality of life and increased symptoms of depression (Huarcaya-Victoria et al., 2023). In Colombia, it was also reported that the COVID-19 lockdown decreased physical activity, increased coffee and alcohol consumption, and led to greater manifestations of anxiety, depression, and loneliness, which affected individuals' well-being and quality of life (de Souza Martins et al., 2023). In Bolivia, it was reported that greater pandemic-related adversity is associated with a lower quality of life (Castillo, 2021). Additionally, those who experienced more significant shortages of food, medicine, and hygiene products were at twice the risk of suffering greater impacts on their physical health, psychological well-being, and quality of life (Wanderley et al., 2020). Similar to Peru, the persistence of post-COVID symptoms was correlated with lower quality of life (Martinez et al., 2023). Finally, in Ecuador, it was noted that among the young adult population, social confinement and isolation led to changes in well-being, directly affecting growth prospects and quality of life. Additionally, high clinical expenses and a lack of social support have resulted in individuals and

families experiencing a poor quality of life, causing social, academic, and economic setbacks (Figueroa, 2021; Gaibor et al., 2022; Quinga et al., 2022). Although COVID-19 negatively impacted the quality of life in all the aforementioned countries, this impact may have been more severe in those countries most affected by COVID-19. In this regard, the Latin America and Caribbean region was one of the epicenters of COVID-19, reporting over 27% of COVID-19-related deaths worldwide, particularly in Brazil, Mexico, Colombia, Argentina, and Peru, which reported the highest number of deaths in the region (Anaya-Covarrubias et al., 2022). Moreover, these countries experienced the greatest GDP decline during the pandemic (Beccaria et al., 2022). All of this may have generated differences in the impact of COVID-19 on the quality of life of the countries involved in this study.

Having an invariant measure of the impact of COVID-19 on the perception of quality of life across countries can be useful for cross-cultural comparisons in both basic and transnational epidemiological research on the effects of COVID-19 on quality of life (Boynton & Greenhalgh, 2004). This is based on the fact that the definition of QoL can vary significantly between cultures as well as the factors that affect quality of life (Kuyken et al., 1994). Retaining sensitivity to this diversity of concepts while generating cross-cultural data is a challenge for quality of life researchers using cross-cultural quality of life assessment measures. Sensitivity to culture is based on the assumption that quality of life may be the same across different cultures, despite the variation among them. Likewise, assessing the impact of COVID-19 on the quality of life of people who experienced the death of a loved one in different countries is important, especially considering that sociocultural factors such as cultural identity can predict and shape the emotional expression of grief over the death of a loved one (Adiukwu et al., 2022; Neimeyer et al., 2014; Smid et al., 2018; Silverman et al., 2021). This leads to the need to identify whether the concept of quality of life is interpreted in the same way in people who experienced the death of a loved one in different cultures, and to what extent it is interpreted in the same way in different cultures (Schmidt & Bullinger, 2003).

Method

Participants

The overall sample consisted of 1,034 adults from Ecuador (n = 219), Colombia (n = 403), Peru (n = 222), and Bolivia (n = 190), selected using non-probability snowball sampling. The determination of the number of participants in each country for determining the factor structure through confirmatory factor analysis was conducted using Soper's (2022) software, which considers the number of observed (six items) and latent (one latent variable) variables in the model, the anticipated effect size ($\lambda = 0.3$), which is the minimum effect size that our calculated sample size can detect, where values of 0.1, 0.3, and 0.5. indicate small, moderate, and large effect sizes, respectively (Westland, 2010). A moderate effect size of 0.3 was chosen, as small effects are more difficult to detect than large ones (Westland, 2010). The desired statistical significance ($\alpha = 0.05$) and power level ($1–\beta = 0.95$) were also determined, resulting in a minimum of 200 participants per country. In this case, all countries exceeded the minimum size, except for Bolivia, which had only ten

cases less than the minimum required (There are only 10 cases of difference). Regarding the alignment method, precise recommendations on the minimum number of participants required are still under development. It has been suggested that a sample size of 100 is too small to produce reliable estimates, and that at least 200 to 300 observations per group are necessary to show superior performance compared to the scalar model, which ignores non-invariance (Pokropek et al., 2020). In this case, the number of participants in each country was close to this estimated minimum, except for Bolivia, which, as mentioned, varied minimally. Additionally, the sample size of each group in this study seems adequate for the alignment method, according to the suggestions of Asparouhov and Muthen (2014) and Marsh et al. (2018) for independent groups, where the ratio between the sample size per group and the number of groups is greater than 6 (Ecuador = 219/4; Colombia = 403/4; Peru = 222/4; and Bolivia = 190/4), which would not generate biased latent parameter estimates. The inclusion criteria were: 1) being of legal age; 2) residing in a participant country; 3) having had a family member or loved one killed by COVID-19; and 4) providing informed consent to participate in the study.

The M_{age} of those evaluated was 35.3 (*SD* = 12.8). The M_{age} varied between countries, ranging from 30.0 years in Bolivia to 37.8 years in Colombia. In addition, female sex predominated in all countries, representing 66.1% of the total sample, while 33.7% corresponded to male sex and 0.3% chose not to declare their sex. Regarding marital status, single and married participants were predominant in all countries, accounting for 52.7% and 30.9% of the total sample, respectively. In terms of educational level, those with completed (60.7%) and incomplete (23.2%) university degrees constituted the largest proportion of the sample. On the other hand, in terms of employment, participants were distributed between permanent work (50.7%), temporary work (22.8%), unemployed (22.7%) or retired (3.8%).

In addition, we explored how long ago they suffered the loss of a family member due to COVID-19, with 57.9% losing a family member more than 12 months ago, followed by 27.7% who lost a family member 6–12 months ago. These responses were the most common in all countries, with a few participants losing a family member in less than three months (1.5%). Likewise, participants lived with people vulnerable to Covid-19, revealing that 60.2% shared their space with this group, while 39.8% did not. In addition, we investigated whether the participants had any chronic disease and found that 88.1% responded negatively, while 11.9% stated that they had a chronic disease. Employment data showed significant variations between countries, as detailed in Table 1.

Table 1
Sociodemographic data

	Overall (*n* = 1034)	Ecuador (*n* = 219)	Colombia (*n* = 403)	Peru (*n* = 222)	Bolivia (*n* = 190)
Age	35.3 ± 12.8	37.4 ± 12.6	37.8 ± 12.3	33.0 ± 13.3	30.0 ± 11.7
Gender					
Male	348 (33.7%)	67 (30.6%)	132 (32.8%)	102 (45.9%)	47 (24.7%)
Female	683 (66.1%)	152 (69.4%)	271 (67.2%)	120 (54.1)	140 (73.7%)
Not disclosed	3 (0.3%)	–	–	–	3 (1.6%)
Civil status					
Married	319 (30.9%)	89 (40.6%)	116 (28.8%)	61 (27.5%)	53 (27.9%)
Partnered	109 (10.5%)	16 (7.3%)	69 (17.1%)	16 (7.2%)	8 (4.2%)
Divorced	52 (5.0%)	24 (11.0%)	18 (4.5%)	3 (1.4%)	7 (3.7%)
Single	545 (52.7%)	88 (40.2%)	194 (48.1%)	141 (63.5%)	122 (64.2%)
Widowed	9 (0.9%)	2 (0.9%)	6 (1.5%)	1 (0.5%)	–

	Overall (n = 1034)	Ecuador (n = 219)	Colombia (n = 403)	Peru (n = 222)	Bolivia (n = 190)
Educational status					
University, complete	628 (60.7%)	154 (70.3%)	274 (68.0%)	104 (46.8%)	96 (50.5%)
University, incomplete	240 (23.2%)	35 (16.0%)	55 (13.6%)	84 (37.8%)	66 (34.7%)
Technician, complete*	70 (6.8%)	6 (2.7%)	43 (10.7%)	10 (4.5%)	11 (5.8%)
Technician, incomplete*	10 (1.0%)	1 (0.5%)	6 (1.5%)	2 (0.9%)	1 (0.5%)
Secondary, complete	71 (6.9%)	17 (7.8%)	23 (5.7%)	17 (7.7%)	14 (7.4%)
Secondary, incomplete	14 (1.4%)	5 (2.3%)	2 (0.5%)	5 (2.3%)	2 (1.1%)
Primary, complete	1 (0.1%)	1 (0.5%)	–	–	–
Employment					
Fixed employment	524 (50.7%)	123 (56.2%)	251 (62.3%)	85 (38.3%)	65 (34.2%)
Temporal employment	236 (22.8%)	33 (15.1%)	88 (21.8%)	68 (30.6%)	47 (24.7%)
Unemployed	235 (22.7%)	52 (23.7%)	48 (11.9%)	59 (26.6%)	76 (40.0%)
Retired	39 (3.8%)	11 (5.0%)	16 (4.0%)	10 (4.5%)	2 (1.1%)
When did you lose a family member to COVID?					
Less than 3 months ago	16 (1.5%)	5 (2.3%)	3 (0.7%)	7 (3.2%)	1 (0.5%)
3 to 6 months ago	77 (7.4%)	18 (8.2%)	25 (6.2%)	17 (7.7%)	17 (8.9%)
6 to 12 months ago	286 (27.7%)	45 (20.5%)	129 (32.0%)	59 (26.6%)	53 (27.9%)
More than 12 months ago	599 (57.9%)	142 (64.8%)	226 (56.1%)	124 (55.9%)	107 (56.3%)
I did not suffer the death of a family member	31 (3.0%)	6 (2.7%)	11 (2.7%)	9 (4.1%)	5 (2.6%)
No response	25 (2.4%)	3 (1.4%)	9 (2.2%)	6 (2.7%)	7 (3.7%)
Do you live with people vulnerable to Covid-19?					
Yes	622 (60.2%)	130 (59.4%)	232 (57.6%)	139 (62.6%)	121 (63.7%)
No	412 (39.8%)	89 (40.6%)	171 (42.4%)	83 (37.4%)	69 (36.3%)
Do you suffer from chronic diseases?					
Yes	123 (11.9%)	21 (9.6%)	49 (12.2%)	30 (13.5%)	23 (12.1%)
No	911 (88.1%)	198 (90.4%)	354 (87.8%)	192 (86.5%)	167 (87.9%)

Note. *Technical careers are short duration academic programs (shorter than traditional university degrees) primarily offered at Institutes or Professional Schools. They aim to provide practical and specific skills, specializing students in a particular area of work, such as marketing, interior design, and automotive mechanics.

Instrument

Sociodemographic data. An Ad Hoc survey was conducted to obtain information on some characteristics of the participants, such as country of residence, age, sex, education, marital status, work, COVID diagnosis and vaccination.

COV19: Impact on Quality of Life (COV19-QoL; Repišti et al., 2020). The COV19-QoL is a brief, unidimensional measure of the impact of COVID-19 on the quality of life. It comprises six items with five Likert-type response options (1 = "strongly disagree" to 5 = "strongly agree"). The sum of the scores for each of the six items results in a total score ranging from 6 to 30. Higher scores indicate a perception of the greater impact of the COVID-19 pandemic on the quality of life. Each of the six items assesses the impact on the

overall quality of life, deterioration of mental and physical health, anxiety, depression, and perception of personal safety (Voitsidis et al., 2021). The translation process of the COV19-QoL was as follows. First, two independent translators translated COV19-QoL from English into Spanish. Second, the Spanish version was translated back into English by two other independent translators. Based on the above translations, the final Spanish version of the COV19-QoL was developed by the research team. Supplementary material 1 shows the items from the English and Spanish versions of the COV19-QoL scale.

Procedure

Data collection was conducted using an online survey developed on the Google Forms platform in all countries. The link and quick response (QR) code of the Google Forms survey were sent to participants and shared via social media platforms such as Facebook, Instagram, and Telegram. The same procedure was followed for all the participating countries. All study information was described in detail at the beginning of the online survey. Only individuals who agreed to provide informed consent were able to participate in and answer the survey questions. The online survey was set up in such a way that it could not be terminated if any questions were left blank. This means that there were no missing data in the samples from each country. The data from the study are part of a larger project "Study of mental health and COVID-19 in a post-pandemic context in Latin America and the Caribbean" that was reviewed and approved by the Institutional Committee for the Protection of Human Subjects in Research (CIPSHI) of the University of Puerto Rico (No. 2223-006). The database used in this study can be freely downloaded at the following link: https://osf.io/bgywk. Additionally, the RStudio codes used for the analysis can also be freely downloaded at the following link: https://osf.io/gwf86

Data Analysis

Statistical analysis was performed using the R Studio program (v. 4.2.2.) using the packages dplyr (Wickham et al., 2023), psych (Revelle, 2023), lavaan (Rosseel, 2023), semTools (Jorgensen et al., 2022), sirt (Robitzsch, 2024). First, descriptive statistics of the items (central tendency, dispersion, and distribution) were examined. To explore univariate normality, the skewness (±2) and kurtosis (±7) coefficients were used (Finney & DiStefano, 2013). Subsequently, Confirmatory Factor Analysis (CFA) was performed using the WLSMV estimator because of the ordinal categorical nature of the items (Brown, 2015). The comparative fit index (CFI), Tucker-Lewis index (TLI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA) were used to evaluate model fit. For the CFI and TLI, a value of 0.90 or higher, was considered adequate, and for the RMSEA and SRMR, a value of 0.08 or lower (Browne & Cudeck, 1992). The chi-square (χ^2) and degrees of freedom (*df*) were also reported but were not used to evaluate the model because of their susceptibility to large samples (Moshagen & Erdfelder, 2016). Reliability was evaluated using the alpha (α) and omega (ω) coefficients (Choi et al., 2009), where values greater than 0.80 are adequate (Raykov & Hancock, 2005).

The invariance of COV19-QoL across countries was assessed using the alignment (approximate invariance) method (Asparouhov & Muthén, 2014). Free optimization was used because it performs better when there are multiple groups, and it may even outperform fixed optimization. This method evaluates the factor loadings and intercepts to ensure invariance among a large number of groups. First, conservative values for the factor loadings ($\lambda = 0.40$) and intercepts ($\nu = 0.20$) were established (Fischer & Karl, 2019). Invariance was evaluated according to R^2, where values close to 1 indicate invariance, while values close to 0 indicate non-invariance. In addition, the percentage of non-invariant parameters was calculated. The percentage value was expected to be less than 25% to ensure invariance between the countries (Muthén & Asparouhov, 2014).

Results

Descriptive Analysis of the Items

Table 2 presents the descriptive results for the items. The response tendency is observed among the options of lower numerical value, so that the average mean varies between 2.39 (SD = 1.30) to 2.78 (SD = 1.23) in the total sample. The skewness is shown to be within the expected range so that univariate normality is assured. A floor effect was observed for all item responses. The associations between the items were strong. It was observed that item 3 "Due to the spread of the coronavirus, I think that my physical health may deteriorate," does not show a floor and ceiling effect. Nevertheless, the associations were strong for the items.

Table 2.
Descriptive statistics: total sample and by country COV19-QoL

Countries	Item	*M*	*SD*	g_1	g_2	Effects		Polychoric Correlation					
						Floor	Celling	1	2	3	4	5	6
Overall	1	2.51	1.26	0.35	-0.95	28.4	7.4	-					
	2	2.54	1.33	0.38	-1.05	29.8	9.9	0.66	-				
	3	2.78	1.23	0.00	-1.07	19.8	7.1	0.59	0.68	-			
	4	2.57	1.27	0.32	-0.98	26.0	8.3	0.63	0.77	0.69	-		
	5	2.39	1.30	0.48	-0.95	34.5	7.4	0.66	0.83	0.66	0.84	-	
	6	2.51	1.24	0.31	-0.98	27.8	6.2	0.60	0.67	0.65	0.75	0.76	-
Ecuador	1	2.57	1.29	0.39	-0.92	26.0	10.0	-					
	2	2.40	1.28	0.46	-0.95	32.9	6.8	0.65	-				
	3	2.75	1.24	0.08	-1.09	20.5	7.8	0.58	0.75	-			
	4	2.46	1.26	0.45	-0.89	28.8	7.3	0.64	0.80	0.77	-		
	5	2.23	1.21	0.56	-0.82	38.4	4.1	0.67	0.86	0.76	0.85	-	
	6	2.49	1.24	0.34	-0.94	27.9	6.4	0.63	0.72	0.64	0.78	0.77	-
Colombia	1	2.28	1.19	0.46	-0.90	35.2	3.5	-					
	2	2.21	1.23	0.70	-0.60	38.7	5.5	0.66	-				
	3	2.59	1.19	0.09	-1.18	23.8	3.2	0.52	0.63	-			
	4	2.38	1.19	0.36	-0.97	30.8	3.7	0.56	0.75	0.63	-		
	5	2.18	1.22	0.66	-0.72	40.4	4.2	0.67	0.82	0.62	0.84	-	
	6	2.33	1.20	0.42	-0.94	33.7	3.7	0.54	0.67	0.63	0.71	0.76	-
Perú	1	2.63	1.20	0.27	-0.84	21.2	7.7	-					
	2	2.69	1.26	0.21	-1.02	21.6	9.0	0.63	-				
	3	2.88	1.21	-0.09	-1.02	17.1	7.7	0.67	0.68	-			
	4	2.74	1.27	0.21	-1.02	19.8	10.4	0.63	0.76	0.74	-		
	5	2.59	1.28	0.27	-1.07	26.1	8.1	0.60	0.81	0.68	0.81	-	
	6	2.74	1.21	0.13	-0.98	18.9	7.7	0.61	0.70	0.75	0.77	0.78	-

Countries	Item	*M*	*SD*	g_1	g_2	Effects		Polychoric Correlation					
						Floor	Celling	1	2	3	4	5	6
Bolivia	1	2.78	1.35	0.08	-1.18	25.3	12.1	-					
	2	3.22	1.41	-0.24	-1.24	16.8	23.7	0.70	-				
	3	3.12	1.23	-0.22	-0.87	13.7	13.7	0.61	0.65	-			
	4	2.92	1.36	0.08	-1.16	20.0	16.8	0.70	0.75	0.61	-		
	5	2.79	1.46	0.17	-1.36	27.4	17.4	0.69	0.74	0.60	0.84	-	
	6	2.64	1.30	0.25	-1.09	25.3	9.5	0.62	0.62	0.58	0.76	0.73	-

Note. M = mean; SD = standard deviation; g1 = skewness; g2 = kurtosis.

Confirmatory Factor Analysis and Reliability by Country

As in the literature, the one-factor model was tested for the total sample by country (Table 3). COV19-QoL showed adequate goodness-of-fit indices (CFI = 1.00, TLI = 0.99, SRMR = 0.02, RMSEA = 0.10). Similarly, the countries in Ecuador, Colombia, Peru, and Bolivia showed adequate fit indices. However, it was observed that the model error was above the expected < 0.08 in the case for Colombia, Peru, and Bolivia. In terms of factor loadings, item 5 "Due to the spread of the coronavirus, I feel more depressed than before" was the item with the highest loading in the total sample and by country. In contrast, item 1 "Due to the spread of the coronavirus, I think my quality of life is lower than before" had the lowest factor loadings. However, all factor loadings were above 0.70, which was expected because of strong association in the polychoric matrix. However, the reliability was above 0.90, which ensured consistency and stability of the responses in the sample.

Table 3.
Confirmatory factor analysis, factor loadings, and internal consistency reliability of total and country COV19-QoL.

Model	Fit							Factor loadings						Reliability	
	χ^2	*df*	*p*	CFI	TLI	SRMR	RMSEA [CI 90%]	1	2	3	4	5	6	α	ω
Overall	93.98	9	<0.001	1.00	0.99	0.02	0.10 [0.08 – 0.11]	0.73	0.88	0.77	0.90	0.93	0.82	0.93	0.92
1. Ecuador	21.44	9	<0.001	1.00	1.00	0.02	0.08 [0.04 – 0.12]	0.72	0.90	0.82	0.81	0.84	0.82	0.94	0.93
2. Colombia	43.19	9	<0.001	0.99	0.99	0.03	0.10 [0.07 – 0.13]	0.71	0.87	0.72	0.88	0.94	0.81	0.92	0.91
3. Peru	50.41	9	<0.001	0.99	0.98	0.03	0.14 [0.11 – 0.18]	0.73	0.86	0.84	0.89	0.90	0.86	0.94	0.93
4. Bolivia	25.95	9	<0.001	0.99	0.99	0.03	0.10 [0.06 – 0.15]	0.78	0.88	0.71	0.90	0.93	0.80	0.93	0.93

Factorial Invariance by Country

The invariance of COV19-QoL was evaluated using the alignment method, in which the invariance of the factorial weights and intercepts were evaluated (Table 4). Based on the factorial weights, R^2 of 1.00 and 0.0% for the non-invariant parameters were obtained, respectively. In the intercepts, an R^2 of 1.00 was found with 4.2% of non-invariant parameters, specifically item 2 "Due to the spread of the coronavirus, I believe that my mental health has deteriorated" from Bolivia. However, the percentage of non-invariant parameters allowed (25%) was not reached, thus ensuring invariance in the intercepts.

Table 4.
Approximate measurement invariance of COV19-QoL using the alignment method.

Parameter	Item	*M*	*Sd*	*Min*	*Max*	Countries				R^2	%
Factor loading	1	0.87	0.04	0.83	0.93	EC	CO	PE	BO	1.00	0.0%
	2	1.09	0.03	1.05	1.05	EC	CO	PE	BO		
	3	0.88	0.10	0.76	0.76	EC	CO	PE	BO		
	4	1.10	0.00	1.10	1.10	EC	CO	PE	BO		
	5	1.16	0.07	1.09	1.22	EC	CO	PE	BO		
	6	0.97	0.05	0.91	1.02	EC	CO	PE	BO		
Intercept	1	2.43	0.09	2.36	2.57	EC	CO	PE	BO	1.00	4.2%
	2	2.47	0.20	2.30	2.76	EC	CO	PE	(BO)		
	3	2.71	0.08	2.62	2.80	EC	CO	PE	BO		
	4	2.46	0.02	2.44	2.48	EC	CO	PE	BO		
	5	2.27	0.03	2.23	2.29	EC	CO	PE	BO		
	6	2.41	0.10	2.27	2.49	EC	CO	PE	BO		

Note. Non-invariant parameters are in parentheses.

Discussion

The main objective of this study was to examine the MI of COV19-QoL in individuals from four South American countries who experienced the death of a family member or loved one due to the pandemic. This multi-country study supported, for the first time, the approximate invariance of COV19-QoL among people from different countries. First, the results showed that the original one-factor model of COV19-QoL was replicated in all four countries evaluated. This adequate fit of the unidimensional model across the four countries is consistent with previous findings in European and Asian countries (Dehkordi et al., 2021; Repišti et al., 2020; Sümen & Adibelli, 2021). However, it should be noted that, with the exception of Ecuador, the remaining three countries presented higher than expected RMSEA values (RMSEA ≥ .08). This is expected in factor models with small degrees of freedom (Kenny et al., 2015; Taasoobshirazi & Wang, 2016). Faced with these cases, it is not appropriate to discard factor models with small degrees of freedom and higher than expected RMSEA values, as the information from the other fit indices (Kenny et al., 2015), which in the case of the COV19-QoL, is good, should be taken into account. Therefore, the findings further strengthen previous literature indicating that quality of life indicators, as measured by COV19-QoL, are experienced and reported as aspects of a single dimension. Thus, it appears that the unidimensional structure of the construct ‘perception of the impact of COVID-19 on quality of life’ does not seem to be affected by the cultural characteristics specific to each country. Likewise, confirming the one-dimensional model of COV19-QoL indicated that its six items reflect only one latent dimension. In addition, the unidimensional model

was adequately reliable and accurate for measuring the perceived impact of COVID-19 on the quality of life. The reliability ranges of COV19-QoL in each country would be adequate to make inferences at the level of each group.

This study provides the first analysis of COV19-QoL in samples from South American countries using a novel statistical method, the alignment method. The findings showed that it was possible to achieve approximate invariance in COV19-QoL across a set of South American countries evaluated. The findings indicated that the factor loadings showed a higher amount of invariance than the intercepts. In both cases, the amount of non-invariance did not exceed the recommended 25% percentage (Muthén & Asparouhov, 2014); therefore, the results were valid and interpretable. This was based on the assumption that the measurement parameters should not necessarily be the same in all groups. Item 2 (*Due to the spread of the coronavirus, I believe that my mental health has deteriorated*) was reported to show the highest degree of non-invariance in Bolivia. This indicates the presence of heterogeneity in how this item is understood between countries. The fact that this item is not invariant could be explained by a set of personal factors, such as living and health conditions and habits, among others; social factors, such as working conditions, morbidity, and mortality in the country; and the presence of a relative or friend with COVID-19, among others.

This study contributes significantly to the literature on the perceived impact of COVID-19 on quality of life, especially on the measurement of the quality of life construct. One of the main weaknesses of this study was that the data were collected using self-report measures. This may generate data that are prone to recall bias and social desirability. Thus, it would be beneficial to include clinical indices or behavioral observations that could add other objective information. Another important limitation is the inclusion of participants through convenience sampling, which reduces the representativeness of the sample and generalizability of the results. In this sense, the evidence of MI applies only to comparisons made between the participating countries. Furthermore, this resulted in the sample being mostly female, single, and university educated. Therefore, future studies should prioritize the use of probability sampling and include more heterogeneous samples. Another shortcoming is that the effects of gender and age were not examined. This did not allow us to establish the degree to which these variables may confound the results. On the other hand, our study did not assess validity based on the relationship with other variables, which would provide further evidence of the validity of the interpretations derived from COV19-QoL. Another limitation was that the use of a cross-sectional design did not allow us to control for cohort effects or assess test-retest reliability or longitudinal MI. On the other hand, this study only evaluated MI among the participating countries, which raises the need for a thorough analysis of mean comparisons, based on the alignment method, between the countries in this study and other South American countries. This would allow for a better understanding of the similarities and differences in the perceived impact of COVID-19 on the quality of life. Finally, the number of participants in each group was not large, which could limit the generalizability of the findings. However, despite the small

sample size, the proportion of non-invariant parameters did not exceed 25%, which did not result in biased parameter estimates (Asparouhov & Muthén, 2014; Lai, 2023). Nevertheless, future studies should focus on a larger sample size for each country.

Conclusion

Despite the limitations, the present study provides a greater and better understanding of the MI of COV19-QoL in a cross-cultural context of people who have experienced the death of a family member or loved one due to the pandemic from South American countries. Without the verification of MI, it cannot be assumed that the different results of comparative cross-cultural studies on the impact of COVID-19 on quality of life of people who have experienced the death of a family member or loved one due to the pandemic can be valid (Chen 2008). The presence of MI will give tools to researchers and mental health professionals to reach a consensus on the diagnosis of the perception of the impact of COVID-19 on the quality of life of people of people who have experienced the death of a family member or loved one due to the pandemic from South American region. However, more cross-cultural studies of MI with COV19-QoL in other nations and/or cultures, especially non-Latin American, are needed. Making international comparisons with countries in other regions would allow further assessment of specific patterns of responses that may differ between countries. In addition, assessing cross-cultural MI, with more groups from different countries, would allow us to detect greater variability and sensitivity to cultural influences between countries for items measuring the impact of COVID-19 on quality of life.

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Merna invarijantnost skale COV19 – uticaj na kvalitet života (COV19-KoL) kod ljudi koji su izgubili voljenu osobu tokom pandemije COVID-19 iz četiri južnoameričke države

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Skala COV19 – Uticaj na kvalitet života (COV19-KoL) je korišćena kao mera percipiranog uticaja COVID-19 na kvalitet života; međutim, malo se zna o njenoj kros-kulturnoj stabilnosti. Ova studija je ispitivala mernu invarijantnost COV19-KoL u uzorcima odraslih (*N* = 1034; *AS*god = 35.7 godina; *SD* = 13.3 godina; 68.3% **žena**) iz četiri države Južne Amerike (Ekvador, Kolumbija, Peru i Bolivija). Indeksi uklapanja jednodimenzionalnog modela COV19-KoL u podatke bili su adekvatni u svim zemljama (CFI = 1.00, TLI = 0.99, SRMR =

0.02, RMSEA = 0.10). Vrednosti alfa i omega indeksa su bile prihvatljive i u rasponu od 0,91 do 0,94 u svim zemljama. Faktorska invarijantnost je procenjena metodom poravnanja (eng. alignment method), a invarijantnost je dobijena za faktorske težine (R^2 = 1.00) i intercepte (R^2 = 1.00), prihvatajući približnu invarijantnost COV19-KoL. COV19-KoL se može preporučiti za smisleno poređenje odnosa između varijabli između grupa i za poređenje latentnih srednjih vrednosti u četiri južnoameričke populacije.

Ključne reči: poravnanje, invarijantnost, smrt, kvalitet života, Južna Amerika

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