Cross-national invariance of the Spanish version of the 8-item Posttraumatic Growth Inventory-Short Form (PTGI-SF) in people who experienced the death of loved ones from four South American countries

Tomás Caycho-Rodríguez [a], Lindsey Vilca [a], Carlos Carbajal-León [a], Pablo Valencia [b], Jonatan Baños Chaparro [c], Daniel Yupanqui-Lorenzo [c], Mario Reyes-Bossio [a], Mariel Delgado-Campusano [d], Rodrigo Moreta-Herrera [e], Diana Ximena Puerta-Cortés [f], Andrés Camargo [g], Julio Torales [h], Daniela Ferrufino-Borja [i], Agueda Muñoz-del-Carpio-Toia, Martin Noe-Grijalva, Marion Schulmeyer [1] [i], & Luis Hualparuca-Olivera [a] [2]

Universidad Privada del Norte, Lima, Perú [a]; Universidad Nacional Autónoma de Mexico, Tlanepantla de Baz, México [b]; Universidad Ricardo Palma, Lima, Perú [c]; Universidad de Ciencias y Humanidades, Lima, Perú [c]; Universidad Peruana de Ciencias Aplicadas,Lima, Perú [d]; Pontificia Universidad Católica del Ecuador, Ambato, Ecuador [e]; Universisad de Ibagué, Ibagué, Colombia [f]; Fundación Universitaria del Área Andina, Bogota, Colombia [g]; Universidade Nacional de Assunção, Assunção, Paraguay [h]; Universidade Privada de Santa Cruz de la Sierra, Santa Cruz de la Sierra, Bolivia [i].

ABSTRACT

Post-pandemic, there is concern about the increase in mental health problems associated with grief due to COVID-19. Recent studies have identified positive outcomes that may have emerged in the face of adversity, which can lead to positive psychological changes, such as posttraumatic growth. The aim of the study was to evaluate the transnational measurement invariance of the 8-item Posttraumatic Growth Inventory-Short Form (PTGI-SF) in individuals who experienced the death of loved ones during the post-COVID-19 period. A total of 1,820 individuals were recruited from four South American countries (Ecuador, Colombia, Peru and Bolivia) using non-probabilistic snowball sampling. The highest average age of participants was observed in Colombia (M = 35.8; SD = 12.5 years), while the lowest was recorded in Bolivia (M = 28.4; SD = 10.5 years). Similarly, a higher proportion of women (>57%) was found across all countries. Confirmatory Factor Analysis (CFA) and multigroup Confirmatory Factor Analysis (CFA) methods were used. The results indicated that a model for measuring posttraumatic growth across the five countries was supported, encompassing four factors: relating to others, appreciation of life and opportunities, personal strength, and spiritual change. Furthermore, the four-factor structure showed sufficient strict invariance across the five countries. Similarly, the PTGI-SF-8

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[1] Correspondence about this article should be addressed **Marion Schulmeyer**: gabrieltalask@gmail.com

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items demonstrated adequate discrimination and difficulty parameters. The findings provide initial evidence to consider the PTGI-SF-8 as a psychometric instrument for assessing posttraumatic growth.

Keywords
cross-cultural, invariance, south american, posttraumatic growth, psychometric

RESUMEN

Pospandemia, existe preocupación por el aumento de los problemas de salud mental asociados con el duelo por COVID-19. Estudios recientes han identificado resultados positivos que pueden haber surgido frente a la adversidad y que pueden conducir a cambios psicológicos positivos, como el crecimiento postraumático. El objetivo del estudio fue evaluar la invariancia de la medición transnacional del 8-item Posttraumatic Growth Inventory-Short Form (PTGI-SF) en personas que experimentaron la muerte de seres queridos durante el período Post-COVID-19. Un total de 1820 personas fueron reclutadas de cuatro países sudamericanos (Ecuador, Colombia, Perú y Bolivia) mediante un muestreo no probabilístico por bola de nieve. La edad promedio más alta de los participantes se observó en Colombia (M = 35,8; DE = 12,5 años), mientras que la más baja se registró en Bolivia (M = 28,4; DE = 10,5 años). De manera similar, en todos los países se encontró una mayor proporción de mujeres (> 57%). Se utilizaron métodos de Análisis Factorial Confirmatorio (AFC), Análisis Factorial Confirmatorio (AFC) multigrupo. Los resultados indicaron que se apoyó un modelo para medir el crecimiento postraumático en los cinco países que abarca cuatro factores: relación con los demás, valor de la vida y oportunidades, fortaleza personal y cambio espiritual. Además, la estructura de cuatro factores muestra una invariancia estricta suficiente en los cinco países. De manera similar, los ítems del PTGI-SF-8 mostraron parámetros de discriminación y dificultad adecuados. Los hallazgos proporcionan evidencia inicial para considerar el PTGI-SF-8 como un instrumento psicométrico para evaluar el crecimiento postraumático.

Palabras clave
transcultural, invariancia, sudamerica, crecimiento postraumático, psicometría

Invariancia transnacional de la versión española del 8-item Posttraumatic Growth Inventory-Short Form (PTGI-SF) en personas que experimentaron la muerte de seres queridos de cuatro países sudamericanos

Introduction

The COVID-19 pandemic became an unprecedented public health problem due to its rapidity of transmission, resulting in high rates of infected persons and deaths (Solomou & Constantinidou, 2020). In this context, a range of mental health problems have emerged in different populations (Clemente-Suárez et al., 2021; Jones et al., 2021; Saragih et al., 2021; Sousa et al., 2021). Regarding Latin America, it was one of the regions with the worst overall mental health symptoms, along with Africa and South Asia (Zhang & Chen, 2021). This is expressed in the prevalence of anxiety (35%), depression (35%), distress (32%) and insomnia (35%) in participants in Latin America (Zhang et al., 2022). This led to the need to deepen studies on the mental health of the general population in Latin America and to have information to support the formulation of public policies to address the mental health problems generated by the COVID-19 pandemic (Hernández et al., 2021). Negative mental health outcomes have been observed following traumatic events such as the COVID-19 pandemic. For instance, as the pandemic spread across countries, the number of COVID-19-related deaths increased, leading to a rise in the number of individuals bereaved by the virus (Chen & Tang, 2021). The particular characteristics of deaths during the pandemic, such as the physical isolation of the deceased without the presence of loved ones and limitations on carrying out funerals and/or burials that prevented saying goodbye in the customary manner according to cultural or religious mourning practices (Stroebe & Schut, 2020), generated complications in the grieving process (Qian et al., 2022). A recent study during the COVID-19 pandemic reported that the percentages of dysfunctional grief related to COVID-19 varied between 7.3% (Brazil and Chile) and 14.6% (El Salvador) (Caycho-Rodríguez et al., 2021).

Following the COVID-19 pandemic, an increase in mental health problems associated with grief related to COVID-19 was observed (Ahmed et al., 2023; Blendermann et al., 2024; Penninx et al., 2022; Zhang et al., 2022). However, recent studies have focused on identifying also positive outcomes that may have emerged in the face of adversity and that may generate positive psychological changes, such as posttraumatic growth (Kalaitzaki et al., 2022; Hyun et al., 2021). Post-traumatic growth (PTG) refers to the positive psychological changes experienced by people as a result of

coping with traumatic or extremely challenging events (Tedeschi & Calhoun, 2004, 1996). Faced with these situations, people acquire better coping skills, improve their interpersonal relationships and develop a greater appreciation for life (Hyun et al., 2021). It has been suggested that the presence of PTG allows understanding and coping with the trauma generated by the COVID-19 pandemic since it explains a crisis from a positive perspective (Hyun et al., 2021; Waters et al., 2021). In addition, the presence of PTG does not eliminate symptoms of post-traumatic stress disorder (PTSD) (Feingold et al., 2022). Thus, moderate PTSD symptoms are generally associated with high PTG levels (Pietrzak et al., 2021; Tsai et al., 2015).

Recent studies have indicated that PTG is associated with improved functioning and greater resilience in the face of the pandemic (Gonda & Tarazi, 2022; Thomson et al., 2022). Additionally, post-traumatic growth was related to higher self-esteem, PTSD, coping style, and social support (Ulset, & von Soest, 2022; Yan et al., 2021). Although post-traumatic growth is a positive psychological consequence of the COVID-19 pandemic, few studies have explored its prevalence and relationships with other variables in Latin American countries (see, for example, Gómez-Acosta et al., 2022; Ramos-Vera, & Serpa, 2021). Most of the research on post-traumatic growth has been conducted in the United States, Europe and Asia (for example, Li et al., 2022; Matos et al., 2021; Prieto-Ursúa, & Jódar, 2020). An important step to facilitate research on posttraumatic growth in a post-pandemic context in Latin America is to have adequate instruments to measure it. One of the most widely used instruments on posttraumatic growth is the Posttraumatic Growth Inventory (PTGI; Tedeschi & Calhoun, 1996).

The PTGI originally consisted of 21 items grouped into five factors (relating to others, new possibilities, personal strength, spiritual change, and appreciation for life). However, a short version of 10 items has also been proposed that assesses the same five factors as the original PTGI (PTGI-SF; Cann et al., 2010). The presence of a shorter version would require less physical effort, collect data in less time and be able to include other measurements of variables of interest (Cann et al., 2010). The psychometric properties of the PTGI-SF have been evaluated in American veterans of the Iraq war (Kaler et al., 2011), divorced Portuguese adults (Lamela et al., 2014), Italian adults who experienced adverse life events (Prati & Pietrantoni, 2014) and, recently in Persian adults (Amiri et al., 2020) among others. In Spanish, the PTGI-SF was applied, for example, in Chilean adults (Garcia, & Wlodarczyk, 2016), Spanish university students (Castro et al., 2015), and Spanish adults during the pandemic (Garrido-Hernansaiz et al., 2023).

A recent study suggested an 8-item version of the PTGI-SF (PTGI-SF-8), eliminating items 1 and 6 from the original version, due to their low factor loadings and that the content was not fully in line with the construct, and with four factors (Relating to Others, Life Value and Opportunities, Personal Strength, and Spiritual Change) (Garrido-Hernansaiz et al., 2023). This new version PTGI-SF-8 presented adequate evidence of structural validity, reliability, sensitivity and criterion-related validity. The four-factor model of the PTGI-SF-8 was tested on different random and subsamples of women and men, resulting in adequate fit indices, even when restrictions of equal factor loadings, factor covariances, intercepts and latent means were imposed. A recent study evaluated the psychometric properties of the PTGI-SF-8 in Arabic-speaking individuals (Fekih-Romdhane et al., 2024). The CFA indicated that the fit of the original model was acceptable. The correlation between the residuals of Items 8 and 19 improved the fit indices and reported adequate reliability. Additionally, this model presented evidence of configural, metric, and scalar invariance across gender.

Although the psychometric evidence of the PTGI-SF-8 version was tested in Spanish (Garrido-Hernansaiz et al., 2023), it was not applied to the Latin American context. This is even more important if we consider, as we said before, that Latin America was one of the regions most affected in its mental health (Zhang & Chen, 2021). Therefore, this study aimed to evaluate the transnational measurement invariance of the PTGI-SF-8 among individuals who experienced the death of loved in four South American countries during the post-covid period.

The study of posttraumatic growth from a multinational perspective allows for the estimation of prevalence rates, the assessment of relationships with various variables and treatment options, and the identification of common characteristics across different countries. From a psychometric perspective, this is feasible only if the measurement instruments function equivalently and the underlying constructs share the same theoretical structure across two or more groups of countries, in order to avoid biased interpretations (Dimitrov, 2010). It has generally been assumed that the mere replication of a theoretical construct, measured by an instrument developed in one language or culture in another, is a guarantee of its cross-cultural equivalence and useful for cross-cultural comparisons (Byrne & Watkins, 2003). However, a prerequisite for this measurement equivalence of an instrument is that the theoretical construct can be measured in each country or culture in the same way and tested simultaneously in all these groups (He & van de Vijver, 2012). Therefore, in order to compare a construct,

measured by a psychological instrument, between different countries or cultures, it is first necessary to demonstrate that its factor structure between different groups is invariant when a simultaneous approach is used, i.e. it is necessary to demonstrate cross-cultural measurement invariance (Byrne & Watkins, 2003; Milfont & Fisher, 2010). Generally, there are three restricted levels of invariance. Configurational invariance allows us to verify whether the factor structure of a measure is the same in all countries or cultures in the absence of equality restrictions on the parameters. In metric invariance, all factor loadings are restricted to equality in order to identify whether items contribute to the underlying construct equally across all groups of countries or cultures. Scalar invariance restricts factor loadings and item intercepts to equality across countries or cultures. If there is evidence of equality of factor structure, factor loadings and intercepts across countries or cultures, then latent means can be meaningfully compared between groups (Dimitrov, 2010).

Assessing the cross-cultural measurement invariance of the PTGI-SF-8 would yield critical data to support its widespread use. Demonstrating that the PTGI-SF-8 is replicable and generalizable to countries or cultures beyond the one in which it was originally developed would provide strong evidence for the universality of the construct across diverse cultural groups. Likewise, assessing the invariance of the PTGI-SF-8 measurement between different countries is justified since the cultural differences of each country have an impact on the events that a person may perceive as traumatic or stressful and on the mechanisms, to cope with them (Kashyap, & Hussain, 2018). Thus, it has been suggested that post-traumatic growth and its associated processes may be influenced by cultural factors surrounding the individual (Calhoun et al., 2010). Moreover, the impact of cultural context extends beyond the measurement of growth to include trauma and post-traumatic stress (Gilmoor et al., 2019; Herbert & Forman, 2010). However, it has been suggested that focusing on the study of growth could offer a more culturally sensitive and valid alternative to the medicalization of post-traumatic stress disorder (Splevins et al., 2010).

In addition to the evaluation of cross-national measurement invariance, some characteristics of the PTGI-SF-8 items were evaluated on the basis of Item Response Theory (IRT). It has been suggested that IRT has several advantages over classical test theory, on the basis of which many measurement instruments, including the PTGI-SF-8, have been constructed (Baker, 1985). Therefore, without an analysis based on the IRT, there is no information on the adequacy or inadequacy of the performance of specific

items in each factor of the PTGI-SF-8. The IRT allows estimating the underlying ability of the participants and the difficulty of each of the items of a measurement instrument (Lin & Pakpour, 2017). It has recently been suggested that confirmatory factor analysis (CFA) and IRT complement each other (Ullah et al., 2021). While CFA allows the identification of the overall factor structure of a measure, IRT provides detailed information on item functioning. In recent years, CFA and IRT have been increasingly used to conduct psychometric analyses of measurement instruments in a wide range of psychological subjects (see, for example Moreta-Herrera et al., 2022; Ventura-León et al. 2022; Vilca et al., 2022).

Method

Participants

A total of 1820 people in people who experienced the death of loved ones from four south american countries (Ecuador, Colombia, Peru and Bolivia) selected by non-probabilistic snowball sampling. The following criteria were used for inclusion in the study: 1) being of legal age according to the regulations of each country; 2) having experienced the death of a loved one; and 3) providing informed consent. Although the number of participants was different in each country, it was greater than the 300 to 375 that is considered adequate to obtain significant results for CTT and IRT models (De Ayala, 1994; Muthén & Muthén, 2002).

Table 1 shows that the highest average age belonged to participants living in Colombia (M = 35.8; SD = 12.5 years) and Ecuador (M = 35.4; SD = 12.1 years). Conversely, the lowest average age was observed among the participants from Bolivia (M = 28.4; SD = 10.5 years). Additionally, it is noted that in all countries, there is a higher proportion of women (> 57%) than of men. There is also a high proportion of single individuals in most countries (> 40%). Regarding the educational level of the participants, it was observed that in Ecuador (65.3%) and Colombia (63.2%), the majority had completed university studies. In contrast, the proportion was much lower in Peru (42.3 %) and Bolivia (45.8 %). Moreover, the majority of participants had stable jobs, except in Peru (34.3%) and Bolivia (36%). It was also noted that the majority of participants resided in an urban area (> 80%). Concerning the pandemic, most participants indicated that they had COVID-19 (> 50%), with the exception of Colombia (44.4%). Additionally, most participants in all countries reported having had family members and friends with

COVID-19 patients (> 90%). Regarding the vaccination process, the vast majority of participants in all countries indicated that they received the COVID-19 vaccine (> 90%), completed the required doses (> 90%), and received a booster dose (> 60%). Finally, Table 1 shows that more than 50% of participants in most countries claimed to have lost a family member or acquaintance due to COVID-19. Specific sociodemographic information is presented in Table 1.

Table 1

Sociodemographic characteristics of the participants

Sociodemographic data	Ecuador (*n* = 401)	Colombia (*n* = 744)	Peru (*n* = 350)	Bolivia (*n* = 325)
Age (M ± SD)	35.4 ± 12.1	35.8 ± 12.5	31.2 ± 12.1	28.4 ± 10.5
Gender, n (%)				
Male	127 (31.7%)	257 (34.5%)	149 (42.6%)	83 (25.5%)
Female	274 (68.3%)	487 (65.5%)	201 (57.4%)	238 (73.2%)
Undeclared	0 (0%)	0 (0%)	0 (0%)	4 (1.2%)
Marital Status n (%)				
Married	146 (36.4%)	184 (24.7%)	75 (21.4%)	77 (23.7%)
Cohabiting	27 (6.7%)	112 (15.1%)	26 (7.4%)	15 (4.6%)
Divorced	34 (8.5%)	29 (3.9%)	7 (2%)	9 (2.8%)
Single	192 (47.9%)	411 (55.2%)	240 (68.6%)	224 (68.9%)
Widowed	2 (.5%)	8 (1.1%)	2 (.6%)	0 (0%)
Educational Level, n (%)				
Complete University	262 (65.3%)	470 (63.2%)	148 (42.3%)	149 (45.8%)
Incomplete University	74 (18.5%)	119 (16%)	132 (37.7%)	121 (37.2%)
Complete Technical Studies	14 (3.5%)	83 (11.2%)	22 (6.3%)	18 (5.5%)
Incomplete Technical Studies	2 (.5%)	9 (1.2%)	3 (.9%)	1 (.3%)
Complete Secondary School	39 (9.7%)	55 (7.4%)	39 (11.1%)	31 (9.5%)
Incomplete Secondary School	5 (1.2%)	5 (.7%)	6 (1.7%)	5 (1.5%)
Complete Primary School	4 (1%)	2 (.3%)	0 (0%)	0 (0%)
Incomplete Primary School	1 (.2%)	1 (.1%)	0 (0%)	0 (0%)
Residential Area, n (%)				
Urban	332 (82.8%)	685 (92.1%)	319 (91.1%)	301 (92.6%)
Rural	69 (17.2%)	59 (7.9%)	31 (8.9%)	24 (7.4%)
Type of Employment, n (%)				
Permanent Employment	207 (51.6%)	437 (58.7%)	120 (34.3%)	117 (36%)
Temporary Employment	69 (17.2%)	170 (22.8%)	110 (31.4%)	75 (23.1%)
Unemployed	107 (26.7%)	110 (14.8%)	107 (30.6%)	129 (39.7%)
Retired	18 (4.5%)	27 (3.6%)	13 (3.7%)	4 (1.2%)
Had COVID-19, n (%)				
Yes	237 (59.1%)	330 (44.4%)	179 (51.1%)	217 (66.8%)
No	99 (24.7%)	243 (32.7%)	95 (27.1%)	46 (14.2%)
I don't know, but I think so	46 (11.5%)	116 (15.6%)	59 (16.9%)	34 (10.5%)
I don't know, but I think not	19 (4.7%)	55 (7.4%)	17 (4.9%)	28 (8.6%)
Family/Friends with COVID-19, n (%)				
Yes	382 (95.3%)	690 (92.7%)	318 (90.9%)	323 (99.4%)
No	19 (4.7%)	54 (7.3%)	32 (9.1%)	2 (.6%)
Received the COVID-19 vaccine				
Yes	394 (98.3%)	730 (98.1%)	346 (98.9%)	320 (98.5%)
No	7 (1.7%)	14 (1.9%)	4 (1.1%)	5 (1.5%)
Received the full dose of vaccines				
Yes	386 (96.3%)	699 (94%)	342 (97.7%)	309 (95.1%)
No	15 (3.7%)	45 (6%)	8 (2.3%)	16 (4.9%)

Sociodemographic data	Ecuador (*n* = 401)	Colombia (*n* = 744)	Peru (*n* = 350)	Bolivia (*n* = 325)
Received the booster dose				
Yes	338 (84.3%)	498 (66.9%)	290 (82.9%)	195 (60%)
No	63 (15.7%)	246 (33.1%)	60 (17.1%)	130 (40%)
Death of a loved one due to COVID-19				
Yes	219 (54.6%)	403 (54.2%)	222 (63.4%)	191 (58.8%)
No	182 (45.4%)	341 (45.8%)	128 (36.6%)	134 (41.2%)

Instruments

Sociodemographic survey

An ad hoc survey was constructed to obtain information on sex, age, country of birth, educational level, employment status, marital status, area of residence, type of work, diagnosis of COVID-19, diagnosis of COVID-19 by family and friends, vaccination, and death of a loved one by COVID-19.

Posttraumatic growth inventory-short form de ocho ítems

(PTGI-SF-8; Garrido-Hernansaiz et al., 2023). The inventory originally consisted of 10 items; however, items 1 and 6 were eliminated because of their low factor loadings and because their content was not fully in line with the construct. Given this, the inventory consisted of 8 items that have 6 Likert-type response options ranging from 0 = I did not experience this change as a result of my crisis; to 5 = I experienced this change to a very large degree as a result of my crisis). You have the following instruction: "Sometimes crises, such as the COVID-19 pandemic, involve significant life changes. Indicate for each of the statements below the degree to which this change occurred in your life. There are no right or wrong answers". The PTGI-SF was originally developed in English, and in this study, the Spanish version of Garrido-Hernansaiz et al. (2023) was used.

Procedure

The survey was developed online through the Google Form platform and consisted of two distinct parts: The first part provided information on the objective of the study and electronic informed consent. The second part presented the sociodemographic survey and the PTGI-SF-8. The survey was distributed through social networks

(Facebook, Twitter and LinkedIn) and email in all participating countries. In each of the countries, the same application process was used. Responding to the online survey took approximately 10 minutes. 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).

Data Analysis

To conduct Confirmatory Factor Analysis (CFA), the maximum likelihood with robust standard error (MLR) estimator was used because the items on the scale had more than five response categories (Rhemtulla et al., 2012). RMSEA, SRMR, CFI, and TLI indices were used to evaluate the model fit. For RMSEA and SRMR indices, values less than .08 were considered acceptable (Kline, 2016). Values greater than .95 were deemed appropriate for CFI and TLI indices (Schumacker & Lomax, 2015). McDonald's omega coefficient (McDonald, 1999) were used to assess the reliability of the scale, where a value greater than .70 was considered adequate (Viladrich et al., 2017).

For evaluating the factorial invariance of the scale according to the nationality of the participants (country), Multi-Group Confirmatory Factor Analysis (MGCFA) was employed, where a sequence of hierarchical variance models was proposed: (1) configural invariance (baseline model), (2) metric invariance (equality of factor loadings), (3) scalar invariance (equality of factor loadings and intercepts), and (4) strict invariance (equality of factor loadings, intercepts, and residuals). A formal statistical test was first used to compare the sequence of models, employing the chi-square difference ($\Delta\chi2$), where non-significant values (p>.05) suggest invariance between groups. Second, a modeling strategy was used, employing differences in CFI (ΔCFI), where values less than <.010 indicate model invariance between groups (Chen, 2007). RMSEA (ΔRMSEA) was also used, where differences less than <.015 indicate model invariance between groups (Chen,

2007). To conveniently examine the differences between countries, composite scores were created by summing the items of the final scale. Cohen's d test was used to assess the magnitude of the differences.

For Item Response Theory (IRT), a Graded Response Model (GRM; Samejima, 1997) was employed, specifically, an extension of the 2-parameter logistic model (2-PLM) for ordered polytomous items (Hambleton, van der Linden, & Wells, 2010). For each item, two types of parameter were estimated: discrimination (a) and difficulty (b). The discrimination parameter (a) determines the slope at which responses to items change according to the level of the latent trait, and the item difficulty parameters (b) determine the amount of latent trait required for the item to be answered. As the scale has six response categories, there are five difficulty estimations per threshold. These estimates indicate the level of the latent variable at which an individual has a 50% chance of scoring a particular response category or above. Item characteristic curves and test characteristic curves (ICC and TCC, respectively) were also calculated.

All statistical analyses were conducted using the "lavaan" package (Rosseel, 2012) for CFA, the "semTools" package (Jorgensen, Pornprasertmanit, Schoemann, and Rosseel, 2018) for factorial invariance, and the "mirt" package for GRM (Chalmers, 2012). The RStudio environment (RStudio Team, 2018) for R (R Core Team, 2019) was used in all cases.

Results

Descriptive Analysis

Table 2 shows that items 2 ("I believe I can make more of my life") and item 7 ("I discovered that I am stronger than I thought") had the highest average scores in most countries. This indicates that the majority of the participants experienced these changes as a result of the COVID-19 pandemic. It is also observed that item 6 ("I have a stronger religious faith") has the lowest average score, meaning most participants reported not

experiencing these changes. Regarding the skewness and kurtosis indices, it is noted that all items present adequate indices (skewness < ±2; kurtosis < ±7) according to the criteria set by Finney and DiStefano (2006).

Table 2

Descriptive analysis of the items in the studied countries

Country	Items	*M*	*SD*	*g1*	*g2*
Ecuador (*n* = 401)	1	2.89	1.72	-.41	-1.06
	2	3.32	1.62	-.73	-.56
	3	2.97	1.67	-.48	-.96
	4	3.02	1.63	-.48	-.87
	5	3.12	1.58	-.59	-.69
	6	2.60	1.83	-.18	-1.40
	7	3.19	1.68	-.66	-.77
	8	3.01	1.61	-.51	-.80
Colombia (*n* = 744)	1	2.86	1.78	-.43	-1.16
	2	3.28	1.65	-.79	-.52
	3	2.98	1.76	-.54	-1.03
	4	2.99	1.66	-.56	-.86
	5	3.04	1.65	-.64	-.75
	6	2.58	1.93	-.16	-1.50
	7	3.17	1.71	-.70	-.75
	8	2.96	1.73	-.51	-1.03
Peru (*n* = 350)	1	3.07	1.64	-.56	-.79
	2	3.43	1.47	-.86	-.15
	3	3.07	1.56	-.56	-.72
	4	3.08	1.47	-.56	-.52
	5	3.22	1.48	-.67	-.37
	6	2.83	1.72	-.42	-1.10
	7	3.33	1.53	-.65	-.56
	8	3.13	1.53	-.59	-.61
Bolivia (*n* = 325)	1	2.97	1.61	-.52	-.81
	2	3.18	1.56	-.57	-.68
	3	2.67	1.71	-.20	-1.24
	4	2.72	1.64	-.28	-1.09
	5	2.82	1.58	-.39	-.89
	6	2.10	1.86	.27	-1.36
	7	3.02	1.67	-.48	-.97
	8	2.69	1.67	-.23	-1.13

Note. M=Mean; *SD*=Standard Deviation; *g1*= Skewness; *g2*= Kurtosis.

Validity based on internal structure

Table 3 reveals that the original four-factor model (Model 1), which consisted of related factors, showed acceptable fit indices in the four Andean community countries. It was also found that the relationship between some factors was very strong (> .90), as shown in Table 4. Based on these findings, two competing models were considered. The Bi-factor model (Model 2) displayed worse fit indices than Model 1 in some countries, and exhibited estimation problems in others. The unidimensional model (Model 3) showed poor fit indices for data. Therefore, Model 1 proved to be the model that best explains the factorial structure of the scale and will thus be used in subsequent psychometric analyses.

Table 3

Fit indices of different scale models in American countries

Model	Country	χ^2	df	p	CFI	TLI	SRMR	RMSEA [90% CI]
1	Ecuador (7)	42.68	14	< .001	.98	.96	.019	.092 [.061 - .124]
	Colombia (8)	70.07	14	< .001	.98	.95	.020	.096 [.074 - .118]
	Peru (9)	38.63	14	< .001	.98	.96	.020	.087 [.055 - .121]
	Bolivia (14)	17.20	14	.245	.99	.99	.018	.033 [.000 - .079]
2	Ecuador (7)[a]	–	–	–	–	–	–	–
	Colombia (8)	58.83	12	< .001	.98	.95	.020	.109 [.082 - .138]
	Peru (9)	28.88	12	.004	.99	.96	.020	.090 [.048 - .133]
	Bolivia (14)	15.97	12	.192	.99	.99	.021	.046 [.000 - .100]
3	Ecuador (7)	81.17	20	< .001	.96	.95	.030	.114 [.089 - .141]
	Colombia (8)	174.93	20	< .001	.94	.92	.035	.137 [.119 - .156]
	Peru (9)	78.47	20	< .001	.96	.94	.031	.116 [.090 - .144]
	Bolivia (14)	91.32	20	< .001	.93	.89	.045	.133 [.106 - .161]

Note. [a] = Negative Error Variances/variances are negative; χ^2 = Chi square; df = degrees of freedom; SRMR: Standardized Root Mean Square Residual; TLI = Tucker-Lewis Index; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; Model 1 = Related factors; Model 2 = Bi-factor modelo; Model 3 = Unidimensional model.

Table 4 shows that the factor loadings of the items were high for the corresponding factors in all countries, demonstrating that they adequately represented each dimension of the construct.

Table 4

Factorial weights and reliability of model 1 items in different American countries

Country	Factorial Weight (λ)								Correlations between factors						Reliability (ω)			
	P4	P8	P1	P2	P5	P7	P3	P6	F1-F2	F1-F3	F1-F4	F2-F3	F2-F4	F3-F4	F1	F2	F3	F4
Ecuador (7)	.85	.81	.76	.91	.92	.89	.92	.77	.93	.99	.93	.93	.82	.90	.82	.82	.90	.82
Colombia (8)	.85	.87	.79	.89	.90	.88	.93	.79	.84	.97	.88	.90	.83	.88	.85	.83	.88	.85
Peru (9)	.86	.84	.80	.89	.91	.92	.87	.82	.88	.95	.90	.89	.94	.91	.84	.83	.91	.83
Bolivia (14)	.81	.83	.80	.89	.85	.82	.87	.75	.71	.89	.81	.79	.78	.84	.80	.83	.82	.79

Note. F1 = Relationship with Others; F2 = Life Values; F3 = Personal Beliefs; F4 = Spiritual Changes; ω = Omega de McDonald.

Scale Reliability

As shown in Table 4, the dimensions of relationships with others (ω = .82 - .90), life values (ω = .83 - .88), personal beliefs (ω = .83 - .91), and spiritual changes (ω = .79 - .83) demonstrated adequate reliability indices in all countries.

Factor invariance by country

As shown in Table 5, the factorial structure of the scale demonstrated evidence of strict invariance across all countries in the sequence of proposed invariance models: metric invariance (ΔCFI = .000; ΔRMSEA = -.008), scalar invariance (ΔCFI = -.001, ΔRMSEA = -.004), and strict invariance (ΔCFI = -.004; ΔRMSEA = -.002).

Table 5

Factorial invariance models of the scale in member countries of the Andean Community

Models of Invariance:	χ^2	df	p	SRMR	TLI	CFI	RMSEA [90%CI]	$\Delta\chi^2$	Δdf	p	ΔCFI	ΔRMSEA
Configural	170.59	56	.000	.019	.97	.984	.085 [90%CI .078 – .092]	–	–	–	–	–
Metric	193.21	68	.000	.024	.97	.984	.077 [90%CI .076 – .088]	12.11	12	.436	.000	-.008
Scalar	218.89	80	.000	.026	.98	.983	.073 [90%CI .086 – .097]	22.12	12	.036	-.001	-.004
Strict	260.61	104	.000	.027	.98	.979	.072 [90%CI .089 – .098]	47.34	24	.003	-.004	-.002

Item Response Theory Model: Graded Response Model (GRM)

To estimate the model, a Graded Response Model (GRM) was used, specifically, an extension of the 2-parameter logistic model (2-PLM) for ordered polytomous items. As shown in Table 6, all items exhibited discrimination parameters above 1 for the factor to which they belong, which can be considered an indicator of adequate discrimination (Zickar et al., 2002). Regarding the difficulty parameters, all the threshold estimators increased monotonically. In other words, a greater presence of the latent trait is required to respond to higher response categories. The most difficult item was item 5 ("Now I know better how I can face problems"). Table 6 also shows the factor loadings of the items with their respective latent dimensions, where it is evident that all items present high factor weights for the factor to which they belong.

Table 6

Parameters and factorial weights of items in the four-factor GRM model

Model	Item	Item parameters									Factorial weights			
		a1	a2	a3	a4	b_1	b_2	b_3	b_4	b_5	F1	F2	F3	F4
Relationship with others	4	3.44	.00	.00	.00	-3.24	-.59	1.51	3.07	4.59	90	–	–	–
	8	3.34	.00	.00	.00	-2.95	-.49	1.37	2.89	4.21	.89	–	–	–
Life values	1	.00	2.78	.00	.00	-2.45	-.42	1.42	2.34	3.41	–	.85	–	–
	2	.00	4.21	.00	.00	-2.56	.25	2.72	4.45	6.17	–	.93	–	–
Personal beliefs	5	.00	.00	4.47	.00	-3.88	-.51	2.21	4.16	5.94	–	–	.94	–
	7	.00	.00	4.08	.00	-2.67	.02	2.11	3.83	5.38	–	–	.92	–
Spiritual changes	3	.00	.00	.00	4.45	-3.73	-.64	1.70	3.38	5.21	–	–	–	.93
	6	.00	.00	.00	2.75	-2.65	-.84	.47	1.31	2.29	–	–	–	.85

Note. a= discrimination parameters; b= difficulty parameters; F1 = Relationship with Others; F2 = Life Values; F3 = Personal Beliefs; F4 = Spiritual Changes.

Discussion

This study assessed the cross-national measurement invariance of the PTGI-SF-8 among individuals who experienced the death of loved in four South American countries. For this, CFA, multigroup analysis, internal consistency reliability and IRT analysis were performed. Strict invariance could be established in all countries. Therefore, psychometric evidence was available for cross-country comparisons of means. In addition, the study compared post-traumatic growth across countries based on a uniform measure such as the PTGI-SF-8.

Overall, the CFA results supported a model for measuring posttraumatic growth in all four countries that encompasses four factors: relating to others, life value and opportunities, personal strength, and spiritual change. This finding replicates the factor structure reported in the Spanish population (Garrido-Hernansaiz et al., 2022) within Latin American countries, allowing for further generalization of the posttraumatic growth model to other Spanish-speaking contexts.

However, in Arabic, while the original model was maintained, the correlation between the residuals of Items 8 and 19 was needed to improve the fit indices (Fekih-Romdhane et al., 2024). This suggests that linguistic differences might have affected the participants' proper understanding of the questions. By contrast, in some countries, the RMSEA value was higher (RMSEA $\geq$ .80), which is expected in models with small degrees of freedom (Kenny et al., 2015; Taasoobshirazi & Wang, 2016). However, models with high RMSEA values and small degrees of freedom should not be discarded since, information derived from other fit indices should be considered (Kenny et al., 2015). Also, the four factors are adequately reliable and accurate for measuring relationships with others, life value and opportunities, personal strength, and spiritual change. The reliability ranges would be appropriate for making group-level inferences and, in general, would indicate that the PTGI-SF-8 is suitable for use in national mental health surveys that seek to assess relationships between different variables. In this case, the McDonald omega coefficient was used, which is a suitable indicator for ordinal variables such as the PTGI-SF-8.

It is also useful to know whether the PTGI-SF-8 could become a test that measures posttraumatic growth adequately in different south american countries. In cross-cultural studies, measurement invariance is an important process to assess the generalizability of findings across different countries and to compare levels of posttraumatic growth across populations. Differences in posttraumatic growth across countries may be the result of individual life experiences or may be attributable to the measure used and people's different interpretations of the questions from country to country (Veenhoven, 1996). Using the MGCFA, which is based on the SEM framework, to assess the measurement invariance of posttraumatic growth, it was found that the four-factor structure shows sufficient strict invariance across the four countries. This makes the second possibility, for the emergence of differences, unlikely. Specifically, the results supported configurational invariance, confirming that the four-factor latent related model of posttraumatic growth was present in all four countries. Similarly, support was also provided for metric invariance, which examined the equivalence of factor loadings across countries (Bollen, 1989). This indicated that participants in all four countries attributed

the same meaning to the latent construct post-traumatic growth as measured by the PTGI-SF-8. Also, the presence of metric invariance would make it possible to compare the associations between posttraumatic growth and other variables across individuals in the four countries assessed, where one unit of change in one country would be equal to one unit of change in another. Scalar invariance was supported, where the equivalence of the item intersections indicated that both the meaning and levels of the underlying items are the same in all countries. Thus, evidence was given to compare factor scores between different groups of countries in a meaningful and valid way. Finally, evidence was also provided for the presence of strict invariance where measurement errors are equal between groups. However, this is considered to be a very strict test and is not entirely necessary for comparisons of means (Millsap & Olivera-Aguilar, 2012).

Additionally, using an IRT approach would provide more realistic information on measurement error and parameter estimation independent of the sample (Embretson & Reise, 2000; Zickar & Broadfoot, 2009). First, all difficulty parameters were adequate and increased monotonically. That is, a greater presence of the latent trait (in this case, posttraumatic growth) is required to answer the higher response categories of the PTGI-SF-8. It was reported that, the most difficult item was item 5 ("I know better now that I can cope with problems"). This is important, as it has been indicated that, individuals differ in the way they cope with problematic and stressful experiences, and that differences in coping are important in determining different mental and physical health outcomes during the COVID-19 pandemic (Prowse, et al., 2021). In this sense, higher levels of posttraumatic growth are needed to choose higher response options in item 5. That is, those with a higher frequency of posttraumatic growth indicators would also present higher coping to problems. The findings on difficulty parameters would allow, at a practical level, to design assessments of posttraumatic growth based on the importance of its indicators (Hays, et al., 2000). Likewise, the discrimination parameters of all items are adequate, indicating that they can differentiate between people with high or low levels of posttraumatic growth. This would allow all PTGI-SF-8 items to cover a broad spectrum of the latent construct of posttraumatic growth (Hays et al., 2000).

Strength and limitations

The strengths of the study include the representation of an international sample comprising individuals from various South American countries. Additionally, the combined use of methods derived from Classical Test Theory (CTT) and Item Response Theory (IRT) provides a robust statistical framework for analyzing and better understanding the psychometric properties of the PTGI-SF-8. Furthermore, this was the first study to examine the measurement invariance of the PTGI-SF-8 across a large number of Latin American countries.

Despite the strengths, the study is not free from the presence of limitations. First, the results correspond to four South American countries and could not be generated for other countries in the region or elsewhere in the world. For this reason, future studies should examine the measurement invariance of the PTGI-SF-8 in more diverse countries and with different languages, including countries in understudied regions such as Africa and the Middle East. Second, the use of an online self-report questionnaire may generate a sampling bias, as only participants with Internet access could answer the survey. However, the use of online questionnaires allows us to obtain a large sample in a quick time. Third, the use of non-probability snowball sampling compromised the representativeness of the samples in each country. Fourth, the participants in each country were predominantly female, single and university educated. Therefore, there is a potential risk of sampling bias. This would suggest that future PTGI-SF-8 cross-national studies should use more balanced sample sizes across countries and different sociodemographic characteristics. Fifth, no data on preexisting mental illness were recorded for participants in each country. Sixth, the findings were based on self-reported data, which could imply a social desirability bias. In this regard, other assessment methods, such as structured interviews, would be appropriate. Seventh, the study simply examined the cross-national measurement invariance of the PTGI-SF-8. Future research should assess the convergent and discriminant validity of the scale with other variables in different countries.

Conclusion

In conclusion, the findings provide initial evidence to consider the PTGI-SF-8 as a psychometric instrument to invariantly assess posttraumatic growth in in people who experienced the death of loved ones from four South American countries. This would provide evidence to recommend the PTGI-SF-8 as a suitable measure to be used in cross-cultural studies of posttraumatic growth and allow for meaningful interpretations regarding comparisons of the PTGI-SF-8 across countries. Also, having an invariant instrument would help to identify those individuals with the potential to cope with the negative impacts left by COVID-19 in each of the countries evaluated. In addition, the findings make an important contribution to expanding the scope and application of the PTGI-SF-8 within the Latin American context. The use of the PTGI-SF-8 across different Latin American cultures is promising and should be encouraged to further advance the generalization of the concept of posttraumatic growth in these countries.

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