









# Psychometric performance of the ultra-short version of the post-traumatic growth inventory in Peruvian adults during the Post-Pandemic: Analysis from Item Response Theory and SEM models

*Funcionamiento psicométrico de la versión ultracorta del inventario de crecimiento postraumático en adultos peruanos durante la pospandemia: análisis a partir de la teoría de respuesta al ítem y modelos SEM.*

Lindsey W. Vilca<sup>1</sup> , Samy L. Huerta<sup>2</sup> , Rose Barbaran-Alvarado<sup>2</sup> , Aaron Travezaño-Cabrera<sup>3</sup> , Julisa Quiroz-Becerra<sup>3</sup> , María Calizaya-Anahua<sup>2</sup> , Estefany Rojas-Mendoza<sup>2</sup> , Vaneryn Alania-Marin<sup>2</sup> 

<sup>1</sup>Universidad Señor de Sipán, Chiclayo, Perú

<sup>2</sup>Instituto Avanzado en Psicometría, Lima, Perú

<sup>3</sup>Universidad Peruana Unión, Lima, Perú

## Cómo citar

Vilca LW, Huerta SL, Barbaran-Alvarado R, Travezaño-Cabrera A, Quiroz-Becerra J, Calizaya-Anahua M, Rojas-Mendoza E, Alania-Marin V. "Psychometric performance of the ultra-short version of the post-traumatic growth inventory in Peruvian adults during the Post-Pandemic: Analysis from Item Response Theory and SEM models", **Avances en Psicometría Iberoamericana (API)**, vol. 1, Diciembre 2025, <https://doi.org/10.26495/bekfw864>

## Información del artículo

Recibido: 07/10/2025  
Aceptado: 15/11/2025  
Publicado: 20/12/2025

## Autor correspondencia

Lindsey W. Vilca  
[lwquiro@gmail.com](mailto:lwquiro@gmail.com)

Este artículo es de acceso abierto distribuido bajo los términos y condiciones de la Licencia Creative Commons Attribution

(CC BY) 

**ABSTRACT: Objective:** This study aimed to study the psychometric functioning of the ultra-short version of the Posttraumatic Growth Inventory through the Item Response Theory (IRT) and evaluate the Differential Item Functioning (DIF).

**Method:** 404 Peruvian adults of both sexes (65.8% women and 34.2% men) between 18 and 58 years ( $M = 24.3$ ,  $SD = 7.9$ ) participated. The Brief Resilient Coping Scale and the General Well-being Index (WHO-5) were also applied.

**Results:** All the items present adequate discrimination and difficulty indices. Also, it was found that item 1 presents DIF between the group of men and women. On the other hand, it was found that resilience significantly predicts posttraumatic growth ( $.50$ ;  $p < .01$ ) and, in turn, posttraumatic growth significantly predicts psychological well-being ( $.40$ ;  $p < .01$ ). **Conclusions:** The ultra-short version shows adequate psychometric functioning and is, therefore, a helpful tool that allows obtaining valid and reliable interpretations of posttraumatic growth.

**Keywords:** Post Traumatic Growth Inventory (PTGI); Item Response Theory; Differential Item Functioning (DIF); Resilience; Psychological well-being

**RESUMEN: Objetivo:** Fue analizar el funcionamiento psicométrico de la versión ultracorta del Inventario de Crecimiento Postraumático mediante la Teoría de Respuesta al Ítem (IRT) y evaluar el Funcionamiento Diferencial del Ítem (DIF).

**Método:** Participaron 404 adultos peruanos de ambos sexos (65,8 % mujeres y 34,2 % hombres) de entre 18 y 58 años ( $M = 24,3$ ,  $SD = 7,9$ ). También se aplicaron la Escala Breve de Afrontamiento Resiliente y el Índice de Bienestar General (WHO-5). **Resultados:** Todos los ítems presentan índices adecuados de discriminación y dificultad. Además, se encontró que el ítem 1 presenta DIF entre el grupo de hombres y mujeres. Por otro lado, se encontró que la resiliencia predice significativamente el crecimiento postraumático ( $.50$ ;  $p < .01$ ) y, a su vez, el crecimiento postraumático predice significativamente el bienestar psicológico ( $.40$ ;  $p < .01$ ). **Conclusiones:** La versión ultracorta muestra un funcionamiento psicométrico adecuado y, por lo tanto, es una herramienta útil que permite obtener interpretaciones válidas y fiables del crecimiento postraumático.

**Palabras Claves:** Inventario de Crecimiento Postraumático (PTGI); Teoría de Respuesta al Ítem; Funcionamiento Diferencial del Ítem (DIF); Resiliencia; Bienestar psicológico.

## 1. INTRODUCTION

More than 756 million cases of Covid-19 have been confirmed globally, including 6.8 million deaths (World Health Organization, 2023). In Peru, more than 4 million cases and more than 219,000 deaths have been reported (Ministerio del Salud (Minsa), 2023). Figures had grown since 2020, when COVID-19 was declared a global pandemic (Huang et al., 2020). Since then, different measures have been taken, such as mandatory social isolation, which brought the loss of jobs, especially in the informal and unorganized sectors. All of this had a negative impact on people's mental health (Kumar & Nayar, 2020; Salari et al., 2020).

In this regard, a study conducted in China on 1,210 people found that 54% rated the psychological impact caused by COVID-19 as moderate or severe, 29% reported moderate to severe anxiety symptoms, and 17% reported depressive symptoms moderate to severe, and 8.1% reported moderate to severe levels of stress from COVID-19 (Wang et al., 2020). In turn, a longitudinal study conducted in the United States highlighted the significant increase in the number of people with depression during the COVID-19 pandemic (Daly et al., 2021). Another study carried out in the same country found that, during the pandemic, people reported mental health problems, such as anxiety (33%), consumption of psychoactive substances (11.9%), suicidal ideation (43.1%), and symptoms related to trauma and stress from COVID-19. The study also found that the impact of the pandemic was greatest in adults under the age of 65 (Czeisler et al., 2021).

Concerning this group, a study in Spain adults showed that 18.7% presented depressive symptoms, 21.6% anxiety, and 15.8% post-traumatic stress disorder (González-Sanguino et al., 2020). In Peru, 30.9% of surviving adult patients of COVID-19 presented depressive symptoms, 31.1% anxious symptoms, 31.1% somatic symptoms, and 29.5% symptoms of post-traumatic stress disorder (Huarcaya-Victoria et al., 2021). Similarly, a systematic review of 43 studies found that adult patients with COVID-19 showed higher levels of depression and post-traumatic stress disorder. Higher levels of psychiatric symptoms were reported among health workers, and a decrease in psychological well-being was observed in the adult population (Vindegaard & Benros, 2020).

Other studies also found that younger adults experienced higher levels of depression and stress (Padrón et al., 2021; Wan Mohd Yunus et al., 2021). A reduction in the social interaction of young people was also associated with a greater presence of mental health problems (Wilder-Smith & Freedman, 2020). Other factors associated with higher education, such as remote learning, new forms of assessment, concern for academic performance, and the forced termination of pre-professional internships, also harmed the mental health of young people (Baloch et al., 2021; Bourion-Bedes et al., 2021; Jiang, 2020; Vilca et al., 2022). On the other hand, a systematic review study also identified that having family members or friends infected with COVID-19, financial uncertainty, worsening family conflict, and restrictions on social contact were the most stressful factors in the adult population (Cielo et al., 2021).

For all these reasons, the young adult population was among the most vulnerable groups during the COVID-19 pandemic. However, protective factors have also been found in the face of the pandemic, such as spiritual well-being, which has been shown to reduce the psychological impact of COVID-19 (Lucchetti et al., 2021). In the same way, it has been shown that emotional intelligence, emotional regulation, and attributed optimism are protective factors for mental health and reduces the risk of post-traumatic stress (Castro & Dueñas, 2022; Persich et al., 2021). Additionally, a healthy lifestyle and psychological resources such as self-care are important to promote overall health improvement and thus reduce adverse pandemic effects (Bermejo-Martins et al., 2021; Tavakol et al., 2023). Similarly, youth with high levels of resilience have shown higher levels of coping, conflict resolution and less concern about COVID-19 (Barzilay et al., 2020; Morales-Rodríguez, 2021).

Post-traumatic growth is another important factor that makes it possible to reduce the impact and sequelae of the pandemic in young people since it favors reflective thinking and cognitive regulation (García et al., 2022). A study conducted on discharged patients with COVID-19 showed that post-traumatic growth is positively related to self-esteem, coping style, and social support (Yan et al.,

2021). Another study found that it is also associated with personality, self-perceived health, and educational level (Feng et al., 2022). In summary, more than twenty-five studies have studied post-traumatic growth during the pandemic, and in most cases, they were carried out in the adult community population (Landi et al., 2022).

In this context, it is important to have a reliable and valid instrument that measures post-traumatic growth to accurately demonstrate the positive changes that arise in the person from an adverse experience. One of the most widely used instruments to measure this construct is the Post Traumatic Growth Inventory (PTGI). The original instrument has 21 items that evaluate five factors: (1) more intimate relationships with others, (2) recognition of new possibilities, (3) a greater sense of personal strength, (4) spiritual development, and (5) a greater appreciation of life (Tedeschi & Calhoun, 1996). The psychometric properties of the PTGI in the original study proved adequate, as all five factors achieved a total cumulative variance of 62% in the Exploratory Factor Analysis. Regarding internal consistency, the scale demonstrated adequate global internal consistency indices ( $\alpha = .90$ ) and test-retest reliability ( $r = .71$ ) (Tedeschi & Calhoun, 1996).

PTGI was adapted to several countries such as Australia (Bates et al., 2004), Spain (Weiss & Berger, 2006), the Netherlands (Jaarsma et al., 2006), Iran (Heidarzadeh et al., 2017), Turkey (Wen et al., 2020), Israel (Taubman-Ben-Ari et al., 2011), Slovenia (Jozefiaková et al., 2022) and Mexico (Penagos-Corzo et al., 2020). Also, its psychometric properties were studied in different populations and contexts, such as cancer patients (Heidarzadeh et al., 2017; Jaarsma et al., 2006), war veterans (Kaler et al., 2011), those affected by natural disasters (García & Włodarczyk, 2016; Penagos-Corzo et al., 2020), divorced (Lamela et al., 2014), mothers (Taubman-Ben-Ari et al., 2011), refugees (Wen et al., 2020) and university students during the COVID-19 pandemic (Garrido-Hernansaiz et al., 2022).

A short version of ten items was developed from the original scale, demonstrating adequate fit indices ( $\chi^2(25) = 200.42$ ,  $p < 0.001$ ,  $AIC = 280.42$ ,  $NFI = .96$ ,  $CFI = .97$ ,  $TLI = .94$ , and  $RMSEA = .07$ ) (Cann, Calhoun, Tedeschi, Taku, et al., 2010). In addition, the dimensions presented adequate levels of internal consistency ( $\alpha = .68$  to  $.80$ ). The short version has also been adapted in different contexts such as Iran (Amiri et al., 2020), Chile (García & Włodarczyk, 2016), Portugal (Lamela et al., 2014), Spain (Garrido-Hernansaiz et al., 2022) and Iraq (Kaler et al., 2011).

In the same way, in Colombia, a study developed the ultra-short version of five items, which measures the five previously mentioned factors (Gómez-Acosta et al., 2023). This version has shown adequate fit indices ( $\chi^2/gf = 4.51$ ;  $SRMR = .04$ ;  $RMSEA = .06$ ;  $CFI = .99$ ,  $TLI = .98$ ), internal consistency ( $\omega = .79$ ), convergent validity (depression  $r = .304$ ; anxiety  $r = .223$ ), and factorial invariance according to sex (Gómez-Acosta et al., 2023). However, the ultra-short version still requires more psychometric evidence in a Spanish-speaking context, making it necessary to analyze the items based on the Item Response Theory (IRT). About this, IRT has three fundamental advantages to evaluating the performance of the ultra-short version (Zanon et al., 2016): (a) Invariance of the item parameters, that is, the item parameters do not vary, even if the people who answer are different, (b) Invariance of the parameter of the evaluated trait concerning the instrument used for its estimation. That is to say, the skill level of the person does not depend on the test, and (c) It provides local measures of precision through the Item Information Curve (IIC) and the test (TIC). These characteristics allow us to know in detail the area in which the trait measured by the test is being measured best. In other words, it allows us to know for which level of the trait the instrument is best designed. In addition, it allows studying the Differential Item Functioning between groups. All of this allows for more reliable comparisons between those evaluated.

For these reasons, this study has the following objectives: (a) Determine the psychometric functioning of the items from the IRT perspective, (b) Evaluate the Differential Item Functioning (DIF), and (c) Evaluate the relationship of the ultra-short version with other instruments, through SEM analysis.

## 2. METHOD

### Participants

For data collection, a non-probabilistic convenience sampling was used, and the following inclusion criteria were used: (a) being of legal age ( $\geq 18$ ), (b) knowing how to read and write, (c) giving informed consent, and (d) being of Peruvian nationality. Table 1 shows that 404 Peruvian adults of both sexes (34.2% male and 65.8% female) between 18 and 58 years ( $M = 24.3$ ,  $SD = 7.9$ ) participated in the study. Table 1 also shows that the majority come from the coast (56.7%), are single (84.2%), and have completed university studies (60.1%). In addition, it is observed that most participants have had Covid-19 (55.7%), and a relative or friend has also had Covid-19 (86.1%).

Table 1  
Sociodemographic data of the participants

Categories	n	%
Age ( $M \pm SD$ )	24.3	7.89
Sex		
Female	266	65.8%
Male	138	34.2%
Region of origin		
Coast	229	56.7%
Mountain range	116	28.7%
Jungle	59	14.6%
Civil status		
Married	59	14.6%
Divorced	1	.2%
Single	340	84.2%
Widower	4	1%
Educational level		
Incomplete primary	1	.2%
Completed secondary	54	13.4%
Incomplete secondary	4	1%
Completed technician	22	5.4%
Incomplete technician	13	3.2%
Complete university	67	16.6%
Incomplete university	243	60.1%
Occupation		
Unemployed	20	5%
Retired	3	.7%
Student	267	66.1%
Permanent job	48	11.9%
Temporary job	66	16.3%
Had covid-19		
Yes, I had Covid-19	225	55.7%
No, I had Covid-19	179	44.3%
Family and friends had Covid-19		
Yes, they had	348	86.1%
No, they did not have	56	13.9%

### Measures

#### *The ultra-short version of the Posttraumatic growth inventory*

For the study, the version adapted to the Spanish-speaking population was used (Gómez-Acosta et al., 2023). The factorial structure of the ultra-short version is one-dimensional and consists of five items that have six response categories: (0) I did not experience this change, (1) I experienced a very slight change, (2) I experienced a slight change, (3) I experienced a moderate change, (4) I experienced a major change and (5) I experienced this change to a great extent. The ultra-short version presents a range of values between 0 and 25 points. In addition, the ultra-short version does not present inverse items; therefore, a higher score would show a greater presence of post-traumatic growth. Regarding its psychometric properties, in the Spanish-speaking population, the one-dimensional model presented adequate data fit indices ( $CFI = .988$ ;  $TLI = .977$ ;  $RMSEA = .058$ ,  $SRMR = .044$ ) and adequate internal consistency values ( $\omega = .79$ ).

### WHO-5 well-being index (WHO-5)

In this study, the version adapted to Peru was used to evaluate aspects related to subjective well-being (Caycho-Rodríguez et al., 2020). The scale is made up of five items that have four response categories: (0) never, (1) sometimes, (2) often, and (3) always. The instrument presents a range of values between 0 and 15 points. In addition, the scale does not present inverse items; therefore, a higher score would show a higher level of well-being. Regarding its psychometric properties, in the version adapted to Peru, the one-dimensional model presented adequate fit indices to the data (CFI = .994, RMSEA = .053, SRMR = .018) and adequate internal consistency values ( $\omega = .76$ ) (Caycho-Rodríguez et al., 2020).

### Brief Resilient Coping Scale

For the study, the version adapted to Peru was used to measure the resilience level (Caycho-Rodríguez et al., 2018). The scale is made up of four items that have five response categories: (1) Strongly disagree, (2) Disagree, (3) Neither disagree nor agree, (4) Agree, and (5) Strongly agree. The instrument presents a range of values between 1 and 20 points. In addition, the scale does not present inverse items; therefore, a higher score would show a higher level of resilience. Regarding its psychometric properties, in the version adapted to Peru, the one-dimensional model presented adequate data fit indices (CFI = .995, RMSEA = .073, SRMR = .016) and adequate internal consistency values ( $\alpha = .87$ ;  $\omega = .88$ ).

### Procedure

Before collecting the data, the study was evaluated and approved by the Center for Research and Innovation in Health (CIISA) ethics committee of the Universidad Peruana Unión (2022-CE-FCS - UPeU-041). Furthermore, informed consent was used in the present study to guarantee the voluntary participation of people. Also, the present study complied with the standards established by the Declaration of Helsinki (World Medical Association, 2013).

A virtual form was used to collect data using the Google Forms digital platform. The form comprises three parts: (a) In the first part, the informed consent was presented, where the study's objectives, anonymity, and confidentiality of the data were explained. (b) In the second part, questions were presented to collect information about the sociodemographic data of the participants. (c) Thirdly, the items of the instruments used in the study were presented. The form was configured so that only people who gave informed consent could proceed with the following parts. The virtual form was shared on social networks such as Facebook, WhatsApp, and Instagram. The average time it took participants to answer the form was 20 minutes.

### Data Analysis

In Content-Based Validity, five psychologists participated and evaluated the scale using four criteria: (a) relevance, (b) representativeness, (c) clarity, and (d) context of the items. The Aiken V coefficient was used to quantify the responses (Aiken, 1980), and an ad hoc program in MS Excel© format was used to calculate it (Ventura-León, 2019). Twenty adults from the target population then rated the items for clarity.

In the Item Response Theory, the fulfillment of the main assumptions was first evaluated to work with the IRT. A Confirmatory Factor Analysis (CFA) estimated a unidimensional model to verify the one-dimensionality assumption. The MLR estimator and the following adjustment indices were used: RMSEA ( $< .08$ ), SRMR ( $< .08$ ), CFI ( $> .95$ ), and TLI ( $> .95$ ) (Kline, 2015; Schumacker & Lomax, 2015). The dynamic cut-point approach was also used to assess the model's fit (McNeish & Wolf, 2021, 2022). Regarding the assumption of local independence of the items, the G2 index was used (Chen & Thissen, 1997), specifically Cramer's V coefficient, which takes values between -1 and 1 (Chalmers, 2012). A large

absolute value indicates a potential case of local dependency (Paek & Cole, 2020). Compliance with the monotonicity assumption was also inspected using the raw residual plots (Wells & Hambleton, 2016).

A Graded Response Model was used to estimate the IRT model (Samejima, 1997), specifically an extension of the 2-parameter logistic model (2-PLM) for ordered polytomous items (Hambleton et al., 2010). The C2 test developed for ordinal items was used to estimate the fit of the model (Cai & Monroe, 2014), and the following fit criteria were used: RMSEA  $\leq$  .06 (Maydeu-Olivares & Joe, 2014) and SRMSR  $\leq$  .05 (Maydeu-Olivares, 2013). The CFI and TLI values were also taken into account using the same adjustment criteria ( $\geq$  .95) used in SEM models (Lubbe & Schuster, 2019). The generalized S-X2 index was used to assess the fit of the items, and its corresponding RMSEA was used to measure effect size (Kang & Chen, 2011).

In the GRM models, two parameters were estimated: discrimination and difficulty. The discrimination parameter determines the slope at which item responses change depending on the level of the latent trait, and the item difficulty parameters determine how much of the latent trait the item requires to be answered. As the scale has six response categories, there are five difficulty estimates, one per threshold. The estimates for these five thresholds indicate the latent variable level at which an individual has a 50% chance of scoring at or above a particular response category. The following graphs representing item and test performance for each latent trait were also calculated: Item Characteristic Curve (ICC), Test Characteristic Curve (TCC), Item Information Curve (IIC), and Test Information Curves (TIC).

The Likelihood Ratio approach for ordinal items was used to evaluate the Differential Item Functioning (DIF) according to the participants' country (Paek & Cole, 2020). Under this approach, two models were estimated: (a) a No-DIF model, where all item parameters are invariant between groups. (b) Another DIF model, where item parameters may be unequal between groups. The No-DIF (reduced model) and DIF (full model) models were compared using the log-likelihood ratio test with the ANOVA function to test for possible differences in item parameters between groups. In this comparison, the null hypothesis establishes that there is no DIF; the item parameters are the same between the groups. A p-value  $<$  .05 was used to reject the null hypothesis. Finally, a Structural Equations Model (SEM) was proposed to evaluate the ultra-short version's relationship with other scales. The MLR estimator was used to estimate the model, and the same adjustment indicators made in the CFA were taken into account.

To estimate the GRM model and the DIF analysis, the "mirt" and "ltm" packages were used (Chalmers, 2012; Rizopoulos, 2006). The "lavaan" package (Rosseel, 2012) was used to estimate the CFA and SEM model. The "dynamic" package was used to estimate the dynamic cut-off points (Wolf & McNeish, 2023). The RStudio environment (RStudio Team, 2018) for R (R Core Team, 2019) was used in all cases.

### 3. RESULTS

#### Content-Based Validity

In this study, good values were found in the criteria of clarity, relevance, and context ( $V > .70$ ). Likewise, adjustments were made based on the judges' recommendations in item 3. In addition, the evaluation carried out by the target population showed that the items were clear and understandable.

#### Descriptive Analysis

It can be seen in Table 2 that most of the participants reported moderate changes as a result of the pandemic in the spiritual areas ( $M = 3.02$ ) and personal beliefs ( $M = 3.14$ ). On the other hand, most of the participants reported minor changes in their relationships with others ( $M = 2.87$ ). Table 2 also

shows that all the response categories of the items were answered. Regarding the asymmetry and kurtosis indices, it is observed that the items present values within the expected parameters ( $As < \pm 2$ ;  $Ku < \pm 7$ ) (Finney & DiStefano, 2006).

Table 2

*Descriptive analysis of the items, response rate of the items and factorial weights*

Indicators	Items <sup>a</sup>	M	SD	g1	g2	Min	Max	$\lambda$
Appreciation of life	1. Aprecio más el valor de mi propia vida [I appreciate more the value of my own life]	2.97	1.55	-.51	-.84	0	5	.72
Spiritual changes	2. Tengo una mejor comprensión de algunas cuestiones espirituales [I have a better understanding of some spiritual issues]	3.02	1.54	-.54	-.79	0	5	.76
Relationship with others	3. Me siento más cercano a los demás [I feel closer to others]	2.87	1.56	-.38	-1.01	0	5	.77
New possibilities	4. He construido un nuevo rumbo o caminos de vida [I have built a new course or paths of life]	2.92	1.51	-.46	-.87	0	5	.77
Personal beliefs	5. Descubrí que era más fuerte de lo que en realidad pensaba [I found out I was stronger than I actually thought]	3.14	1.49	-.69	-.49	0	5	.76

*Note.* M = Medium; SD = Standard deviation; g1 = Asymmetry; g2 = Kurtosis; a = Simple translation, for study purposes only

### Item calibration with the GRM (2-PML)

The assumption of one-dimensionality was evidenced through a CFA. The study found that the one-dimensional model presented adequate fit indices to the data ( $\chi^2 = 9.10$ ;  $df = 5$ ;  $p = .105$ ;  $CFI = .99$ ;  $TLI = .98$ ;  $SRMR = .019$ ;  $RMSEA = .058$  [IC90% .000 – .118]). In addition, using the dynamic cutoff points, evidence was found that the one-dimensional model is close to what is acceptable since the empirical indices of SRMR (.019) and RMSEA (.071) are lower than the specification error cutoff point from level 2 (SRMR = .019; RMSEA = .124). Also, the empirical CFI index (.988) is higher than the level 2 specification error cutoff (CFI = .969). It is important to mention that the factorial weights of all the items were high (see Table 2). All this shows evidence in favor of a one-dimensional model in the data. Regarding the assumption of local independence, the standardized values of Cramer's V of the items ranged from -.222 to .206, confirming the assumption of local independence. Furthermore, the raw residual plots for the items do not show a strong deviation from monotonicity.

A Gradual Response Model (GRM) was used to estimate the models, specifically an extension of the 2-parameter logistic model (2-PLM) for ordered polytomous items. The estimated GRM model showed adequate fit indices ( $C2[df] = 16.62[5]$ ;  $p = .001$ ;  $RMSEA = .075$ ;  $SRMSR = .047$ ;  $TLI = .98$ ;  $CFI = .99$ ). In addition, it can be seen in Table 3 that most of the items present non-significant p values ( $p > .05$ ). Furthermore, all items show small RMSEA values ( $< .043$ ). Therefore, it can be affirmed that the items present adequate fit indices in the GRM model.

Regarding the parameters of the GRM model, Table 3 shows that the discrimination parameters of all the items are above the value of 1.35, which is generally considered a high level of discrimination (Baker, 2001). Regarding the difficulty parameters, all estimators of the thresholds increased monotonically. A greater presence of the latent trait is required to answer the higher response categories.

Table 3  
Parameters of the GRM model items

Item	Item Parameter						Item fit indices		
	a	b <sub>1</sub>	b <sub>2</sub>	b <sub>3</sub>	b <sub>4</sub>	b <sub>5</sub>	S_X2	RMSEA	p-value
1	2.21	-1.63	-1.02	-.47	-.08	1.32	77.15	.043	.001
2	2.42	-1.67	-.97	-.53	.11	1.16	56.09	.027	.087
3	2.38	-1.61	-.86	-.34	.22	1.30	41.52	.000	.492
4	2.72	-1.62	-.93	-.41	.17	1.31	64.10	.039	.009
5	2.56	-1.62	-1.13	-.58	.02	1.13	49.20	.021	.207

Note. a= discrimination parameters; b= difficulty parameters

Figure 1: shows that the response categories of the items are monotonically related to the levels of post-traumatic growth. As one moves from left to right in the ICCs, the probability of choosing a response category increase and then decreases as responses move to the next higher category.

Figure 1  
Item Characteristic Curve of the ultra-short version of the Posttraumatic Growth Inventory

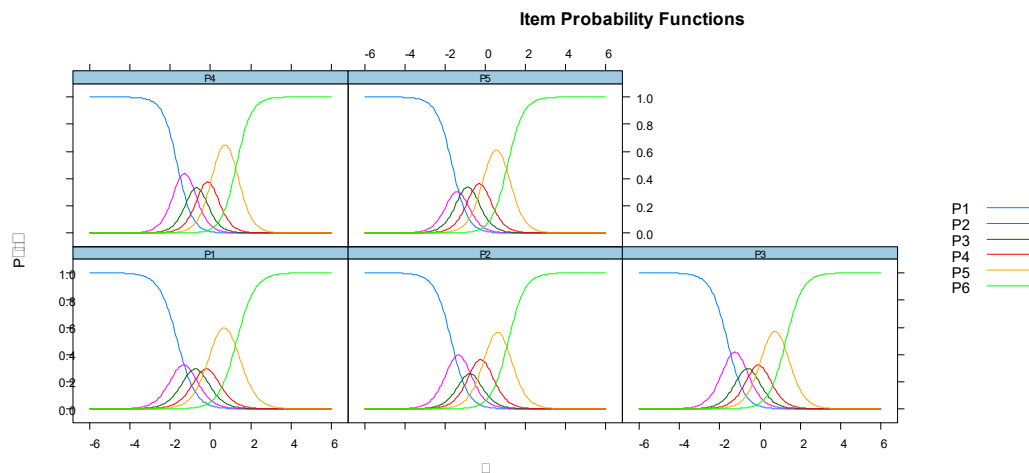


Figure 2 shows a strong increase in the total scores of the scale as the real level of post-traumatic growth increases. On the other hand, Figure 3 shows the Item Information Curve and the Test (IICs and TIC, respectively). In the IIC, items 4 and 5 are the most accurate on the scale to assess the latent trait. In addition, the ICT shows that the test is more reliable (accurate) in the scale range between -2 and 2.

Figure 2  
 Test Characteristic Curve of the ultra-short version of the Posttraumatic Growth Inventory

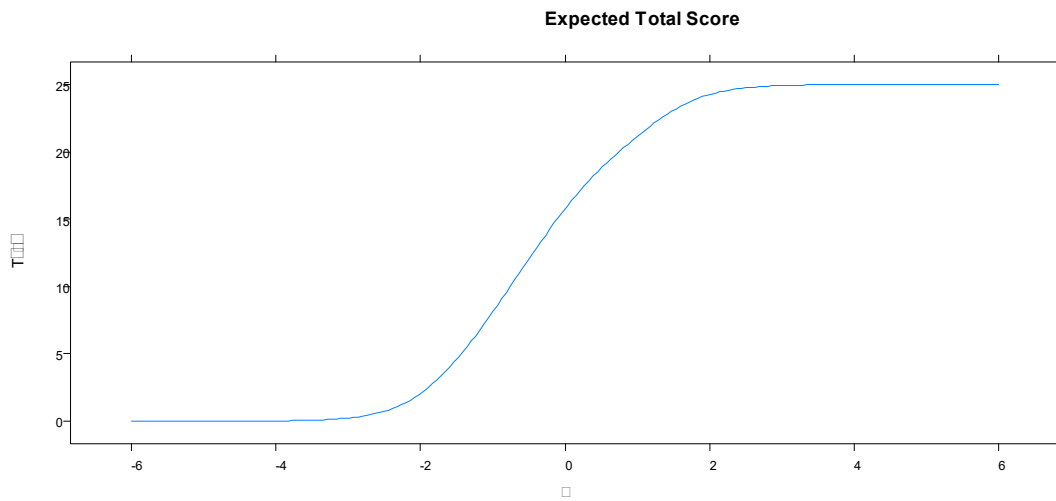
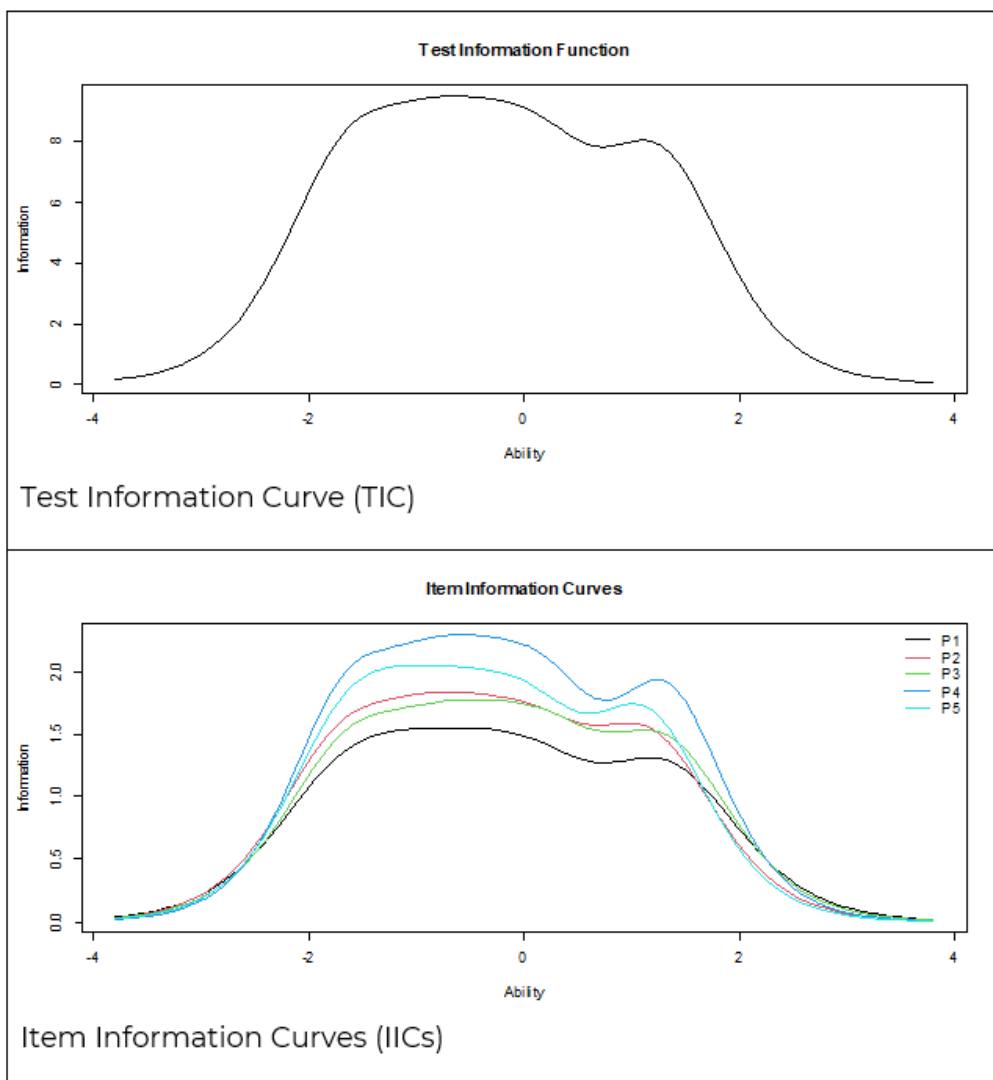


Figure 3  
 Item and Test Information Curves for the ultra-short version of the Posttraumatic Growth Inventory



**Differential Item Functioning (DIF)**

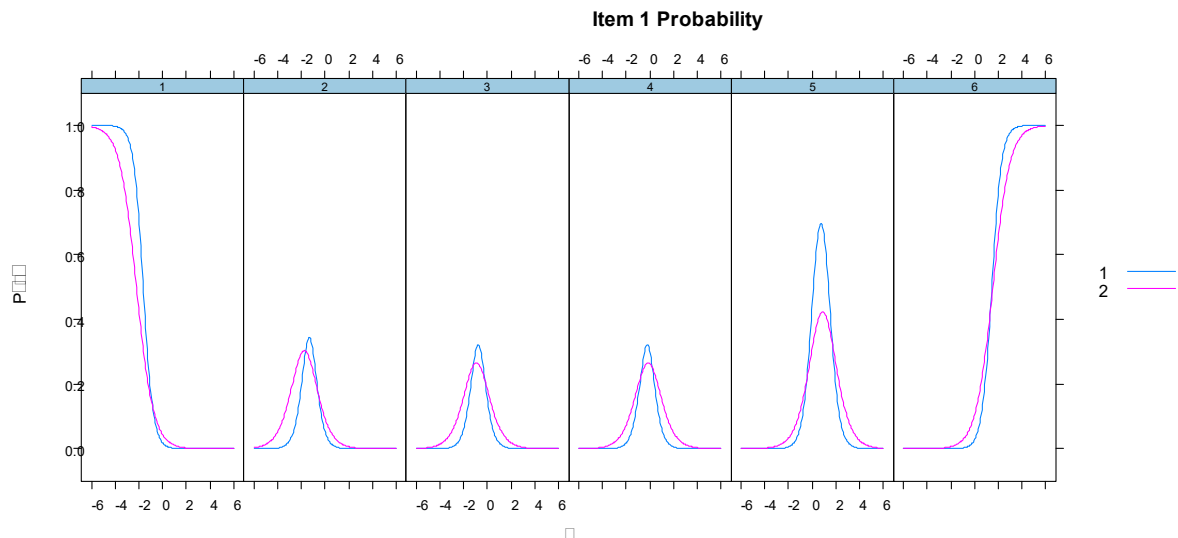
Table 4 shows the differential analysis of the items between men and women. It is observed that item 1 presents a differential functioning between both groups ( $p = .001$ ), where this item has greater discriminative power for the group of women. This difference can also be observed in the ICC of the item between both groups (see Figure 4). For the other items, the ANOVA analysis shows no presence of DIF.

Table 4

*Differential Item Functioning*

Item	Female						Male						AIC	SABIC	BIC	$\chi^2$	df	p
	a	b <sub>1</sub>	b <sub>2</sub>	b <sub>3</sub>	b <sub>4</sub>	b <sub>5</sub>	a	b <sub>1</sub>	b <sub>2</sub>	b <sub>3</sub>	b <sub>4</sub>	b <sub>5</sub>						
1	2.46	-1.62	-1.04	-.50	.04	1.44	1.40	-2.20	-1.31	-.53	.24	1.53	5953.21	5984.68	6105.27	14.74	6	.022
2	2.44	-1.71	-1.00	-.55	.07	1.31	1.77	-2.11	-1.21	-.63	.25	1.26	5959.83	5991.31	6111.88	8.13	6	.229
3	2.25	-1.88	-.95	-.35	.25	1.44	2.02	-1.56	-.88	-.41	.23	1.43	5962.99	5994.47	6115.04	4.96	6	.548
4	2.26	-1.79	-1.11	-.48	.23	1.56	3.0 8	-1.72	-.84	-.39	.08	1.24	5960.29	5991.76	6112.34	7.67	6	.263
5	2.30	-1.76	-1.28	-.62	.01	1.22	2.34	-1.86	-1.18	-.65	.07	1.32	5965.86	5997.33	6026.05	2.1	6	.910

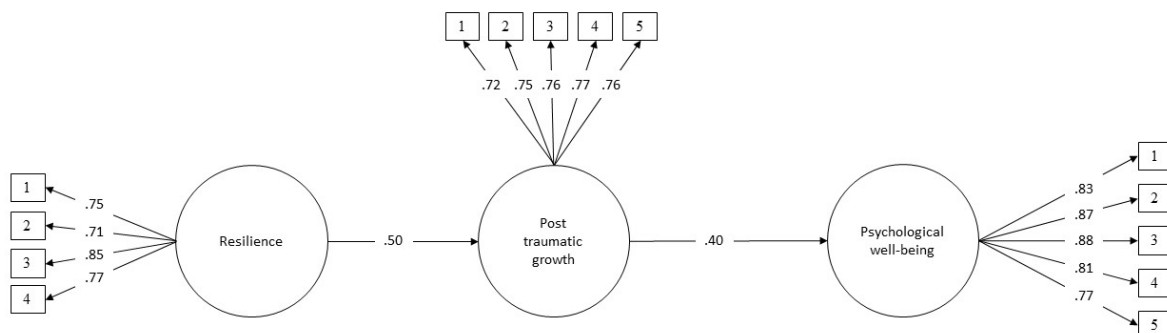
Figure 4  
Item Characteristic Curve with DIF of the ultra-short version of the Posttraumatic Growth Inventory



**Validity based on the relationship with other variables**

Considering the literature review, an SEM model was proposed to evaluate the impact of resilience on post-traumatic growth and, in turn, the impact of post-traumatic growth on the level of psychological well-being. It was evidenced that the structural model presents adequate adjustment indices ( $\chi^2 = 171.09$ ;  $df = 75$ ;  $p < .01$ ;  $RMSEA = .065$ [IC90% .052 – .078];  $CFI = .96$ ;  $TLI = .95$ ). Also, the measurement models are adequately represented by their items since the factorial weights are high in the factor that corresponds to them (see Figure 5). Figure 5 shows that resilience significantly predicts post-traumatic growth (.50;  $p < .01$ ). In addition, post-traumatic growth significantly predicts the level of psychological well-being (.40;  $p < .01$ ).

Figure 5  
SEM model of Post Traumatic Growth



#### 4. DISCUSSION

In contexts of difficulty and crisis, such as the COVID-19 pandemic, evaluating and studying the factors that allow personal growth despite difficulties is important. Post-traumatic growth is one of the most important and studied factors during the pandemic (Landi et al., 2022). The scientific literature mostly uses the PTGI and its different versions, such as the ultra-brief inventory, to measure this construct. However, no psychometric studies of the ultra-brief version under the IRT have yet been reported in Latin America. Also, evidence of the Differential Analysis of the Items has yet to be shown.

Faced with this, the present study evaluated the psychometric functioning of the ultra-brief Post-traumatic Growth Inventory items through the Item Response Theory. A CFA was carried out to evaluate the assumption of One-dimensionality, where it was evidenced that the model presented adequate fit indices to the data. This methodological approach is similar to what has been done in other studies (Thiyagarajan et al., 2022; Toraman et al., 2022). It is important to mention that to evaluate the fit indices, the dynamic cut-off point approach was used, which allows a more precise and real evaluation of the degree of fit of the model to the data (McNeish & Wolf, 2021, 2022). Regarding the other two assumptions, the local independence of the items and compliance with monotonicity were demonstrated. Therefore, all this evidence guarantees the veracity of the estimates (Bean & Bowen, 2021).

The study showed that all the items present adequate levels of discrimination; the five items allow adequate differentiating of the responses of people with different levels of post-traumatic growth. This result is consistent with the high factorial weights of the items found in the CFA. Both results show that each item adequately measures each of the five domains shown in the scientific literature: (a) greater appreciation for life, (b) more intimate relationships with others, (c) reinforcement of personal strengths, (d) recognition of new possibilities and (e) spiritual development (Tedeschi & Calhoun, 1996). In addition, they coincide with the theoretical contributions found in the scientific literature, which explain that post-traumatic growth is an adaptive process that successfully resolves a traumatic or adverse event. This adaptive process involves evaluating and developing new life narratives that are more positive (Joseph et al., 2012; Neimeyer, 2004; Park, 2010).

Among the items with the greatest discriminative power were items 4 and 5, which refer to developing a new life path and developing personal strengths, respectively. This result is expected, as it has been suggested that traumatic experiences such as the COVID-19 pandemic can destroy fundamental beliefs and assumptions about oneself, others, and the world (Bryant, 2019; Kaseda & Levine, 2020). Faced with this, finding a new direction or vision of life gives a new meaning to the traumatic event, enabling positive changes in the person (Tedeschi & Calhoun, 2004). In addition, adverse situations allow the development of people's strengths and psychological resources, making post-traumatic growth possible (Alat et al., 2023; Turliuc & Candel, 2022). Regarding the difficulty indices, all the ultra-short version items showed increasing monotonic values; that is, people with low levels of post-traumatic growth will tend to choose the first or second category, while people with a higher level of the trait will choose the higher categories. This pattern shows that the content of the five items allows all response alternatives to be measured, and there is no loss of information.

Concerning the Differential Item Functioning (DIF), it was evidenced that only item 1 presents DIF between men and women, where this item has greater discriminative power for the group of women. That is, item 1 better distinguishes low and high post-traumatic growth levels in women. This difference in the item's functioning could be explained by the characteristics and psychological resources associated with women. It has been suggested that women are more likely to reflect on constructive and productive issues, such as personal strengths or the importance of social connections (Tolin & Foa, 2006; Vishnevsky et al., 2010). Furthermore, reflective rumination is associated with greater post-traumatic growth in women (Calhoun et al., 2000). Another important aspect is the coping style used; several studies show that women mostly use emotion-based coping, unlike men, who tend to inhibit their emotional experiences as a coping mechanism (Matud, 2004;

O'Rourke et al., 2022). Emotion-focused coping actively engages women in the core mechanisms of post-traumatic growth (Jin et al., 2014). All these characteristics could cause women to be more receptive to item 1, which refers to reflection on the value of one's life.

Regarding the validity based on the relationship with other variables, it was found that resilience has significantly related to post-traumatic growth. This result is similar to that reported in other studies, where a positive relationship was found between both variables (Bensimon, 2012; Nishi et al., 2010; Ogińska-Bulik, 2015). Other studies have also shown that resilience significantly predicts people's post-traumatic growth (Dong et al., 2017; Wilson et al., 2014), especially during the COVID-19 pandemic (Shi et al., 2022). On the other hand, the present study also showed that post-traumatic growth is positively related to the degree of psychological well-being. This result is consistent with the evidence shown in the scientific literature, where post-traumatic growth contributes positively to the well-being of people after the traumatic event (Cann, Calhoun, Tedeschi, & Solomon, 2010; Mols et al., 2009; Veronese et al., 2017). These results show that the Ultra Brief Post Traumatic Growth Inventory shows empirical relationships with other variables, which are consistent with the evidence shown in the scientific literature.

The present study's results should be considered considering its limitations. In the first place, a non-probabilistic convenience sampling was used for data collection; this, on the one hand, limits the generalization of the results and, on the other hand, causes the sociodemographic characteristics of the sample to be unbalanced. Therefore, future studies should use probabilistic sampling techniques that allow for representative adult population samples. Secondly, self-report measures were used; this approach could increase response bias due to social desirability. It is important to note that the measurement of the construct is based mostly on self-report instruments. In this sense, future studies should consider obtaining data from different sources, such as in-depth interviews, to better understand the study variables. Third, the study was cross-sectional and in a specific geographic area. Therefore, future investigations should consider longitudinal designs and more extensive geographic areas to understand better the findings presented.

Despite the limitations, the Ultra Brief Post Traumatic Growth Inventory items show adequate psychometric functioning both in their discriminative capacity and in difficulty. Therefore, the items provide useful information on the levels of post-traumatic growth, allowing an adequate measurement of the construct in the adult population. It was also evidenced that item 1 presents a differential functioning between the group of men and women. It is important to consider this result when comparing post-traumatic growth between the two groups. It is important to mention that it is the first study to show evidence of the psychometric performance of the ultra-short version through IRT in the Spanish-speaking population.

On the other hand, the number of inventory items can be advantageous when a brief and cost-effective measure is required to measure the construct. Brief instruments are better suited for virtual surveys and situations where the examinee has a short attention span (Konrath et al., 2018). They are also useful when evidence is required for new methods or theories since ease of interpretation is needed (Dolan et al., 2015). The results of this study will likely contribute to the advancement of the measurement of this construct. It also contributes to understanding the relationship between post-traumatic growth and other associated variables, such as well-being and resilience.

## Declarations

### **Authors' contributions:**

LWV, SLH, RB-A, AT-C, JQ-B and MC-A provided initial conception, organization, and main writing of the text. LWV analyzed the data and prepared all figures and tables. LWV, SLH, RB-A, AT-C, JQ-B, MC-A, ER-M and VA-M were involved in data collection and acted as consultants and contributors to research design, data analysis, and text writing, read and approved the draft.

**Conflicts of interest:**

The author(s) declare(s) that there is no conflict of interest with respect to the research, authorship, and/or publication of this article.

**Funding details**

The author(s) did not receive financial support for the research, authorship, and/or publication of this article.

**Acknowledgments:**

Not applicable

**Data availability statement**

Upon request authors are prepared to send relevant documentation or data in order to verify the validity of the results.

**Ethics approval**

This study was approved by the Center for Research and Innovation in Health (CIISA) ethics committee of the Universidad Peruana Unión (2022-CE-FCS - UPeU-032). The study also followed the standards established in the Declaration of Helsinki (World Medical Association, 2013).

**ORCID iDs**

Lindsey W. Vilca	<a href="https://orcid.org/0000-0002-8537-9149">https://orcid.org/0000-0002-8537-9149</a>
Samy L. Huerta	<a href="https://orcid.org/0000-0001-5782-149X">https://orcid.org/0000-0001-5782-149X</a>
Rose Barbaran-Alvarado	<a href="https://orcid.org/0000-0002-2858-850X">https://orcid.org/0000-0002-2858-850X</a>
Aaron Travezaño-Cabrera	<a href="https://orcid.org/0000-0002-4967-1572">https://orcid.org/0000-0002-4967-1572</a>
Julisa Quiroz-Becerra	<a href="https://orcid.org/0000-0003-0071-4647">https://orcid.org/0000-0003-0071-4647</a>
María Calizaya-Anahua	<a href="https://orcid.org/0009-0007-9809-2829">https://orcid.org/0009-0007-9809-2829</a>
Estefany Rojas-Mendoza	<a href="https://orcid.org/0000-0001-6889-482X">https://orcid.org/0000-0001-6889-482X</a>
Vaneryn Alania-Marin	<a href="https://orcid.org/0000-0003-1601-1479">https://orcid.org/0000-0003-1601-1479</a>

**REFERENCES**

- Aiken, L. R. (1980). Content validity and reliability of single items or questionnaires. *Educational and Psychological Measurement*, 40(4), 955–959. <https://doi.org/10.1177/001316448004000419>
- Alat, P., Das, S. S., Arora, A., & Jha, A. K. (2023). Mental health during COVID-19 lockdown in India: Role of psychological capital and internal locus of control. *Current Psychology*, 42(3), 1923–1935. <https://doi.org/10.1007/s12144-021-01516-x>
- Amiri, H., Rezapour, M., Nekoei-Moghadam, M., & Nakhaee, N. (2020). Translation and Adaptation of the Posttraumatic Growth Inventory-Short Form into Persian. *The Open Psychology Journal*, 13(1), 326–332. <https://doi.org/10.2174/1874350102013010326>
- Baker, F. B. (2001). *The Basics of Item Response Theory*. ERIC Clearinghouse on Assessment and Evaluation.
- Baloch, G. M., Sundarasan, S., Chinna, K., Nurunnabi, M., Kamaludin, K., Khoshaim, H. B., Hossain, S. F. A., & AISukayt, A. (2021). COVID-19: Exploring impacts of the pandemic and lockdown on mental health of Pakistani students. *PeerJ*, 9, 1–15. <https://doi.org/10.7717/peerj.10612>

- Barzilay, R., Moore, T. M., Greenberg, D. M., DiDomenico, G. E., Brown, L. A., White, L. K., Gur, R. C., & Gur, R. E. (2020). Resilience, COVID-19-related stress, anxiety and depression during the pandemic in a large population enriched for healthcare providers. *Translational Psychiatry*, 10(291), 1–8. <https://doi.org/10.1038/s41398-020-00982-4>
- Bates, G. W., Trajstman, S. E. A., & Jackson, C. A. (2004). Internal consistency, test-retest reliability and sex differences on the posttraumatic growth inventory in an Australian sample with trauma. *Psychological Reports*, 94(3 1), 793–794. <https://doi.org/10.2466/pr0.94.3.793-794>
- Bean, G. J., & Bowen, N. K. (2021). Item Response Theory and Confirmatory Factor Analysis: Complementary Approaches for Scale Development. *Journal of Evidence-Based Social Work (United States)*, 18(6), 597–618. <https://doi.org/10.1080/26408066.2021.1906813>
- Bensimon, M. (2012). Elaboration on the association between trauma, PTSD and posttraumatic growth: The role of trait resilience. *Personality and Individual Differences*, 52(7), 782–787. <https://doi.org/10.1016/j.paid.2012.01.011>
- Bermejo-Martins, E., Luis, E. O., Fernández-Berrocal, P., Martínez, M., & Sarrionandia, A. (2021). The role of emotional intelligence and self-care in the stress perception during COVID-19 outbreak: An intercultural moderated mediation analysis. *Personality and Individual Differences*, 177, 110679 Contents. <https://doi.org/10.1016/j.paid.2021.110679>
- Bourion-Bedes, S., Tarquinio, C., Batt, M., Tarquinio, P., Lebreuilly, R., Sorsana, C., Legrand, K., Rousseau, H., & Baumann, C. (2021). Psychological impact of the COVID-19 outbreak on students in a French region severely affected by the disease: results of the PIMS-CoV 19 study. *Psychiatry Research*, 295, 113559. <https://doi.org/10.1016/j.psychres.2020.113559>
- Bryant, R. A. (2019). Post-traumatic stress disorder: a state-of-the-art review of evidence and challenges. *World Psychiatry*, 18(3), 259–269. <https://doi.org/10.1002/wps.20656>
- Cai, L., & Monroe, S. (2014). A New Statistic for Evaluating Item Response Theory Models for Ordinal Data. <https://files.eric.ed.gov/fulltext/ED555726.pdf>
- Calhoun, L. G., Cann, A., Tedeschi, R. G., & McMillan, J. (2000). A correlational test of the relationship between posttraumatic growth, religion, and cognitive processing. *Journal of Traumatic Stress*, 13(3), 521–527. <https://doi.org/10.1023/A:1007745627077>
- Cann, A., Calhoun, L. G., Tedeschi, R. G., & Solomon, D. T. (2010). Posttraumatic Growth and Depreciation as Independent Experiences and Predictors of Well-Being. *Journal of Loss and Trauma*, 15(3), 151–166. <https://doi.org/10.1080/15325020903375826>
- Cann, A., Calhoun, L. G., Tedeschi, R. G., Taku, K., Vishnevsky, T., Triplett, K. N., & Danhauer, S. C. (2010). A short form of the posttraumatic growth inventory. *Anxiety, Stress and Coping*, 23(2), 127–137. <https://doi.org/10.1080/10615800903094273>
- Castro, R. M., & Dueñas, C. P. (2022). Emotional Intelligence and Anxiety during the COVID-19 Pandemic: A study on their relationships in young adults. *Ansiedad y Estrés*, 28(2), 122–130. <https://doi.org/10.5093/anyes2022a14>
- Caycho-Rodríguez, T., Ventura-León, J., Azabache-Alvarado, K., Reyes-Bossio, M., & Cabrera-Orosco, I. (2020). Validez e invariancia factorial del Índice de Bienestar General (WHO-5 WBI) en universitarios peruanos. *Revista Ciencias De La Salud*, 18(3), 1–15. <https://doi.org/10.12804/revistas.urosario.edu.co/revsalud/a.9797>
- Caycho-Rodríguez, T., Ventura-León, J., García-Cadena, C. H., Tomás, J. M., Domínguez-Vergara, J., Daniel, L., & Arias-Gallegos, W. L. (2018). Evidencias Psicometricas de una Medida Breve de Resiliencia en Adultos Mayores Peruanos no Institucionalizados. *Psychosocial Intervention*, 27(2), 73–79. <https://doi.org/10.5093/pi2018a6>
- Chalmers, R. P. (2012). Mirt: A multidimensional item response theory package for the R environment. *Journal of Statistical Software*, 48(6), 1–29. <https://doi.org/10.18637/jss.v048.i06>

- Chen, W. H., & Thissen, D. (1997). Local Dependence Indexes for Item Pairs Using Item Response Theory. *Journal of Educational and Behavioral Statistics*, 22(3), 265–289. <https://doi.org/10.3102/10769986022003265>
- Cielo, F., Ulberg, R., & Di Giacomo, D. (2021). Psychological Impact of the COVID-19 Outbreak on Mental Health Outcomes among Youth: A Rapid Narrative Review. *International Journal of Environmental Research and Public Health*, 18(11), 6067. <https://doi.org/10.3390/ijerph18116067>
- Czeisler, M., Lane, R. I., Wiley, J. F., Czeisler, C. A., Howard, M. E., & Rajaratnam, S. M. W. (2021). Follow-up Survey of US Adult Reports of Mental Health, Substance Use, and Suicidal Ideation during the COVID-19 Pandemic, September 2020. *JAMA Network Open*, 4(2), 1–6. <https://doi.org/10.1001/jamanetworkopen.2020.37665>
- Daly, M., Sutin, A. R., & Robinson, E. (2021). Depression reported by US adults in 2017–2018 and March and April 2020. *Journal of Affective Disorders*, 278(September 2020), 131–135. <https://doi.org/10.1016/j.jad.2020.09.065>
- Dong, X., Li, G., Liu, C., Kong, L., Fang, Y., Kang, X., & Li, P. (2017). The mediating role of resilience in the relationship between social support and posttraumatic growth among colorectal cancer survivors with permanent intestinal ostomies: A structural equation model analysis. *European Journal of Oncology Nursing*, 29, 47–52. <https://doi.org/10.1016/j.ejon.2017.04.007>
- Feng, L.-S., Dong, Z., Wu, X., Zhang, L., Yan, R., Ma, J., & Zeng, Y. (2022). COVID-19-related post-traumatic growth in the general public: a cross-sectional study from Yunnan, China. *Psychology, Health & Medicine*, 27(4), 925–930. <https://doi.org/10.1080/13548506.2021.1966700>
- Finney, S. J., & DiStefano, C. (2006). Non-normal and Categorical data in structural equation modeling. In G. R. Hancock & R. O. Mueller (Eds.), *Structural equation modeling: a second course* (pp. 269–314). Information Age Publishing.
- García, F. E., Andrades, M., Matus, F. R., Segovia, Z. D., Alarcón, S., Fonseca, I., & Lucero, C. (2022). Post-traumatic Symptoms and Posttraumatic Growth in Higher Education Students in Chile during the COVID-19 Pandemic. *Actualidades En Psicología*, 36(132), 1–16. <https://doi.org/10.15517/ap.v36i132.45386>
- García, F. E., & Włodarczyk, A. (2016). Psychometric Properties of the Posttraumatic Growth Inventory–Short Form Among Chilean Adults. *Journal of Loss and Trauma*, 21(4), 303–314. <https://doi.org/10.1080/15325024.2015.1108788>
- Garrido-Hernansaiz, H., Rodríguez-Rey, R., Collazo-Castiñeira, P., & Collado, S. (2022). The posttraumatic growth inventory-short form (PTGI-SF): A psychometric study of the spanish population during the COVID-19 pandemic. *Current Psychology*, 0123456789. <https://doi.org/10.1007/s12144-021-02645-z>
- Gómez-Acosta, A., Ramos-Vera, C., & Sierra Barón, W. (2023). Validation of an ultra-short version of the posttraumatic growth inventory in Colombian adults exposed to COVID-19. *Death Studies*, 47(4), 490–498. <https://doi.org/10.1080/07481187.2022.2098415>
- González-Sanguino, C., Ausín, B., Castellanos, M. Á., Saiz, J., López-Gómez, A., Ugidos, C., & Muñoz, M. (2020). Mental health consequences during the initial stage of the 2020 Coronavirus pandemic (COVID-19) in Spain. *Brain, Behavior, and Immunity*, 87, 172–176. <https://doi.org/10.1016/j.bbi.2020.05.040>
- Hambleton, R. K., van der Linden, W. J., & Wells, C. S. (2010). IRT models for the analysis of polytomously scored data: Brief and selected history of model building advances. In M. L. Nering & R. Ostini (Eds.), *Handbook of polytomous item response theory models* (pp. 21–42). Routledge/Taylor & Francis Group.
- Heidarzadeh, M., Naseri, P., Shamshiri, M., Dadkhah, B., Rassouli, M., & Gholchin, M. (2017). Evaluating the Factor Structure of the Persian Version of Posttraumatic Growth Inventory in Cancer Patients. *Asian Nursing Research*, 11(3), 180–186. <https://doi.org/10.1016/j.anr.2017.07.003>
- Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., Zhang, L., Fan, G., Xu, J., Gu, X., Cheng, Z., Yu, T., Xia, J., Wei, Y., Wu, W., Xie, X., Yin, W., Li, H., Liu, M., ... Cao, B. (2020). Clinical features of patients infected

- with 2019 novel coronavirus in Wuhan, China. *The Lancet*, 395(10223), 497–506. [https://doi.org/10.1016/S0140-6736\(20\)30183-5](https://doi.org/10.1016/S0140-6736(20)30183-5)
- Huarcaya-Victoria, J., Barreto, J., Aire, L., Podestá, A., Caqui, M., Guija-Igreda, R., Castillo, C., & Alarcon-Ruiz, C. A. (2021). Mental Health in COVID-2019 Survivors from a General Hospital in Peru: Sociodemographic, Clinical, and Inflammatory Variable Associations. *International Journal of Mental Health and Addiction*, 21(2), 1264–1285. <https://doi.org/10.1007/s11469-021-00659-z>
- Jaarsma, T. A., Pool, G., Sanderman, R., & Ranchor, A. V. (2006). Psychometric properties of the Dutch version of the posttraumatic growth inventory among cancer patients. *Psycho-Oncology*, 15(10), 911–920. <https://doi.org/10.1002/pon.1026>
- Jiang, R. (2020). Knowledge, attitudes and mental health of university students during the COVID-19 pandemic in China. *Children and Youth Services Review*, 119, 105494. <https://doi.org/10.1016/j.chilyouth.2020.105494>
- Jin, Y., Xu, J., & Liu, D. (2014). The relationship between post traumatic stress disorder and post traumatic growth: Gender differences in PTG and PTSD subgroups. *Social Psychiatry and Psychiatric Epidemiology*, 49(12), 1903–1910. <https://doi.org/10.1007/s00127-014-0865-5>
- Joseph, S., Murphy, D., & Regel, S. (2012). An Affective-Cognitive Processing Model of Post-Traumatic Growth. *Clinical Psychology and Psychotherapy*, 19(4), 316–325. <https://doi.org/10.1002/cpp.1798>
- Jozefiaková, B., Kaščáková, N., Adamkovi, M., Hašto, J., & Tavel, P. (2022). Posttraumatic Growth and Its Measurement: A Closer Look at the PTGI's Psychometric Properties and Structure. *Frontiers in Psychology*, 13, 801812. <https://doi.org/10.3389/fpsyg.2022.801812>
- Kaler, M. E., Erbes, C. R., Tedeschi, R. G., Arbisi, P. A., & Polusny, M. A. (2011). Factor structure and concurrent validity of the Posttraumatic Growth Inventory-Short Form among veterans from the Iraq War. *Journal of Traumatic Stress*, 24(2), 200–207. <https://doi.org/10.1002/jts.20623>
- Kang, T., & Chen, T. T. (2011). Performance of the generalized S-X 2 item fit index for the graded response model. *Asia Pacific Education Review*, 12, 89–96. <https://doi.org/10.1007/s12564-010-9082-4>
- Kaseda, E. T., & Levine, A. J. (2020). Post-traumatic stress disorder: A differential diagnostic consideration for COVID-19 survivors. *Clinical Neuropsychologist*, 34(7–8), 1498–1514. <https://doi.org/10.1080/13854046.2020.1811894>
- Kline, R. B. (2015). *Principles and Practice of Structural Equation Modeling* (4th ed.). The Guilford Press.
- Kumar, A., & Nayar, K. R. (2020). COVID 19 and its mental health consequences. *Journal of Mental Health*, 30(1), 1–2. <https://doi.org/10.1080/09638237.2020.1757052>
- Lamela, D., Figueiredo, B., Bastos, A., & Martins, H. (2014). Psychometric properties of the portuguese version of the posttraumatic growth inventory short form among divorced adults. *European Journal of Psychological Assessment*, 30(1), 3–14. <https://doi.org/10.1027/1015-5759/a000161>
- Landi, G., Pakenham, K. I., Mattioli, E., Crocetti, E., Agostini, A., Grandi, S., & Tossani, E. (2022). Post-traumatic growth in people experiencing high post-traumatic stress during the COVID-19 pandemic: The protective role of psychological flexibility. *Journal of Contextual Behavioral Science*, 26, 44–55. <https://doi.org/10.1016/j.jcbs.2022.08.008>
- Lubbe, D., & Schuster, C. (2019). A Graded Response Model Framework for Questionnaires With Uniform Response Formats. *Applied Psychological Measurement*, 43(4), 290–302. <https://doi.org/10.1177/0146621618789394>
- Lucchetti, G., Góes, L. G., Amaral, S. G., Ganadjian, G. T., Andrade, I., Almeida, P. O. de A., do Carmo, V. M., & Manso, M. E. G. (2021). Spirituality, religiosity and the mental health consequences of social isolation during Covid-19 pandemic. *International Journal of Social Psychiatry*, 67(6), 672–679. <https://doi.org/10.1177/0020764020970996>
- Matud, M. P. (2004). Gender differences in stress and coping styles. *Personality and Individual Differences*, 37(7), 1401–1415. <https://doi.org/10.1016/j.paid.2004.01.010>

- Maydeu-Olivares, A. (2013). Goodness-of-Fit Assessment of Item Response Theory Models. *Measurement: Interdisciplinary Research and Perspectives*, 11(3), 71–101. <https://doi.org/10.1080/15366367.2013.831680>
- Maydeu-Olivares, A., & Joe, H. (2014). Assessing Approximate Fit in Categorical Data Analysis. *Multivariate Behavioral Research*, 49(4), 305–328. <https://doi.org/10.1080/00273171.2014.911075>
- McNeish, D., & Wolf, M. G. (2021). Dynamic Fit Index Cutoffs for Confirmatory Factor Analysis Models. *Psychological Methods*. <https://doi.org/10.1037/met0000425>
- McNeish, D., & Wolf, M. G. (2022). Dynamic fit index cutoffs for one-factor models. *Behavior Research Methods*. <https://doi.org/10.3758/s13428-022-01847-y>
- Ministerio del Salud (Minsa). (2023). Sala situacional COVID-19 Perú. [https://covid19.minsa.gob.pe/sala\\_situacional.asp](https://covid19.minsa.gob.pe/sala_situacional.asp)
- Mols, F., Vingerhoets, A. J. J. M., Coebergh, J. W. W., & van de Poll-Franse, L. V. (2009). Well-being, posttraumatic growth and benefit finding in long-term breast cancer survivors. *Psychology & Health*, 24(5), 583–595. <https://doi.org/10.1080/08870440701671362>
- Morales-Rodríguez, F. M. (2021). Fear, stress, resilience and coping strategies during covid-19 in Spanish university students. *Sustainability*, 13(11), 5824. <https://doi.org/10.3390/su13115824>
- Neimeyer, R. A. (2004). Fostering Posttraumatic Growth: A Narrative Elaboration. *Psychological Inquiry*, 15(1), 53–59. <https://www.jstor.org/stable/20447202>
- Nishi, D., Matsuoka, Y., & Kim, Y. (2010). Posttraumatic growth, posttraumatic stress disorder and resilience of motor vehicle accident survivors. *BioPsychoSocial Medicine*, 4(1), 7. <https://doi.org/10.1186/1751-0759-4-7>
- O'Rourke, T., Vogel, C., John, D., Pryss, R., Schobel, J., Haug, F., Haug, J., Pieh, C., Nater, U. M., Feneberg, A. C., Reichert, M., & Probst, T. (2022). The Impact of Coping Styles and Gender on Situational Coping: An Ecological Momentary Assessment Study With the mHealth Application TrackYourStress. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.913125>
- Ogińska-Bulik, N. (2015). The relationship between resiliency and posttraumatic growth following the death of someone close. *Omega (United States)*, 71(3), 233–244. <https://doi.org/10.1177/0030222815575502>
- Padrón, I., Fraga, I., Vieitez, L., Montes, C., & Romero, E. (2021). A Study on the Psychological Wound of COVID-19 in University Students. *Frontiers in Psychology*, 12, 1–15. <https://doi.org/10.3389/fpsyg.2021.589927>
- Paek, I., & Cole, K. (2020). *Using R for Item Response Theory Model Applications*. Routledge.
- Park, C. L. (2010). Making Sense of the Meaning Literature: An Integrative Review of Meaning Making and Its Effects on Adjustment to Stressful Life Events. *Psychological Bulletin*, 136(2), 257–301. <https://doi.org/10.1037/a0018301>
- Penagos-Corzo, J. C., Tolamatl, C. R., Espinosa, A., Lorenzo Ruiz, A., & Pintado, S. (2020). Psychometric Properties of the PTGI and Resilience in Earthquake Survivors in Mexico. *Journal of Loss and Trauma*, 25(4), 364–384. <https://doi.org/10.1080/15325024.2019.1692512>
- Persich, M. R., Smith, R., Cloonan, S. A., Woods-Lubbert, R., Strong, M., & Killgore, W. D. S. (2021). Emotional intelligence training as a protective factor for mental health during the COVID-19 pandemic. *Depression and Anxiety*, 38(10), 1018–1025. <https://doi.org/10.1002/da.23202>
- R Core Team. (2019). A language and environment for statistical computing (R version 3.6.1). R Foundation for Statistical Computing. <http://www.r-project.org/>
- Rizopoulos, D. (2006). ltm: An R package for latent variable modeling and item response theory analyses. *Journal of Statistical Software*, 17(5), 1–25. <https://doi.org/10.18637/jss.v017.i05>
- Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software*, 48(2), 1–36. <https://doi.org/10.18637/jss.v048.i02>

- RStudio Team. (2018). RStudio: Integrated Development Environment for R. RStudio, Inc. <http://www.rstudio.com/>
- Salari, N., Hosseinian-Far, A., Jalali, R., Vaisi-Raygani, A., Rasoulpoor, S., Mohammadi, M., Rasoulpoor, S., & Khaledi-Paveh, B. (2020). Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: A systematic review and meta-analysis. *Globalization and Health*, 16(1), 1–11. <https://doi.org/10.1186/s12992-020-00589-w>
- Samejima, F. (1997). Graded Response Model. In W. J. van der Linden & R. K. Hambleton (Eds.), *Handbook of Modern Item Response Theory* (pp. 85–100). Springer. [https://doi.org/https://doi.org/10.1007/978-1-4757-2691-6\\_5](https://doi.org/https://doi.org/10.1007/978-1-4757-2691-6_5)
- Schumacker, R. E., & Lomax, R. G. (2015). *A Beginner's Guide to Structural Equation Modeling* (4th ed.). Routledge.
- Shi, J., Sznajder, K. K., Liu, S., Xie, X., Yang, X., & Zheng, Z. (2022). Resilience and Posttraumatic Growth of Patients With Breast Cancer During the COVID-19 Pandemic in China: The Mediating Effect of Recovery. *Frontiers in Psychology*, 12, 1–9. <https://doi.org/10.3389/fpsyg.2021.811078>
- Taubman-Ben-Ari, O., Findler, L., & Sharon, N. (2011). Personal growth in mothers: Examination of the suitability of the posttraumatic growth inventory as a measurement tool. *Women and Health*, 51(6), 604–622. <https://doi.org/10.1080/03630242.2011.614324>
- Tavakol, Z., Ghannadi, S., Tabesh, M. R., Halabchi, F., Noormohammadpour, P., Akbarpour, S., Alizadeh, Z., Nezhad, M. H., & Reyhan, S. K. (2023). Relationship between physical activity, healthy lifestyle and COVID-19 disease severity; a cross-sectional study. *Journal of Public Health (Germany)*, 31(2), 267–275. <https://doi.org/10.1007/s10389-020-01468-9>
- Tedeschi, R. G., & Calhoun, L. G. (1996). The Posttraumatic Growth Inventory: Measuring the Positive Legacy of Ikauma. *Journal of Traumatic Stress*, 9(3), 455–471. <https://doi.org/10.1007/BF02103658>
- Tedeschi, R. G., & Calhoun, L. G. (2004). Psychological Inquiry Posttraumatic Growth: A Developmental Perspective. *Psychological Inquiry*, 15(1), 1–18. <https://doi.org/10.1207/s15327965pli1501>
- Thiyagarajan, A., James, T. G., & Marzo, R. R. (2022). Psychometric properties of the 21-item Depression, Anxiety, and Stress Scale (DASS-21) among Malaysians during COVID-19: a methodological study. *Humanities and Social Sciences Communications*, 9(1), 1–8. <https://doi.org/10.1057/s41599-022-01229-x>
- Tolin, D. F., & Foa, E. B. (2006). Sex differences in trauma and posttraumatic stress disorder: A quantitative review of 25 years of research. *Psychological Bulletin*, 132(6), 959–992. <https://doi.org/10.1037/0033-2909.132.6.959>
- Toraman, Ç., Karadağ, E., & Polat, M. (2022). Validity and reliability evidence for the scale of distance education satisfaction of medical students based on item response theory (IRT). *BMC Medical Education*, 22(1), 1–13. <https://doi.org/10.1186/s12909-022-03153-9>
- Turliuc, M. N., & Candel, O. S. (2022). The relationship between psychological capital and mental health during the Covid-19 pandemic: A longitudinal mediation model. *Journal of Health Psychology*, 27(8), 1913–1925. <https://doi.org/10.1177/13591053211012771>
- Ventura-León, J. (2019). Back to content-based validity. *Adicciones*, 1–3. <https://doi.org/10.20882/adicciones.1213>
- Veronese, G., Pepe, A., Massaiu, I., De Mol, A.-S., & Robbins, I. (2017). Posttraumatic growth is related to subjective well-being of aid workers exposed to cumulative trauma in Palestine. *Transcultural Psychiatry*, 54(3), 332–356. <https://doi.org/10.1177/1363461517706288>
- Vilca, L. W., Chávez, B. V., Fernández, Y. S., Caycho-Rodríguez, T., & White, M. (2022). Impact of the fear of catching COVID-19 on mental health in undergraduate students: A Predictive Model for anxiety, depression, and insomnia. *Current Psychology*, 1–8. <https://doi.org/10.1007/s12144-021-02542-5>

- Vindegaard, N., & Benros, M. E. (2020). COVID-19 pandemic and mental health consequences: Systematic review of the current evidence. *Brain, Behavior, and Immunity*, 89, 531–542. <https://doi.org/10.1016/j.bbi.2020.05.048>
- Vishnevsky, T., Cann, A., Calhoun, L. G., Tedeschi, R. G., & Demakis, G. J. (2010). Gender differences in self-reported posttraumatic growth: A meta-analysis. *Psychology of Women Quarterly*, 34(1), 110–120. <https://doi.org/10.1111/j.1471-6402.2009.01546.x>
- Wan Mohd Yunus, W. M. A., Badri, S. K. Z., Panatik, S. A., & Mukhtar, F. (2021). The Unprecedented Movement Control Order (Lockdown) and Factors Associated With the Negative Emotional Symptoms, Happiness, and Work-Life Balance of Malaysian University Students During the Coronavirus Disease (COVID-19) Pandemic. *Frontiers in Psychiatry*, 11, 566221. <https://doi.org/10.3389/fpsy.2020.566221>
- Wang, C., Pan, R., Wan, X., Tan, Y., Xu, L., Ho, C. S., & Ho, R. C. (2020). Immediate Psychological Responses and Associated Factors during the Initial Stage of the 2019 Coronavirus Disease (COVID-19) Epidemic among the General Population in China. *International Journal of Environmental Research and Public Health*, 17(5), 1729. <https://doi.org/10.3390/ijerph17051729>
- Weiss, T., & Berger, R. (2006). Reliability and validity of a Spanish version of the posttraumatic growth inventory. *Research on Social Work Practice*, 16(2), 191–199. <https://doi.org/10.1177/1049731505281374>
- Wells, C. S., & Hambleton, R. K. (2016). Model Fit with Residual Analyses. In W. J. van der Linden (Ed.), *Handbook of Item Response Theory*. <https://doi.org/10.1201/9781315119144>
- Wen, K., McGrath, M., Acarturk, C., Ilkkursun, Z., Fuhr, D. C., Sondorp, E., Cuijpers, P., Sijbrandij, M., & Roberts, B. (2020). Post-traumatic growth and its predictors among Syrian refugees in Istanbul: A mental health population survey. *Journal of Migration and Health*, 1–2(December), 100010. <https://doi.org/10.1016/j.jmh.2020.100010>
- Wilder-Smith, A., & Freedman, D. O. (2020). Isolation, quarantine, social distancing and community containment: Pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak. *Journal of Travel Medicine*, 27(2), 1–4. <https://doi.org/10.1093/jtm/taaa020>
- Wilson, B., Morris, B. A., & Chambers, S. (2014). A structural equation model of posttraumatic growth after prostate cancer. *Psycho-Oncology*, 23(11), 1212–1219. <https://doi.org/10.1002/pon.3546>
- Wolf, M. G., & McNeish, D. (2023). dynamic: An R Package for Deriving Dynamic Fit Index Cutoffs for Factor Analysis. *Multivariate Behavioral Research*. <https://doi.org/10.1080/00273171.2022.2163476>
- World Health Organization. (2023). WHO Coronavirus (COVID-19) Dashboard. <https://covid19.who.int/>
- World Medical Association. (2013). World Medical Association Declaration of Helsinki Ethical Principles for Medical Research Involving Human Subjects. *JAMA*, 310(20), 2191–2194. <https://doi.org/10.1001/jama.2013.281053>
- Yan, S., Yang, J., Ye, M., Chen, S., Xie, C., Huang, J., & Liu, H. (2021). Post-traumatic Growth and Related Influencing Factors in Discharged COVID-19 Patients: A Cross-Sectional Study. *Frontiers in Psychology*, 12, 658307. <https://doi.org/10.3389/fpsyg.2021.658307>
- Zanon, C., Hutz, C. S., Yoo, H., & Hambleton, R. K. (2016). An application of item response theory to psychological test development. *Psicologia: Reflexao e Critica*, 29(18). <https://doi.org/10.1186/s41155-016-0040-x>