Original

De Jong Gierveld Loneliness Scale: Validity, Reliability and Fairness in Peruvian Adults

Escala de Soledad De Jong Gierveld: Validez, Confiabilidad y Equidad en Adultos Peruanos

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ABSTRACT

Introduction: Loneliness, whether transient or long-lasting, is one of the mental health issues with significant public impact and distinctive characteristics. However, it has not been adequately addressed, in part due to the lack of specialized instruments for certain populations. Although the De Jong Gierveld Loneliness Scale (DJGLS), based on Weiss's multidimensional model, has been adapted to different contexts, its use in Peru remains limited.

Objective: To establish the psychometric properties of the De Jong Gierveld

Loneliness Scale (DJGLS) in Peruvian adults, evaluating its internal structure, reliability, and validity in this population

Methods: An online survey of 1248 Peruvians (ages 18-70, M= 27.4, SD= 11.3) from almost all regions. This instrument was analysed for its internal structure validity, validity in relation to another variable, measurement invariance and internal consistency reliability.

Results: Values were obtained that support the validity of the internal structure, confirming the interrelation of the scale components and the factorability of the data matrix. Here we present a model of one general factor and two specific factors, which is coherent with theory and has execution in the required context, evidencing acceptable reliability values and invariance between sexes.

Conclusions: Adequate psychometric properties, which allow for a better data collection process in further related research, are revealed.

Keywords: loneliness; validity; reliability; fairness; adults.

RESUMEN

Introducción: La soledad, transitoria o duradera, constituye uno de los problemas de salud mental de gran impacto público y con características peculiares. Sin embargo, esta variable no ha sido abordada oportunamente, entre otras razones, por la escasez de instrumentos específicos para determinadas poblaciones. Aunque la Escala de Soledad de De Jong Gierveld (DJGLS), basada en el modelo multidimensional de Weiss, ha sido adaptada a distintos contextos, en Perú aún es limitada.

Objetivo: Determinar las propiedades psicométricas de la Escala de Soledad de De

Jong Gierveld (DJGLS) en adultos peruanos, evaluando su estructura interna, confiabilidad y validez en esta población.

Métodos: Se aplicó una encuesta en línea a 1248 peruanos (edades de 18 a 70 años, M=27.4, DE=11.3) de casi todas las regiones del país. Se analizó la validez de la estructura interna, la validez en relación con otra variable, la invariancia de la medición y la confiabilidad de consistencia interna.

Resultados: Se obtuvieron valores que respaldan la validez de la estructura interna, confirmando la interrelación de los componentes de la escala y la factorización de la matriz de datos. Se presenta un modelo de un factor general y dos factores específicos, coherente con la teoría y aplicable en el contexto requerido, evidenciando valores de confiabilidad aceptables e invariancia entre sexos.

Conclusiones: Se demuestran propiedades psicométricas adecuadas, que permitirán un mejor proceso de recolección de datos en futuras investigaciones relacionadas.

Palabras clave: soledad; validez; confiabilidad; equidad; adultos.

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Introduction

The World Health Organization (WHO) highlights the need to take responsibility in

the political and public health spheres for social isolation and loneliness, especially among older adults, which was aggravated by the COVID-19 pandemic. It also proposes actions to reduce its consequences. [1] Regarding the impact of the pandemic, in a National Poll on Healthy Aging (NPHA, January 2023) from the University of Michigan, USA, subjects aged 50-80 years were asked about loneliness (related to feelings of isolation and lack of companionship) and their social interactions. The NPHA compared reports from 2018 and 2020 (26% reaching 56%) with those from 2021 and 2022 (56% dropping to 34%). It currently remains a public health problem. [2]

Worldwide, several studies point to loneliness as a mental health problem of great public relevance. People experience the feeling of loneliness in a transitory or lasting way, perhaps to think about themselves. Also, it is usually defined as a subjective and unpleasant experience, consequence of a feeling of deficit in social relationships. [3],[4] being experienced with distress and avoidance by most. [5] It is also considered as a cognitive and affective reaction to the loss of social relationships. [6]

From these definitions, three common characteristics can be recognized:

1. It results from the inadequate management of interpersonal relationships.
2. It is experienced subjectively regardless of physical distance.
3. It carries a stressful and unpleasant burden.

In the present day, as we face a context so different from what we once knew and observe the various emotional reactions of individuals, we can identify that many have experienced this silent disorder known as anxiety. This is a very recurrent topic in research since the traits they show are visible in society. The factors associated with loneliness, particularly in older adults, are varied: living without a

companion, loss of a spouse, children leaving home, death of their children, retirement, deterioration of health either physical or mental, and depression, which can be a cause or effect of loneliness.

Therefore, it is necessary and essential to provide specialists with an updated and reliable instrument to obtain rigorous results, which will facilitate optimal screening of the levels of loneliness in Peruvian adults. Several instruments were found to measure this variable; however, the DJGLS has been frequently used. Therefore, since this instrument would be of great help in exploring loneliness, the following question was formulated: What are the psychometric properties of the DJGLS in Peruvian adults?

The proposed topic is pertinent since it is within the parameters of mental health sciences, being a key point in behavioral manifestations. In the scenario of the problematic reality, it is mainly focused on determining the psychometric properties of this scale. The topic is relevant because it focuses on an adult population between 18 and 70 years old, which in Peru represents the age group with the right to vote who lead the way to the country's development. In turn, it is significant because it focuses interest on one of the most important topics such as loneliness that can occur chronically in Peruvian adults associated with various life circumstances, and which will help shed light on possible indicators that alert us to levels of loneliness in the Peruvian population. In this context, the objective of the study was to establish the psychometric properties of the De Jong Gierveld Loneliness Scale (DJGLS) in Peruvian adults, evaluating its internal structure, reliability, and validity in this population.

Literature Review

Research developed in Mexico analyzed the Spanish version of the 11-item DJGLS in older adults. Using EFA and CFA, a two-factor structure was found that explained 67.2% of the total variance. It presented high reliability (α = 0.899), indicating that it is suitable for use in this population. [7] Also in Mexico, they identified the internal structure of the ESTE loneliness scale, constructed in Spain for older adults. [8] Hosseinabadi et al., validated a Persian version of the 11-item DJGLS. The CFA results confirmed two factors and an acceptable reliability. [9] Reinwarth et al. presented the validation of a single-item instrument ("I often feel lonely/have few contacts") in representative German populations (N = 4,984) conducted in 2020. Construct validity was supported by associations with other variables (depression, anxiety, life satisfaction, household size and partner). [10] Likewise, Zeinalhajlou et al. in Iran analyzed the Persian version of the perceived social disconnection and isolation scales in Iranian older adults, found acceptable reliability and validity for use in this population. [11] Chemisquy et al., in Argentina, also provided psychometric evidence of the DJGLS in 307 university students (18 and 54 years old). The factor loadings and internal consistency of the items were optimal. [12] Finally, De Holanda Coelho, in Brazil, adapted the reduced version of the DJGLS for this context in 939 subjects, where exploratory and confirmatory analyses were performed, obtaining fit, as well as reliability by internal consistency. The presence of adequate psychometric properties for its application in the aforementioned country was concluded. [13]

García, in Lima Norte, analyzed the DJGLS in which 362 people of both sexes participated. Content validity was found, the items were described and then the CFA, obtaining adequate scores. [14] Also, in Lima Metropolitana, they analyzed this Scale in 509 people (371 men and 138 women), and performed EFA and CFA, with a better fit of the bifactorial model. In addition, appropriate internal consistency (α = .80), evidencing suitability for its application. [15] In Lima Metropolitana and

Callao, the Social and Emotional Loneliness Scale in its reduced version (SELSA-S) was analyzed in adults (n=391), obtaining evidence of content validity. Likewise, with the EFA they demonstrated a latent factor structure of two dimensions. To assess validity in relation to other variables, the DJGLS and the Psychological Well-Being Scale were used, and acceptable internal consistency reliability was obtained. Finally, the corresponding percentile scales were developed.

Loneliness is conceptualized from a philosophical, social, anthropological and psychological approach. From the psychological point of view, loneliness is seen as a voluntary lack of companionship, where the person decides to continue, either working or living away from others, where it is the other people who move away. [6] It is also considered subjective, since the person may feel lonely even when accompanied. Moreover, loneliness is in essence multidimensional, encompassing elements of personality, social interaction and behavioral skills. It is considered subjective, since it is based on perception according to the context. It can be seen as a harmful experience or as an occasion for self-knowledge, and, additionally, it is sequential, since it involves a process, as it presents, in addition to previous experiences, manifestations and consequences, which will be modified in their magnitude and durability. [16]

Methods

Participants

The DJGLS was analyzed in 1248 Peruvian adults. This study used the online survey technique and subjects were selected through non-probabilistic convenience sampling, who were asked to respond via social networks. The online survey was open for two months (November 4 to December 30, 2023). The corresponding inclusion and exclusion criteria were considered, as adults within

the specified age range, residing in Peruvian territory, who accepted the informed consent and completed the instruments through the Google form. After collecting the responses, the final number of participants reached a total of 1,277. However, after data cleaning, 29 subjects were eliminated (14 responded inconsistently regarding employment status and marital status not compatible with their age, 5 indicated that they were from another country and 10 gave incomplete responses). In the final sample, people between 18-30 years of age (40% men and 30% women) and residence in the department of Lima (40.1% men and 36.5% women) stood out.

Measurement

The online self-administered survey technique was used, which was applied through a written questionnaire and distributed by WhatsApp, email and Facebook. The DJGLS and Theo van Tilburg (1999) [4] come from Amsterdam, the Netherlands; its administration can be individual or collective, whose duration is between 10 to 15 minutes, composed of 2 dimensions and 11 adult items. Buz and Prieto Adánez (2013) adapted and translated it into Spanish. [17] Subsequently, it was adapted to Peru and applied to youth and adults. [15] In turn, it was adapted for Lima Norte, Peru. [14] The DJGLS covers two dimensions: social loneliness (items: 1, 4, 7, 8 and 11) and emotional loneliness (items: 2, 3, 5, 6, 9 and 10). [17]

Scoring and interpretation. Consisting of 11 questions, with three alternatives: 1=no, 2=more or less and 3=yes. It is scored in a dichotomized manner, assigning one point to the more or less or no answer options (inverse items: 1, 4, 7, 8 and 11), and in the case of the direct items, one point is assigned if the answer is “more or less” or “yes”. Then, adding the values of all items, the total score is reached, which ranges from 0 (absent loneliness) to 11 (maximum loneliness). [3]

Original psychometric properties. They reported high reliability (α = .80 to .90) and homogeneity = .3 and .5, sufficient but not very strong. In addition, they revealed unidimensionality of the test. However, the researcher is free to work with one or two factors.

Psychometric properties for Peru. The factor analysis was performed, finding two factors, where 61.846% of the total variance is explained, which is acceptable. On the other hand, it did not show the requirement of normal distribution (Shapiro-Wilk = .93 with a $p < .05$).

Divergent validity was obtained with the variable self-esteem ($p<.01$). In reliability, high values were obtained in the total scale (α = .864), social loneliness dimension (α = .776) and emotional loneliness dimension (α = .899).

Procedure

The study was conducted after obtaining the necessary permission from the instrument's author to measure the variable according to the established objectives. Subsequently, the online survey was administered using the Google Forms application, which included informed consent, the sociodemographic data sheet, and the measurement scale. The link to the form was distributed to participants according to the established inclusion criteria.

The survey was administered through social media platforms, including WhatsApp, Facebook, and email. During this process, obtaining explicit consent from participants for voluntary participation was prioritized, while ensuring anonymity and privacy. Finally, responses from participants who did not meet the required sample profile were excluded, allowing for bias-free statistical analyses.

Ethical Aspects

Based on the Declaration of Helsinki, [18] referring to medical research on human beings, the subject's health was the primary concern (avoiding putting their health at risk), while guaranteeing and promoting respect for their dignity and rights. The protocol was approved by the Research Ethics Committee of the Universidad Cesar Vallejo (Opinion 336-CEI-EPM-UCV-2023) on December 4, 2023, which is based on the principles of responsible ethical conduct, and, specifically, on art 09 of the UCV Code of Ethics, which considers plagiarism as a serious offense [19] the research could then be executed. Participation in the questionnaire was voluntary, based on informed consent, in line with the principles endorsed by the APA. Likewise, peruvian psychologist's code of ethics was complied with in chapter three, which mentions that people must give their answers with prior approval. As a result, participants were made aware that their data would be anonymous and how it would be used.

Statistical Analysis

First, a prior analysis of the items was done, with statistical coefficients such as AM, SD, g^1, g2, IHC, h^2. In addition, the tetrachoric correlation matrix (r = [.30; .90]) was recorded [20] which are presented in table 1.

Second, the CFA using the Lavaan package. The input was the tetrachoric correlation matrix, given that the data did not correspond to continuous numerical variables with a normal distribution fit. Also, the robust WLSMV estimator of weighted least squares with mean and variance adjustment was applied, due to the binary nature of the values in the responses. [21] Likewise, different factorial structures were tested. [22] Different fit indices were used to test the models, among these: $\chi 2$, $p < .05$; CFI ≥ .94, TLI ≥ .94, SRMR ≤ .08, RMSEA ≤ .07 and RMSEA

Confidence Intervals (Li ≤ .05 and Ls ≤ .10). Also, because the χ2 presents sensitivity to sample size, χ2/gl ≤ 5 was analyzed which can be seen in table 2.

In addition, from these bifactor models, specific indices were examined through the EFA tools package. The combination of the magnitudes of the hierarchical omega coefficient for the overall factor ($\omega_H > .70$) [23] for the specific factors ($\omega_{hs} \geq .30$), [24] of the construct replicability coefficient (H > .90), [25] of the Explained Common Variance (ECV > .60), and of the Percentage of uncontaminated correlations (PUC < .80). [23] Finally, the percentage of variance of the factors (ω_H^2, ω_{hs}^2) was calculated as evidence of the instrument's explanatory power.

Third, the internal consistency reliability was examined with ω for multidimensional scales, [26] recommendable for congeneric measures and magnitudes ≥ .80 were selected as the standard cut-off point.

Fourth, the indicators of factorial equivalence were calculated according to sex, using the sem Tools package. Four sequential levels of invariance were selected: a) unrestricted (configural), b) factor loadings (metric), c) loadings and intercepts (strong), and d) loadings, intercepts and residuals (strict), considering changes (Δ) in CFI ≤ .010, RMSEA ≤ .015 and SRMR ≤ .030 [27] to decide on interpretability of items by examinees, and equivalence of scores obtained on the test, without considering membership groups. [28]

Finally, validity values were analyzed in relation to other variables (Table 5) and their 95% confidence intervals (95% CI), which indicate a plausible range of population correlations where the study sample is located.

Results

Table 1 shows that all items meet the previously established parameters, which facilitates the reduction of the data matrix to a more limited number of latent factors: the Corrected Homogeneity Index (CHI ≥ .30) and the communalities (h^2 ≥ .40). Likewise, the matrix of tetrachoric correlations presents absence of multicollinearity (|r| < .90). However, the inter-item relationships are strong enough to consider the presence of a latent variable (|r| > .30). Regarding the distribution, the asymmetry (g^1) and kurtosis (g^2) values were found to be between ±1.5, so that the Gaussian curve is moderately symmetrical and pointed.

Table 1. Preliminary Statistical Analysis of Items on the Loneliness Scale (n=1248)

Factors	Ítems	AM	SD	g^1	g^2	CHI	h^2	|r|									
								1	4	7	8	11	2	3	5	6	9
F1	1	0.53	0.50	-0.10	-1.99	.62	.41	1	—	—	—	—	—	—	—	—	—
	4	0.54	0.50	-0.15	-1.98	.82	.73	.70	1	—	—	—	—	—	—	—	—
	7	0.73	0.44	-1.05	-0.89	.83	.80	.49	.70	1	—	—	—	—	—	—	—
	8	0.72	0.45	-0.96	-1.07	.82	.77	.47	.69	.93	1	—	—	—	—	—	—
	11	0.57	0.50	-0.28	-1.93	.80	.71	.57	.74	.72	.72	1	—	—	—	—	—
F2	2	0.63	0.48	-0.54	-1.71	.75	.62	.45	.44	.40	.36	.55	1	—	—	—	—
	3	0.55	0.50	-0.21	-1.96	.79	.69	.51	.59	.42	.42	.50	.68	1	—	—	—
	5	0.70	0.46	-0.87	-1.24	.79	.70	.30	.35	.26	.24	.33	.66	.67	1	—	—
	6	0.53	0.50	-0.12	-1.99	.69	.52	.36	.52	.50	.47	.56	.62	.56	.55	1	—
	9	0.60	0.49	-0.41	-1.84	.80	.71	.32	.38	.27	.25	.39	.66	.63	.84	.61	1

	10	0.49	0.50	0.03	-2.00	.80	.70	.53	.59	.45	.45	.55	.61	.82	.64	.65	.66

Note. AM = Arithmetic Mean; SD = Standard Deviation; g^1 = Skewness; g^2 = Kurtosis; CHI = Corrected Homogeneity Index; h^2 = Communality; |r| = Correlation

Once the metric quality of the 11 items had been verified, the internal structure was analyzed. Along these lines, Table 2 and Figure 1, different measurement models consistent with previous studies were tested through the application of successive confirmatory factor analyses. First, a unidimensional model was considered. However, this reported a poor fit, indicating that loneliness is a more complex, non-simplifiable construct that cannot be reduced to a single indicator. Second, an uncorrelated two-factor model was tested (|r| = .00). Despite this, the fit was even lower than the previous one, implying that the indicators of loneliness are not interpretable as independent of each other, but, on the contrary, are related. In other words, different types of loneliness may be interrelated in the human experience, and cannot be considered completely separate. Third, a two-factor correlated model was tested. It showed better fit with respect to the previous ones, so loneliness is composed of emotional and social indicators that interact and influence each other. However, this model fails to fit the RMSEA and SRMR, so there is a mean discrepancy between the observed covariance matrix and the expected covariance matrix for the model, which may suggest that there are certain inter-item correlations that the model is not capturing accurately. Fourth, a model with control for the method effect, associated with inverse item wording for the social loneliness dimension, was tested, but it did not converge, which seems to indicate that this specification does not make theoretical or practical sense in relation to the data inserted for the analysis. Fifth, a second-order reflective model was tested, but the RMSEA and SRMR values indicate that loneliness cannot necessarily be explained by a hierarchical structure of two first-order factors and one second-order factor. Finally, a bifactor model was tested, hypothesizing the

existence of a "general dimension" of loneliness that influences the experiences of emotional and social loneliness. This model showed the best fit to the data.

Table 2. Fit Indices of the Loneliness Scale (n=1248)

Models	χ^2	df	χ/df	CFI	TLI	RMSEA [90% CI]	SRMR	WRMR
Unidimensional	1388.94	44	31.567	.894	.868	.157 [.150; .164]	.169	4.525
Uncorrelated Factors	2656.687	44	6.379	.795	.743	.218 [.211; .225]	.298	7.971
Correlated Factors	596.564	43	13.874	.956	.944	.102 [.094; .109]	.095	2.707
Second Order	521.305	44	11.848	.962	.953	.093 [.086; .101]	.104	3.049
Bifactor	147.583	33	4.472	.991	.985	.053 [.044; .062]	.035	1.054

Note. χ^2 = chi-square ratio; df = degrees of freedom; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual; WRMR = Weighted Root Mean Square Residual.

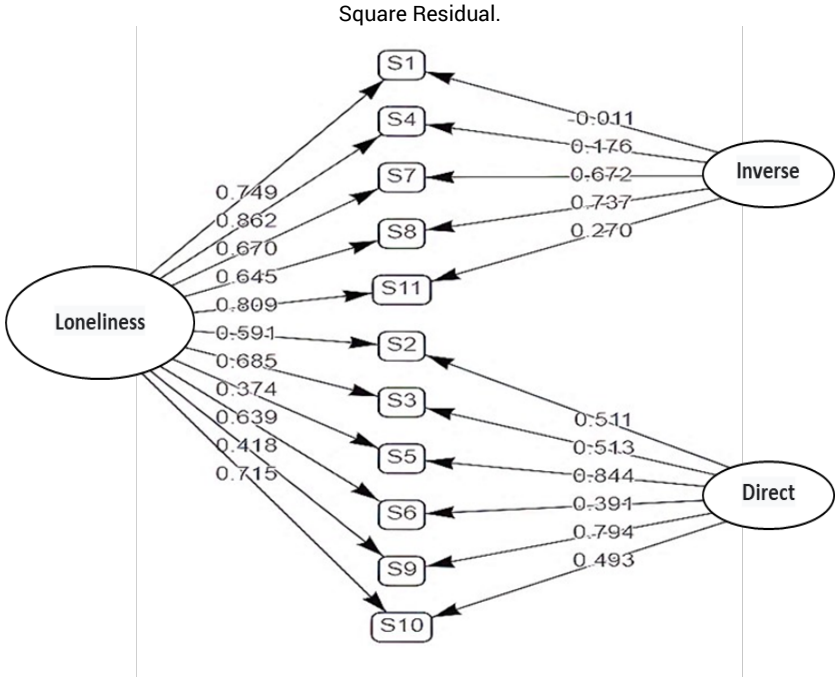

Fig. 1. Path Diagram of the Bifactor Model.

Additionally, Table 3 presents the specific indices for the bifactor models. The magnitude of the hierarchical ω coefficient for the specific factors (ωhs ≥ .30) and their values of the explained common variance (ECV <.50) do not allow interpreting the emotional loneliness and social loneliness scores as clearly defined and independent dimensions. In contrast, the magnitude of the hierarchical omega coefficient for the overall factor (ω_H > .70), the value of its common variance

explained (ECV > .60), the Percentage of Uncontaminated Correlations (PUC < .80), and the construct replicability coefficient (H > .90) are evidence in favor of unidimensionality. Likewise, this underlying structure has an explanatory capacity of 53.58% of the variance. Finally, these data for the loneliness variable, considering this bifactor model, are highly reliable (ω ≥ .80). This means that obtaining a global score for the Loneliness Scale is empirically justified.

Table 3. Factorial loadings and specific indices of the bifactor model

Items	General	Inverses	Directs
1. There is always someone you can talk to about your daily problems.	.75 [.69; .81]	-.01 [-.13; .11]	—
4. There are enough people you can turn to in case of need.	.86 [.52; .66]	.176 [.07; .29]	—
7. You have many people you can completely trust.	.67 [.62; .75]	.672 [.55; .80]	—
8. There are enough people with whom you have a very close friendship.	.65 [.81; .91]	.737 [.61; .87]	—
11. You can always count on your friends when you need them.	.81 [.29; .46]	.270 [.17; .37]	—
2. You miss having a really good friend.	.59 [.57; .70]	—	.51 [.44; .59]
3. You feel a sense of emptiness around you.	.69 [.58; .76]	—	.51 [.44; .59]
5. You miss the company of other people.	.37 [.56; .73]	—	.84 [.78; .91]
6. You think your circle of friends is too limited.	.64 [.34; .50]	—	.39 [.31; .47]
9. You miss having people around you.	.42 [.66; .77]	—	.79 [.74; .85]
10. You often feel abandoned.	.72 [.76; .86]	—	.49 [.42; .57]
Omega coefficient (ω)	.961	.942	.935
Hierarchical omega coefficient (ωH)	.732	.185	.484
Replicability coefficient H	.918	.680	.843
Explained common variance (ECV)	.592	.280	.524
Percentage of uncontaminated correlations (PUC)	.545		

Note. All standardized factor loadings of the items are statistically significant (p < .001) except for item 1. [...] = 90% confidence intervals of the standardized factor loadings.

Factorial equivalence

The results of the factorial invariance analysis based on sex are presented (Table 4). The magnitudes of the variations (Δ) in the CFI (<.010), the RMSEA (<.015) and the SRMR (≤ .030) are minimal, except for the RMSEA at the metric level, which shows some distance from what is recommended in the literature, which could represent that both men and women tend to interpret the construct slightly differently. In spite of everything, the sum of the evidence as a whole is in favor of factorial equivalence. Therefore, the scores obtained in the DJGLS are attributable to the presence of the variable loneliness, which allows measuring loneliness in the Peruvian adult population without bias, regardless of sex.

Table 4. Measurement Invariance by Gender (n men=653 [52.3%], n women=595 [47.7%])

Levels	χ^2	$\Delta\chi^2$	df	Δdf	CFI	ΔCFI	RMSEA	ΔRMSEA	SRMR	ΔSRMR
Configural	185.646	—	66	—	.991	—	.054	—	.041	—
Metric	15.186	35.460	85	19	.995	.004	.035	.019	.045	.004
Strong	187.345	37.159	82	3	.992	.003	.045	.010	.043	.001
Strict	187.345	.000	82	0	.992	.000	.045	.000	.043	.000

Note. X^2 = chi-square ratio; $\Delta\chi^2$ = magnitude of chi-square ratio variations; Δdf = magnitude of variations in degrees of freedom; ΔCFI = magnitude of variations in CFI; ΔRMSEA = magnitude of variations in RMSEA; ΔSRMR = magnitude of variations in SRMR.

Nomological validity

Finally, the validity of the DJGLS in relation to other variables was assessed using Pearson's correlation coefficient, as detailed in Table 5. On the one hand, a direct and median relationship ($r = .39$, $p < .001$) was found between loneliness and death anxiety. On the other hand, a positive and median relationship ($r = .35$, $p < .001$) was found between loneliness and suicidal ideation. The results demonstrate convergent validity, since these constructs maintain coherent relationships with their nomological network.

Table 5. Validity Based on the Relationship with Other Variables of the Loneliness Scale through Pearson's correlation coefficient [r] (n=1248)

Variable	M	SD	1	2
1. Loneliness	6.59	3.42	—	—
2. Death Anxiety	25.83	6.93	.36**	—
			[.31, .41]	
3. Suicidal Ideation	7.66	3.98	.35**	.34**
			[.30, .40]	[.29, .39]

Note. M = Mean; SD = Standard Deviation. Values in brackets indicate the 95% confidence interval for each correlation. ** indicates p < .01.

Discussion

The reliability and validity of the DJGLS were determined, showing acceptable values and being possible to use it in the Peruvian context. According to the internal structure and factorial invariance, the main findings of the study evidenced adequate adjustment of the scale measures [22] corresponding to a bifactor model with the WLSMV method, superior to the alternatives of unidimensionality, related, unrelated and second-order factors (X^2 = 147. 583, gl: 33, CFI = .991, TLI = .985, RMSEA = .053, SRMR = .035, WRMR = 1.054), with factor loadings ranging from .42 to .81 for the general factor, from -.01 to .73 for inverse items and from .39 to .84 for direct items. The Results indicate factorial invariance metrics evidenced by gender (52.3% male and 47.7% female).

In addition, as evidence of nomological validity, relationships were detected with other variables such as suicidal ideation (r = .35, p < .01) and anxiety about death (r = .36, p < .01). In the same sense, the reliability measure of the ω = .961, for the factor with inverse items .942 and for direct items .935. Such evidence is consistent with that reported by Giraldo-Rodríguez and collaborators who demonstrated the adequate functioning of the scale in the population of older adults. [7]

A high level of reliability was found for internal consistency, as it exceeds the value of .80. These results are similar (α = .89) to those reported in another study [7] For their part, Ventura and Caycho also found acceptable reliability values (α = .80). [15]

Regarding construct validity with the CFA, based on the matrix of tetrachoric correlation, different factorial structures were tested, being the bifactor model (hypothesizing the existence of a "general dimension" of loneliness), which influences the experiences of emotional and social loneliness, obtaining better results in the indexes analyzed. [29] This evidences that the studied scale is constituted by two dimensions. This underlying structure has an explanatory capacity of 53.58% of the variance. The evidence supports the adequacy of the Loneliness Model with a general factor, and the presence of the social and emotional loneliness dimensions. [17]

Other studies found similar results, such as Giraldo-Rodríguez and collaborators who found adequate values of fit through the CFA and the items interpret 67.2% of the total variance. [7] Ventura-León and Caycho conducted a similar analysis with CFA, and found that the bifactor model has better fit values, and would be the most appropriate model for this instrument. [15] Likewise, several researchers, using the CFA, showed that the Jong Gierverld Loneliness Scale presents acceptable values, which demonstrate adequate construct validity. [9],[12],[14]

Convergent validity was found, which indicates a plausible range of correlations, and it was identified that the dimensions that constitute the evaluated scale correlate with each other significantly, since these constructs maintain coherent relationships with their nomological network. In this regard, this type of validity is important because it allows to see the existing interrelationship between the constructs of a scale, showing coherence among themselves.

The results demonstrate adequate psychometric properties of the DJGLS, which agreed with the results of Hosseinabadi et al. who, in addition to evaluating psychometric properties with the CFA, after a process of translation and

retranslation, managed to demonstrate its concurrent validity. [9] The convergence of loneliness measures with other scales is a property that is maintained in other studies. In this research it is related to measures of death anxiety and suicidal ideation in a group of older adults.

To assess evidence of fairness, a factorial invariance analysis by sex was conducted. The results indicated that the measurement levels are consistent regardless of sex, suggesting that the scores accurately reflect the loneliness variable without sex-related biases among participants in the Peruvian adult population. Additionally, factorial invariance by sex enhances the generalizability of the findings, indicating that the measure of loneliness is equally valid and consistent for both sexes. This evidence supports the applicability of the bifactor model across diverse populations and underscores its utility in research aimed at understanding loneliness in specific contexts.

The adaptation of the scale has transcended language barriers, and adequate behavior of the measures has been demonstrated with the Brazilian translation, [13] as well as in the Middle East. To this evidence we can add the contribution of Chemisquy et al., regarding the Argentine dialect variants of the scale, who studied the performance of the DJGLS in university students aged 18 to 54 years, using the CFA. [12] Thus, the evidence of validity by internal structure was solid, as was the reliability by internal consistency in samples different from that of the study. The DJGLS measures may be useful for assessing the degree of loneliness in populations with differential age and sex characteristic groups, considering also the evidence of invariance of the confirmatory model supported in this research.

Other evidence on the validity, reliability, conformation of a bifactor model with adequate fit metrics and acceptable internal consistency measures of the

instrument studied have been found in studies conducted in Lima Metropolitana. [8],[14] Likewise, the results are similar to those reported by González-Tovar and Garza-Sánchez, who were able to identify the structure of the ESTE Scale to measure loneliness in older adults, with a higher proportion of women (55.8%) in the sample of their study. [8] In addition to the scales that measure loneliness, consistent results are consistent with the single-item measure. [10] According to the evidence found, the Loneliness Scale is suitable for its application in a Peruvian context, as it is a valid and reliable test, which was also reported in previous studies. [7]–[12],[14],[15]

Theoretical and practical implications

The results of this study have significant theoretical implications for the conceptual framework of loneliness, which can be analyzed from various philosophical, social, anthropological, and psychological perspectives. The adoption of a bifactor model to assess loneliness offers a valuable contribution to the understanding of this complex emotional experience. From a philosophical perspective, loneliness is conceived as a voluntary lack of companionship, and the choice to withdraw from others may be motivated by work or lifestyle factors. This aspect is reflected in the bifactor model, which captures the variability in experiences of loneliness, either by choice or by distance imposed by others. In addition, the subjectivity of loneliness, described by Cuny as the ability to feel lonely, even when accompanied, is supported by the diversity of factor loadings and the range of experiences contemplated in the model. [6]

From the social and anthropological perspective, loneliness is seen as a multidimensional phenomenon that encompasses elements of personality, social interaction and behavioral skills. [16] The bifactorial structure of the model reflects

this multidimensionality, allowing a more complete assessment of loneliness in its various facets. The consideration of loneliness as an experience that can be perceived as harmful or as an opportunity for self-awareness is also aligned with the sequential nature of the model, which incorporates both previous experiences as well as manifestations and consequences that are modifiable in magnitude and durability.

The transcendence in practice of the study is, on the one hand, to use the instrument in the clinical setting for the identification and understanding of risk factors associated with the unpleasant experience that older adults experience in the deficit of interpersonal relationships. [30] On the other hand, it can be applied to screen and propose intervention programs to address social isolation and loneliness in older adults. [1] The implementation of specific actions proposed by the WHO is required to reduce the consequences of loneliness and to recognize that despite the post-pandemic decrease, it continues to be a current problem [2] and of international impact, transient or long-lasting.

Strengths and limitations

The main strength of the study lies in the fact that the DJGLS has been validated for the first time in a general Peruvian population. Additionally, a significant contribution is the confirmation of the bifactor model of the investigated instrument. However, the study has several limitations. First, a cross-sectional design was employed, which limits the ability to establish causal relationships. Second, although loneliness is a universal experience, the use of a non-probabilistic sampling method restricts the generalization of the findings to the broader population. Third, convenience sampling might introduce selection bias by including only individuals with access to social media. Finally, the study focused

exclusively on the general population and did not address clinical populations, which would represent a relevant alternative for future research.

Conclusion

The DJGLS is reported to have adequate psychometric properties in Peruvian adults. That is, this scale is valid, reliable and sensitive to discriminate loneliness from other factors. Likewise, we found data suggesting invariance between sexes in the non-clinical population. Therefore, this instrument is useful for self-report and screening of loneliness levels in the general population of Peruvian adults. The contribution of the study is valuable for planning mental health protection policies, and to be able to implement preventive and assistance programs that allow the timely detection of groups at greater risk and vulnerability, prone to develop psychological disorders associated with loneliness, which may affect overall health.

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Conflict of interest

The authors declare that there is no conflict of interest

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