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Analysis from the classical test theory and item response theory of the Satisfaction with Life Scale (SWLS) in an Ecuadorian and Colombian sample

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ABSTRACT

Verify the measurement equivalence by nationality (Colombia and Ecuador), internal consistency, and discrimination and difficulty from the Item Response Theory of the Satisfaction with Life Scale. Instrumental study based on Classical Test Theory (CTT) and Item Response Theory (IRT). 464 university students, 217 of Colombian (54.4% women, mean age = 20.9 years, SD = 3.4), and 250 Ecuadorian (60% women, mean age = 21 years, SD = 2.0). The SWLS presented a single-factor model for both the Colombian and Ecuadorian samples. In addition, the instrument presented measurement equivalence between countries at the metric level and has adequate internal consistency according to the CTT criteria. Finally, regarding the IRT criteria, the items present adequate discrimination and difficulty. The SWLS presents evidence of cross-cultural invariance in addition to having new properties based on the IRT that have not been fully investigated before.

KEYWORDS

Classical test theory; item response theory; measurement equivalence; satisfaction with life; reliability

Introduction

Satisfaction with life is one of the most studied and researched psychological attributes within the constructs of quality of life and well-being. Satisfaction with life encompasses a global assessment that any individual makes of all aspects of his or her life (Diener, 1995). This assessment requires a broad set of cognitive skills and the evaluation of many aspects of life to be performed (Bastian et al., 2014; Diener & Diener, 1995; Diener et al., 1999). That is why satisfaction with life constitutes a key cognitive component of subjective or “hedonic” well-being.

The relevance of satisfaction with life is evidenced in the abundant studies investigating its association with other related constructs, such as spirituality (Deb et al., 2020), optimism (Torres-Salazar et al., 2020), resilience (Cejudo et al., 2016), mental health (Moreta-Herrera et al., 2018), stress (Hawi & Samaha, 2017; KuangTsan & FuYuan, 2017), self-esteem (Muñoz & Alonso, 2015) and psychological well-being (Yáñez-Ramos & Moreta-Herrera,

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2020). In all these studies, satisfaction with life has been found to be associated with and even cause the other constructs. This highlights how important satisfaction with life can be to understand other related phenomena.

Psychometric properties of the SWLS

Many of the studies investigating satisfaction with life were carried out using the Satisfaction with Life Scale (SWLS, Diener et al., 1985) which allows the identification and evaluation of this construct. The SWLS is a five-item self-report questionnaire. Regarding the psychometric properties of the SWLS, various studies that have explored this scale, mainly on factorial validity, find a unidimensional structure. Studies investigating construct validity, have analyzed its association with other variables such as fatigue, quality of life, optimism, anxiety or pessimism. Analyses of its internal consistency have shown highly favorable results (between $\alpha = .80$ and $\alpha = .87$).

Studies exploring its psychometric properties have been conducted using different samples, including the general population, university students, adolescents, and children in countries such as Germany (Hinz et al., 2018), Turkey (Durak et al., 2010), Pakistan (Barki et al., 2020), Spain (Cabañero et al., 2004), and in Latin America: Mexico, Chile, Colombia and Ecuador (Alfaro et al., 2016; Arias & García, 2018; Bernal & Arocena, 2014; Castro et al., 2012; Padrós et al., 2015; Ruiz et al., 2019).

Several studies have evaluated measurement equivalence (ME) in different sample characteristics, such as gender, culture or nationality of origin. The objective of ME is to verify, through multi-group factor analyses, if the interpretation of the items from a group is similar to the interpretation given by another group. Thus, if differences are found when ME is met, these can be understood as a product of differences between groups and not in the interpretation each group gave to the scale (Asparouhov & Muthén, 2014; Byrne & van de Vijver, 2010; Jovanović & Brdar, 2018; Moreta-Herrera & Velástegui-Parra, 2020). This is a particularly relevant characteristic of a scale when comparisons between samples are performed since variations in the use of language or even slight issues in the translation process of the scale may lead to different interpretations of the items, and utterly, to a different construct being measured. This introduces an unexpected source of bias in the interpretation of the results (Elosua, 2012; Jang et al., 2017; Moreta-Herrera et al., 2021).

In the case of ME across nationalities of the SWLS, several studies have reported invariance between Germans, Russians, and Chinese (Bieda et al., 2017); Austrians, Bosnian-Herzegovians, Croats, Montenegrins and Serbs (Jovanović & Brdar, 2018); and across 26 countries (not including Ecuador or Colombia; Jang et al., 2017). In countries from Latin America, invariance has been found between Mexicans and Spaniards (Esnaola et al., 2017); Chileans and Ecuadorians (Schnettler et al., 2017), Mexicans, Argentines and Nicaraguans (Dimitrova & Domínguez Espinosa, 2015) and between Colombians and Spaniards (Ruiz et al., 2019). According to these results, it seems that items from the SWLS are interpreted very similarly across populations despite differences in social, economic and cultural characteristics.

However, this psychometric property appears not always to be present, given that there is also evidence of measurement variance between populations from different countries. For example, between Brazilians and Americans (Zanon et al., 2014) and between Chinese and Americans (Roster et al., 2006). Such differences would limit comparative and multi-group

research on satisfaction with life. In the case of the SWLS, no study has investigated measurement equivalence between samples from Ecuador and Colombia. Although both countries share the language, there are significant differences in culture and language use.

Complementarily, the psychometric evidence of the SLWS is mainly based on the postulates of the Classical Test Theory (CTT) where all items from a scale are understood to measure the underlying construct is the same degree, thus, providing an evaluation of the scale as a whole (Cappelleri & Hays, 2014). Although this provides a broad understanding of the instrument's performance, an analysis of each item's performance can provide significantly more information. Item Response Theory (IRT) allows such investigation, by analyzing the participants' performance on each item (Hays et al., 2000).

In this way, psychometric properties of the SWLS from the IRT such as (a) discrimination and (b) difficulty can be investigated as parameters (Pretorius & Padmanabhanunni, 2022; Sanmartín et al., 2016; Vittersø et al., 2005). Considering all this, it seems necessary to explore the properties of the SWLS in the Ecuadorian and Colombian population, not only from the CTT but also from the IRT in order to strengthen our understanding of this instrument's performance (Moreta-Herrera, Caycho-Rodríguez, et al., 2022).

Aims and hypotheses

The aims of the study are (a) to corroborate the ME of the SLWS between the Ecuadorian and Colombian populations, (b) to verify the internal consistency of the SWLS, and (c) to verify the difficulty and discrimination parameters of the SWLS items according to the IRT. We expect to find (H1) ME between countries, (H2) adequate internal consistency, and (H3) that the discrimination and difficulty parameters of the SWLS are adequate.

Method

Design

The present verifies the factorial structure of the SWLS, the ME between Colombian and Ecuadorian populations, its internal consistency and the parameters of difficulty and discrimination of the items.

Participants

The total sample consists of 464 participants from two countries. The Colombian sample includes 217 participants (45.6% men), with a mean age of 20.9 years ($SD = 3.4$), 80.6% of whom define themselves as mestizos and the remaining 19.4% as indigenous, white, Afro-Colombian, Raizal and others. Most participants lived in urban areas (96.3%) and the remaining were in rural areas. All participants were university students from 18 careers from four universities in Ibagué, Colombia, three of which were private universities and the remaining public.

The Ecuadorian group is conformed of 250 participants (40% men), with a mean age of 21 years ($SD = 2$), of which 97.2% self-identified as mestizo and the remaining 2.8% as indigenous, white and Afro-Ecuadorian. Eighty-eight per cent of the sample lived in urban areas and 12% in rural areas. Similar to the Colombian group, all participants are university

students from a public university (40%) and a semi-private university (60%) from Ambato, Ecuador. Participants were recruited from four different university degrees. The sample is non-probabilistic. All participation was voluntary (no compensation involved) and participants were required to sign a written acceptance after being briefed about the study and before completing the questionnaire.

Instruments

Satisfaction with Life Scale (SWLS; Diener et al., 1985), adapted and translated into Spanish by Cabañero et al. (2004). It is designed to evaluate the broad level of satisfaction in the life of a person. The questionnaire consists of five items and participants have to score the level they agree with each item on a 7-point Likert scale ranging from Strongly disagree (1) to Strongly agree (7).

Procedure

After obtaining institutional approval from the participating universities, the study was advertised among students. Those interested in participating were briefed about the aims of the study and were required to sign an informed consent form before completing the questionnaire. Results from the questionnaire were introduced into a database and analyzed. All procedures were carried out in accordance with the Declaration of Helsinki.

Analyses

The statistical treatment of the data comprises the following blocks of analysis. The first refers to the preliminary analysis segmented by group of the SWLS items (see Table 1) using descriptive information such as arithmetic mean (M) and standard deviation (SD). Likewise, an analysis of asymmetry (g_1) and kurtosis (g_2) was included to corroborate the assumption of univariate normality, which is fulfilled when scores are within the range ± 1.5 (Ferrando & Anguiano-Carrasco, 2010). The assumption of multivariate normality was also

Table 1. Descriptive statistics of the Satisfaction with Life Scale segmented by nationalities.

Item	Colombia				Ecuador			
	M	SD	g_1	g_2	M	SD	g_1	g_2
1. In most ways my life is close to my ideal [<i>En la mayoría de los aspectos, mi vida se acerca a mi ideal</i>]	5.1	1.3	-1.1	0.7	5.3	1.3	-1.1	1.1
2. The conditions of my life are excellent [<i>Las condiciones de mi vida son excelentes</i>]	5.5	1.2	-1.3	2.1	5.4	1.2	-0.9	0.4
3. I am satisfied with my life [<i>Estoy completamente satisfecho/a con mi vida</i>]	5.3	1.4	-1.0	0.4	5.6	1.2	-1.1	1.2
4. So far I have gotten the important things I want in life [<i>Hasta ahora, he conseguido las cosas más importantes que quiero en la vida</i>]	4.9	1.4	-0.7	-0.0	5.2	1.3	-0.6	0.1
5. If I could live my life over, I would change almost nothing [<i>Si pudiera vivir mi vida de nuevo, no cambiaría nada</i>]	4.2	1.9	-0.1	-1.3	4.8	1.8	-0.6	-0.7
Mardia			176.89***	6.01***			217.21***	14.88***

Note: *** $p < .001$; M = mean; SD = standard deviation; g_1 = skewness; g_2 = kurtosis.

verified through the Mardia test, where results are expected not to be significant ($p > .05$) (Cain et al., 2017).

The second block of analyses corresponds to independent confirmatory factor analyses with data from the two groups of participants in order to evaluate factorial validity (see Table 2). The confirmatory factor analysis was performed using the Robust Maximum Likelihood Estimation (RMLE) given the discrete nature of the items and the absence of multivariate normality (Holtmann et al., 2016). Model fit of factor analyses was evaluated using an absolute fit index (Chi-square [χ^2]), a relative fit index (Comparative Fit Index [CFI]) and a fit index not based on centrality (Root Mean Square of Approximation [RMSEA]). A good fit is considered when p in χ^2 does not reach significance ($p > .05$); the CFI is greater than 0.9; and the RMSEA is less than .08 (Brown, 2015; Byrne, 2006). Regarding the factor loadings, it is expected that these loads exceed .5 for an optimal fit of the model and a better explanation of the variance (Dominguez Lara et al., 2018; Moreta-Herrera, Dominguez Lara, et al., 2022).

Also a Multi-group Confirmatory Factorial Analysis (CFA-MG) with RMLE is performed to verify the ME of the SWLS, which is performed by comparing models of increasing levels of restriction: metric, scalar and residual uniqueness (Byrne & van de Vijver, 2010). ME is confirmed in the absence of significance ($p > .05$) in the $\Delta\chi^2$ (Asparouhov & Muthén, 2014) and $\Delta\text{CFI} < -.01$ and $\Delta\text{RMSEA} \geq .01$ (Chen, 2007) or if $\Delta\text{CFI} < -.002$ and $\Delta\text{RMSEA} \geq .007$ (Meade et al., 2008). In addition to the CFA-MG, internal consistency was analyzed by calculating the McDonald's omega coefficient (ω , McDonald, 1999) along with its confidence intervals. These analyses were performed both for the whole sample and each group of participants (Colombian and Ecuadorian).

Finally, the difficulty and discrimination parameters from the IRT are analyzed. For this, after verifying the assumption of unidimensionality and local independence, the Graded Response Model is used, which is an extension of the 2-Parameter Logistic Model for ordered polytomous items (Hambleton et al., 2010; Samejima, 1997). In IRT, items in a questionnaire are understood to vary in difficulty in relation to the participant's ability. Parameter a examines the slope in which the responses to the items change depending on the individual's skill level. Here, item values are expected to be greater than 1. Parameter b analyzes how the item behaves along the scale of ability, which is determined at the median probability point (50%) of the individual's ability to obtain a correct answer. Since responses on SWLS are based on a seven-item scale, there are six difficulty estimates (1 for each threshold). The information curves are analyzed, both for the scale, with the Test Information Curve (TIC) and the items, with the Item Information Curve (IIC).

Table 2. Factorial invariance analysis at different levels of restriction using robust estimations.

	χ^2 (DF)	CFI	RMSEA	$\Delta\chi^2$ (DF)	Δp	ΔCFI	ΔRMSEA
Baseline model - Colombia	14.5 (5)	.971	.09	-	-	-	-
Baseline model - Ecuador	9.5 (5)	.989	.07	-	-	-	-
Unrestricted	28.36 (10)	.978	.07	-	-	-	-
Metric	38.66 (14)	.974	.05	7.26 (4)	.122	.005	.005
Scalar	67.73 (18)	.940	.10	28.37 (4)	.001	.034	.024
Residual	69.98 (19)	.937	.09	19.70 (1)	.126	.002	.001

Note: χ^2 : Chi Cuadrado; df: Degrees of freedom; CFI: Comparative fit index; RMSEA: Root mean square of approximation; Δ : Difference.

Analyses were performed in R version 3.6.1. (R Core Team, 2019), using the Lavaan, MBESS, SemTools, ltm and MNV packages.

Results

Preliminary analysis

Table 1 shows descriptive statistics from SWLS items. These results indicate that the items appear to be homogeneous, fluctuating between 4.2 and 5.5 for Colombian participants and between 4.8 and 5.6 for Ecuadorians. The assumption of univariate normality is met, except for item 2 of the Colombian group in which the expected parameter for kurtosis is exceeded. In the case of multivariate normality, the assumption is not met, since the scores of the Mardia test for the groups by nationality are significant ($p < .05$).

Analysis of measurement invariance and internal consistency

Table 2 shows the fit indices from the CFA for a one-factor model, both for the Colombian and Ecuadorian samples. Both models (Ecuadorian and Colombian) show an adequate fit according to the absolute (χ^2) and relative (CFI) fit indices. In the case of the RMSEA, the Ecuadorian sample also shows an adequate fit, however, this is not the case for the Colombian sample, where the RMSEA is slightly higher than expected. Figure 1 depicts the model with factor loadings for both the Colombian (left) and Ecuadorian (right) groups. The magnitude of the loadings shows that all items are performing adequately. In the case of the Colombian sample, these range between .54 (item 5) and .9 (item 3), and for the Ecuadorian sample, between .55 (item 5) and .89 (item 3).

Concerning the ME analyses (see Table 2), only metric invariance was observed, since the difference between the fit indices (Δ) exceeded the tolerance points to confirm scalar

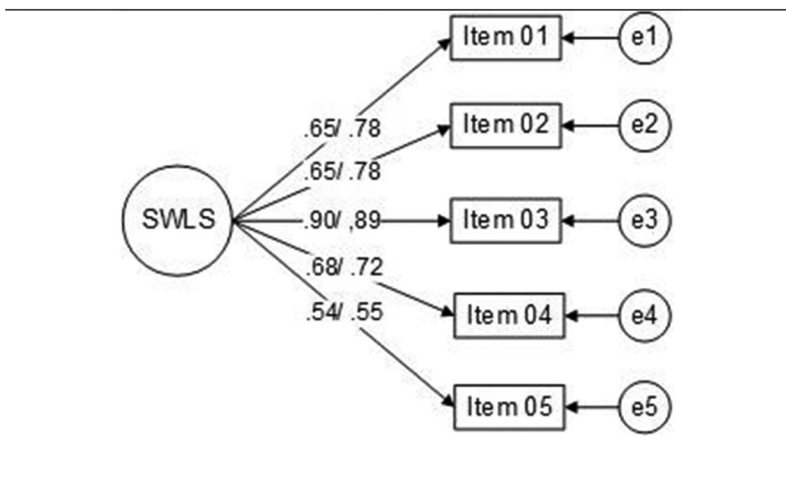


Figure 1. Structural model of the Satisfaction with Life Scale and factor loadings from the Colombian and Ecuadorian samples. Note: On the left, factor loadings from the Colombian sample and on the right from the Ecuadorian sample.

Table 3. Item difficulty and discrimination indices from the Satisfaction with Life Scale.

	a	b1	b2	b3	b4	b5	b6
Item 1	2.10	-2.97	-1.98	-1.60	-0.90	-0.04	1.68
Item 2	2.02	-3.35	-2.50	-1.92	-1.02	-0.29	1.29
Item 3	4.19	-2.65	-2.02	-1.45	-0.86	-0.35	0.92
Item 4	2.01	-3.00	-2.20	-1.47	-0.67	0.23	1.36
Item 5	1.34	-2.56	-1.42	-0.79	-0.27	0.42	1.61

Note: *a*: discrimination; *b*: difficulty.

invariance and residual uniqueness. ME of the SWLS only reaches metric invariance for the groups under analysis, since it seems that item 5 is not invariant since the scores of the intercepts differ significantly.

Regarding the internal consistency of the SWLS, the Colombian sample obtained an ω of .80, with a 95% confidence interval of 0.75–0.85. The Ecuadorian sample obtained an ω of .84, with a 95% confidence interval of 0.81–0.87. These results indicate that the reliability is acceptable for both groups.

Analyses of item discrimination and difficulty

Table 3 shows the psychometric properties of the SWLS based on the IRT. Concerning parameter *a*, in all cases these are above the cutoff point ($a > 1$), indicating an adequate level of discrimination. In the analysis of parameter *b*, as the thresholds (b1 to b6) increase the estimators rise monotonically, making the difficulty level also increase, so that for each response level a greater degree of skill is required to respond appropriately.

Figure 2 shows the Item Information Curves (IIC; panel a) and the Test Information Curve (TIC; panel b). From the IIC, it can be seen that item 3 (“I am satisfied with my life”) provides the most information about the latent variable, presenting a greater discriminatory capacity in comparison to the other items. The TIC reveals a good performance of the scale based on the abilities of individuals to measure the construct, especially between the ranges -2 and 1.

Discussion

The study aimed to identify ME between the Colombian and Ecuadorian populations in the SWLS, its internal consistency, and the parameters of discrimination and difficulty from the IRT. Descriptive analyses show that the scores of the SWLS items are homogeneous in terms of their distribution. In addition, they mostly exhibit univariate normality, but not multivariate normality, which motivated the use of robust estimations in the CFA, CFA-MG, and internal consistency to reduce measurement bias as much as possible (Holtmann et al., 2016). This is a relevant aspect to consider since most of the prior studies did not consider the lack of multivariate normality for the analyses (e.g., Arias & García, 2018; Barki et al., 2020; Dimitrova & Domínguez Espinosa, 2015).

In relation to its factor validity, the single-factor baseline model using RMLE presented an adequate adjustment (Brown, 2015; Byrne, 2006; Dominguez Lara et al., 2018; Holtmann et al., 2016) for both samples. These results are in line with prior studies reporting also a single-factor solution for the SWLS, both in non-Spanish-speaking countries (Barki et al., 2020; Hinz et al., 2018) and in Spanish-speaking countries (Arias & García, 2018; Castro

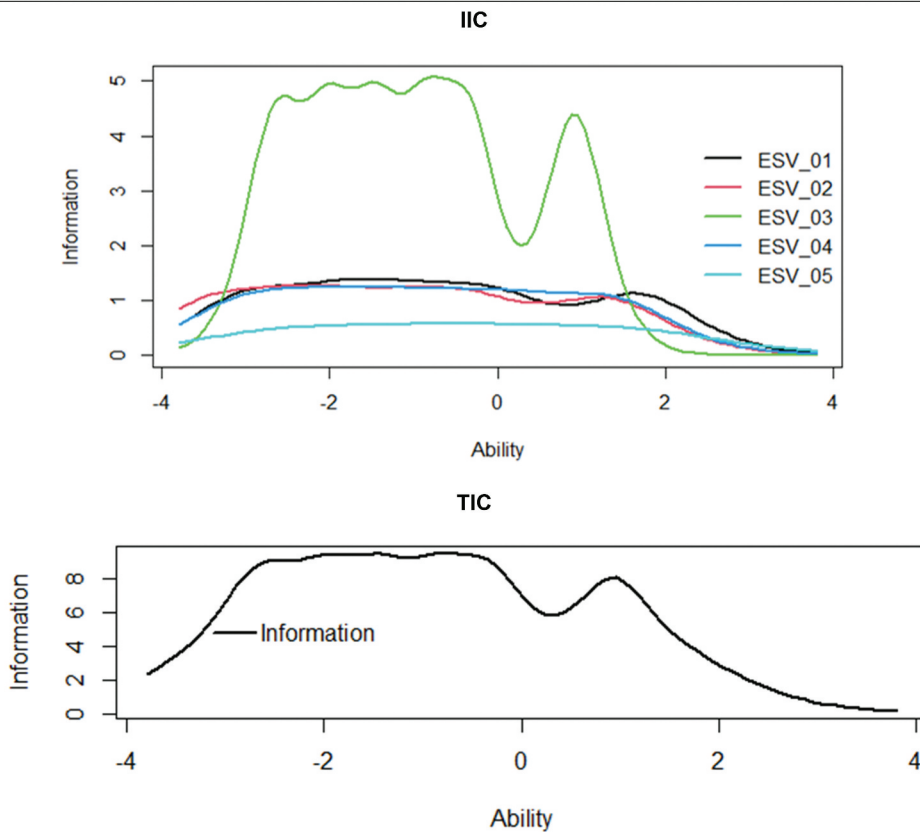


Figure 2. Item information and test information curves. Note: *IIC*: Item Information Curves; *TIC*: Test Information Curve.

et al., 2012; Padrós et al., 2015). However, neither of these studies used robust estimations. This would indicate that the SLWS is consistent in terms of the measured construct, even despite linguistic and cultural differences, and even when using robust estimations.

Regarding ME between countries, the SWLS presented metric invariance when comparing nested models of different levels of restriction (Asparouhov & Muthén, 2014; Byrne & van de Vijver, 2010; Meade et al., 2008). Although we could not find equivalent intercepts (mainly in SWLS item 5), we did find equal factor loading across groups. This could mean that, although Ecuadorian and Colombian participants interpreted items similarly, pattern of responses differ between groups. Our results add to those of other studies in which invariance has also been found between populations from different countries (Bieda et al., 2017; Dimitrova & Domínguez Espinosa, 2015; Esnaola et al., 2017; Jang et al., 2017; Jovanović & Brdar, 2018; Ruiz et al., 2019; Schnettler et al., 2017). Additionally, the internal consistency, at its point estimate and 95% confidence interval level, was also found to be adequate for both groups.

In the analysis of item difficulty and discrimination based on the IRT, it was found that the items have adequate discrimination, with Item 3 presenting the best discriminatory capacity. This can be interpreted as the item that best captures the latent variable and yields the greatest precision in the evaluation of satisfaction with life. Regarding the difficulty, it was found that it

increases monotonically at each threshold step. All these results indicate that the SWLS is a valid and reliable instrument to evaluate satisfaction with life across different populations (Pretorius & Padmanabhanunni, 2022; Sanmartín et al., 2016; Vittersø et al., 2005).

Regarding the implications of the study, we have provided evidence of its psychometric properties from the classical test theory and item response theory. The use of different theoretical perspective in the psychometric analyses represent a significant contribution to the investigation of this measure since it provides a level of depth in the study of this instrument's performance that is not commonly reported. In addition to this, our results add to the existing literature regarding ME of the SWLS across countries. Based on the accumulated evidence, the SWLS is a versatile instrument that holds its internal structure despite cultural differences, allowing for empirical multi-group studies by countries to be conducted. However, it should be noted that our participants showed different response patterns. One other important contribution of the present study is the use of a graded response model to estimate the IRT discrimination and difficulty scores. Although there are studies that explore item discrimination and difficulty, the graded response model represents a more sophisticated method rarely used for polytomous items, which allows greater precision. This constitutes a significant contribution since no other study investigating the psychometric properties of the SWLS has used it to our knowledge.

On the other hand, the current study also presents certain limitations that should be considered in future research. Despite the diversity found in terms of background in our sample (race, social class, area of origin, and degree pursued), all participants were university students, and thus, only represent a small portion of the Colombian and Ecuadorian populations leaving out people of lower levels of education and different age groups (middle-aged, and older adults). Since the investigated participants share many characteristics in common, they could exhibit a more homogeneous response behavior that could be found when including other segments of the population. In the future, it is necessary to incorporate other population segments, including clinical populations.

Finally, there is sufficient evidence to establish that the SWLS is a reliable measure to assess life satisfaction in university students of several countries, including Colombia and Ecuador. In this way, this work contributes to a body of research that uses the SWLS in various fields of measurement and intervention of human well-being.

Authors' contributions

All authors have read, reviewed, and approved the final text of the article.

Disclosure statement

No potential conflict of interest was reported by the authors.

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