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Article *in* North American Journal of Psychology · December 2022

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Life satisfaction is defined as an individual global assessment of cognitive perception of their actual condition with the current standard of living. *Satisfaction With Life Scale* (SWLS) is the most widely used measurement instrument in measuring life satisfaction. However, most SWLS psychometric studies rarely report Omega coefficients, sampling adequacy (MSA) measures, and factor score qualities. One hundred and eighty-nine Indonesian students participated in an unrestricted factor analysis study of SWLS. The factor structure and psychometric analysis were carried out using the FACTOR program. The study's limitations and implications for the psychometric properties of SWLS are discussed.

Keywords: Satisfaction with Life Scale, Unrestricted Factor Analysis, Unidimensionality, FACTOR

The *Satisfaction With Life Scale* (SWLS) is a widely used scale in life satisfaction research. The SWLS is a self-report inventory composed of only five items (Diener et al., 1985; Lewis et al., 1995; Pavot & Diener, 1993). The SWLS correlates negatively with clinical measures of distress, sadness, and anxiety and positively with other measures of well-being.

Satisfaction with an individual's life is heavily influenced by work, relationships with family and friends, personal development, and health and well-being. Several researchers examined the quality of SWLS psychometrics (e.g., López-Ortega et al., 2016; Ngamal et al., 2018; Shevlin & Bunting, 1994) and confirmed a single-factor structure of SWLS.

Four researchers have just carried out the SWLS psychometric studies in Indonesia (e.g., Akhtar, 2019; Muttaqin, 2022; Muttaqin, 2020; Natanael & Novanto, 2021). All of the studies emphasized the congeneric measurement model and the SWLS invariance.

Most psychometric quality tests of psychological scales, including the SWLS, do not inform how factor scores are used for individual assessment, dimensionality testing, construct replicability, and McDonald's Ordinal Omega reliability.

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North American Journal of Psychology, 2022, Vol. 24, No.4, 743-754.

Measurement reliability is critical in social science research. Several metrics of total score dependability have been created, including coefficient Alpha (Cortina, 1993; Cronbach, 1951), coefficient Omega (McDonald, 1999), and greatest lower bound (GLB; Bentler, 1972) reliability.

The coefficient alpha has been the most extensively utilized of these, and it is reported in practically every study involving the measurement of a construct using many items in social and behavioral research. However, unless the items are tau-equivalent, coefficient alpha is known to underestimate genuine reliability (Yang & Green, 2011); thus, coefficient omega is regarded as a valuable alternative to coefficient alpha in determining the measurement reliability of the overall score.

Because factor loading quantifies the intensity of an item's link with a factor, the amount to which a group of items (as indicated by their total score) accurately assesses the factor is a function of the factor loadings of the items. As a result, the dependability of a unidimensional test's total score may be evaluated using parameter estimates from a one-factor model fitted to the item scores. The coefficient omega, based on a one-factor model, is a metric that compensates for the shortcomings of alpha. When a one-factor model can approximate the covariance between items, the coefficient omega formulation roughly fits the dependability concept (McDonald, 1999).

In addition to reliability issues, this study also tried to convey that the whole psychometric application considers FA for item calibration and individual scoring. In this context, a good FA solution has to achieve an acceptable level of goodness of model-data fit and provide a clearly interpretable and strong pattern solution expected to be replicable across samples. This condition is permanent if the evaluation of the test framework is the only main study interest. In addition, factor score estimates must be determined and accurate validity evaluations made based on projected scores and, more importantly, in individual evaluations.

Individual ratings' primary purpose is consistency, and a significant degree of ambiguity indicates that respondents cannot be consistently rated along a set of qualities (Cliff, 1977). This also implies that the validity of the link between the estimated factor scores and the critical criteria is questionable. Given the practical significance of the issue, a degree of indeterminacy should be routinely handled in factor analysis research of the sort detailed here, but this does not appear to be the case with some previous research (Grice, 2001).

A measure to determine how effectively a group of items represents a factor was introduced by Hancock and Mueller (2000). Multiple properties that make up this overall idea are mainly the quality of the items as indicators of the factor and the replicability of the factor solution across studies.

The mentioned psychometric information above has not been conveyed in the SWLS studies. Therefore, the current study aims to fill in this psychometric information and examine the structure of the SWLS factor during the pandemic. This study used an unrestricted factor analysis approach to avoid different results from exploratory and confirmatory factors analysis (Ferrando & Lorenzo-Seva, 2000).

METHOD

Research institutions and the community service board of Universitas Tarumanagara have approved this study to protect the rights and welfare of humans participating as subjects in this study. The reviewers also evaluated and monitored the research process by reviewers to ensure the research process followed research ethics with humans.

Participants

After filling out the informed consent form, a convenience sample of 189 Indonesian college students from Jakarta (80.4% female, 19.6% male; M_{age} = 19.34 years, *SD* = 1.56) participated in the study. According to Fabrigar et al. (1999), sample sizes should be larger than five times the number of variables. Our study included 189 respondents based on this reason for assessing the adequacy of sample size for factor analysis.

Materials

Satisfaction with life. The 5-item *Satisfaction With Life Scale* (SWLS)-Indonesian version (Diener et al., 1985) was administered. SWLS has been translated and adapted into Indonesian and is available on the developer's website (https://eddiener.com). "The conditions of my life are excellent," "I am satisfied with my life," and "So far, I have gotten the important things I want in life" are sample items of the SWLS. Participants rated their agreement with each statement using a 7-point scale ranging from 1 (Strongly Disagree) to 7 (Strongly Agree). Higher scores indicated a higher level of overall life satisfaction. In previous studies, the Indonesian version of the SWLS has an Alpha coefficient of .80 and is unidimensional (Akhtar, 2019; Mutaqqin, 2020); invariance of gender and age measures of SWLS (Mutaqqin, 2022).

Analysis

The analysis used the unrestricted factor analysis approach and was carried out with the FACTOR (11.05.01) program developed by Ferrando & Lorenzo-Seva (2017) to fit the exploratory factor analysis model. Robust Promin rotation was developed to produce simple and stable rotated solutions through the samples (Lorenzo-Seva & Ferrando, 2019). The procedure for determining the number of dimensions was the optimal implementation of Parallel Analysis (PA; Timmerman & Lorenzo-Seva, 2011). The polychoric correlations were used for the dispersion matrix and Parallel Analysis (PA) to determine the number of dimensions. This study used the Robust Unweighted Least Squares (RULS) as a method for factor extraction with 500 bootstrap samples.

RESULTS

Our analysis showed that kurtosis was 4.695; $p<.001$, which meant that the multivariate data was asymmetrical. Since the data were not normally distributed, a polychoric correlation was recommended (Basto & Pereira, 2012). The Kaiser-Meyer-Olkin (KMO) test resulted in a value of .780 (fair), and Bartlett's test of sphericity value was 475.1 (df = 10; $p<.001$), which indicated that the data were moderately suitable for factorial analysis (Kaiser, 1970).

Before conducting factor analysis, the MSA index is needed to determine which items do not match the measurement construct. The single-variable measure of sampling adequacy (MSA) developed by Kaiser is a valuable indicator for identifying incorrect items. The bootstrap resampling was used to calculate MSA confidence intervals (CIs). The relevant item might be maintained in the analysis if the lower end of the CI was bigger than Kaiser's .50 threshold.

Table 1 The Indices of SWLS Normed Item-MSA

Items	Quartile of Sum response scores	Relative difficulty index	Normed MSA	Bootstrap 95% Confidence interval	
SWLS5	2	.506	.846	(.720	.899)
SWLS1	3	.610	.773	(.665	.852)
SWLS2	3	.624	.753	(.672	.827)
SWLS4	3	.649	.769	(.684	.840)
SWLS3	3	.665	.785	(.685	.860)

Table 1 shows that the point-estimated MSA value is larger than .50, implying that each item is measured in the same domain as the other items in the pool. No item is proposed for removal.

Real-Data Percentage of Variance

The polychoric correlation matrix was used as the minimum rank factor analysis (MRFA) base. From the real data percentage of variance, the advised number of dimensions is one based on the 95th percentile recommendation of the parallel analysis. In terms of instrument quality characteristics, the 60% explanatory variance of the instrument is a must (Ferrando & Lorenzo-Seva, 2013). Table 2 shows that the real data percentage of variance amounted to 70.50%, which shows the excellent quality of the scale.

Table 2 The Variance Real-Data Percentage

Variable	Real-data % of the variance	Mean of random % of the variance	95 percentile of random % of the variance
1	70.502*	41.208	52.094
2	14.716	29.669	36.176
3	8.788	19.502	25.274
4	5.993	9.619	16.924

* When the 95th percentile is taken into account, the recommended number of dimensions is 1

The minimal rank factor analysis of 500 random correlation matrices was obtained by the raw data permutation to assess the scale's unidimensionality. In this context, the explained common variance (ECV) index was an index that should be computed at the single item level. ECV cut-off values larger than .85 had been recommended for a substantially unidimensional solution (Ferrando & Lorenzo-Seva, 2019).

Residual absolute loadings (MIREAL) items were also utilized as a unidimensionality test. Consequently, the means of these loadings may be employed as a universal measure of unidimensionality. These indices addressed the core principle of unidimensionality, which claimed that residual loadings must be small regardless of the number of the dominant factor's loadings (Green et al., 1984). The most popular rule of thumb for determining if loading is significant is when it comes to threshold levels of 30 (Grice, 2001). A value of UniCo (Unidimensional Congruence) bigger than .95 was also used to suggest unidimensionality (Ferrando & Lorenzo-Seva, 2018). The summary of the unidimensionality test was Unico = .985 (> .950); ECV = .868 (> .850); and MIREAL = .240 (< .300) implying that data are seen as inherently unidimensional.

The study's robust goodness of fit statistics was based on mean and variance-adjusted chi-square statistics (Asparouhov & Muthen, 2010). In terms of CFA adjustment rates, the following indices were used: CFI (≥ .95), GFI (≥ .95), AGFI (≥ .95), and RMSR (≤ .08) (Hair et al., 2019). In addition to the EFA results, CFA's model modification quality ratings showed no issues .95 threshold (.971 - .994). The RMSR (.060) was lower than the.08 required. The EFA and CFA parameters of this study were both acceptable.

In addition to obtaining goodness of fit information, a successful factor analysis solution must provide (a) a clear and robust interpretable pattern solution that can be repeated across samples and research, as well as (b) a definite and accurate estimate of the factor score (Devlieger & Rossel, 2017).

The Generalized G-H Index was used to evaluate how well the items reflect the factor and assess the construct's replicability and the adequacy of the factorial solution. The index measures the highest percentage of factor variation that the items may measure and two features of the factorial analysis: a) the items' quality as factor indicators and; b) the predicted replicability of the solution across studies. Hancock and Mueller (2011) advocated a .70 cut-off value, while Rodriguez et al. (2016) proposed .80. The H-Latent metric assesses how effectively continuous latent response variables underpin observed item scores can detect the factor. In contrast, the H-Observed metric shows how reliably well-observed item scores can identify it.

The analysis results show that the H-latent value was .883 and the H-Observed was .859. The two values of H revealed that (a) the SWLS might be recognized by the continuous latent response factors underlying observed item scores, and (b) the solution's projected replicability across studies was attained.

Quality and Effectiveness of Factor Score Estimates

According to Cliff (1977), the primary purpose of the individual evaluation is uniformity in person ranking. This implies that respondents cannot be grouped along a trait continuum consistently. The degree of indeterminacy should be checked regularly in FA studies.

Factor score estimates are excellent proxies for representing the latent factor scores when the FDI value is near one. If factor scores are employed for individual evaluation, FDI values of more than .90, marginal reliabilities greater than .80, Sensitive Ratio (SR) of greater

Table 3 The SWLS Factor Score Quality

Estimates	Factor 1
Factor Determinacy Index (FDI)	.977
EAP Marginal Reliability	.954
Sensitivity Ratio (SR)	4.576
Expected Percentage of True Differences (EPTD)	96.20%

than 2, and Expected True Differences (EPTD) of greater than 90% are suggested. Table 3 shows information related to factor score estimates.

The analysis of the effectiveness of the factor score from the SWLS showed that SWLS could be used for individual assessment.

The SWLS reliability was good, as indicated by the value of Standardized Cronbach's Alpha (.868) and McDonald's ordinal Omega (.871), which were > .80 (Nájera Catalán, 2019)

DISCUSSION

In Indonesia, studies using the SWLS were widely carried out in various cultures (e.q. Ferdiana et al., 2018; Siswandani et al., 2019). The other SWLS study results show gender and age measurement invariance of the SWLS (Muttaqin, 2022). Our study adds psychometric aspects that have not been addressed in the SWLS studies in Indonesia.

This study examines the dimensions of SWLS with factor extraction, factor loading, and communalities to confirm the goodness of fit, assuming that it is unidimensional. With the unrestricted factor analysis approach, our study did not separate the sample based on the differences between the EFA and CFA methods, as is traditionally done by many researchers in factor structure testing. Instead, the same sample was used to test the model fit of the formed factors.

When analyzing ordinal data, assumption violations are often unavoidable in EFA. In the social and behavioral sciences, response scale instruments are often employed to examine unobserved latent qualities (Furr & Bacharach, 2014). Our study favored polychoric correlations since the variables' univariate distributions were asymmetric and had an excess of kurtosis. Ferrando et al. (2019) demonstrated that either the linear model (product-moment covariances or correlation-based) or the categorical variable model (polychoric correlations-based) could be used in any FA solutions, whether it is unrestricted or restricted.

The values of Explained Common Variance (ECV), Residual Absolute Loadings (MIREAL), and Unidimensional Congruence (UniCo) were used to assess unidimensionality,. The Explained Common Variance (ECV) value, slightly greater than .85, MIREAL= .24, and Unidimensional Congruence (UniCo) > .95, indicates that SWLS is unidimensional. This suggests that only one source of variance, or one latent variable, is responsible for the systematic variation seen in the variance of items in the SWLS. When the variation caused by the life satisfaction construct is considered, this principle states that a set of SWLS items is considered unidimensional if there are no correlated residuals between the items. If items are considered manifestations of life satisfaction, test results are interpreted in the same way as an indicator of a person's position relative to the latent construct of life satisfaction.

A successful factor analysis solution must achieve an appropriate degree of fit and produce an interpretable and robust pattern solution that is anticipated to be replicated across samples and studies (Devlieger & Rosseel, 2017; Ferrando & Lorenzo-Seva, 2013;). The parallel analysis-based procedure shows the same conclusion: the unidimensional solution is replicable. This means the number of SWLS factors discovered in the sample could be reproduced in other samples drawn from the same population (Timmerman & Lorenzo-Seva, 2011).

Item analysis and individual scoring are two of the most prevalent implementations of the general factor analysis (FA) model, and they are often based on a two-stage random-regressors estimate technique (Ferrando & Lorenzo-Seva, 2013; McDonald, 1982). This study provides additional indices for determining how accurate the factor score estimates allow respondents to be consistently ordered and effectively differentiated across the range of trait values appropriate for the measure's purposes. Factor analysis related to factor scores is still new and vital to do and report.

A factor score estimate is a numerical figure illustrating a person's relative spacing or position on a latent factor. Based on the analysis of factor estimates, the FDI value exceeds .90, the sensitive ratio is > 2, and the Expected True Differences (EPTD) are greater than 90%. This finding shows that factor scores of SWLS can be used for individual assessment with definite, accurate, and reliable factor score estimations.

This study has limitations related to the specific characteristics of the sample, namely adolescent students coming from only one big city, so the study's conclusions are limited. The convenience sampling technique also limits the representativeness of participants. This study also did not examine the predictive validity of SWLS, so the psychological outcomes of life satisfaction are unknown.

For future studies, it would be interesting to conduct concurrent validity testing using other life satisfaction scales such as the *Standard Life Satisfaction Instrument* (SLSI; Kim & Sok, 2012) and the *Multidimensional Life Satisfaction Scale* (MSLSS; Kapıkıran, 2013).

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