Original Research

Factor structure and psychometric properties of translated Sinhala version of Resilience Scale-14 among Grade 10 adolescents in Colombo District, Sri Lanka

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Abstract

Introduction: Resilience means ability to bounce back following exposure to adversity.

Objectives: To translate Resilience Scale-14 (RS-14) into Sinhala language and assess its factor structure and psychometric properties among Grade 10 adolescents in Sri Lanka

Methods: Translation of RS-14 was conducted according to the WHO guidelines, after which it was named as 14-Item Sinhala Resilience Scale (14-Item SRS). Final sample size computed for factor analysis was 496. Eight schools were chosen purposively from Colombo District. Two classes from each school and 31 students per class were selected using simple random sampling. Overall response was 470 leaving 235 each for Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). Factorability was assessed using Kaiser–Meyer-Olkin (KMO) and Bartlee's tests. Factor extraction was conducted using relevant statistical methods. Factor retention was assessed with Kaiser's criterion, Cattell's Scree test and PA, followed by Oblimin rotation. Adjusted robust maximum likelihood estimation assessed the CFA.

Results: Mean age of the adolescents was 15.4 years (SD=0.32). The sample consisted of 57% females and 97.2% Sinhalese. KMO was 0.814. Bartlett's test demonstrated $p<0.05$ and multicollinearity was not detected. Both EFA and CFA proved a two-factor structure retaining all 14 items. Two factors with six and eight items respectively were named 'Personal competencies' and 'Personal characteristics'. Total variance of the two factors was 56%. Internal consistency was proved with Cronbach alpha values of 0.881 and 0.822 and composite reliability of 0.9 and 0.91, respectively. Convergent and discriminant validity was established for both factors, substantiating construct validity. Good fit was demonstrated by several statistical parameters.

Conclusions & Recommendations: Validated 14-Item SRS is recommended to assess resilience among Sinhala-speaking Grade 10 adolescents in Sri Lanka.

Key words*: Resilience, Adolescents, 14-Item Sinhala Resilience Scale*

Introduction

The definition of resilience has been evolving throughout the years. The American Psychological Association (APA) defines resilience as "the ability to adapt well to adversity, trauma, tragedy, threats or even significant sources of stress" (1). Even though resilience was considered as a trait earlier, Masten (2) described it as a dynamic process that encompasses complex interactions between a person's adverse experiences and protective factors.

Adolescence is a highly stressful transition between childhood and adulthood, which is often marked by major physical, biological and psychological changes. These pressures can lead to risky behaviours like substance abuse and unsafe sexual practices, which may harm long-term physical and mental health. Without resilience, adolescents may struggle to lead fulfilling lives, making it important to have reliable tools to assess resilience.

Although resilience is strongly associated with positive psychological outcomes in adolescents, there is still no consensus on the most appropriate method for assessing adolescent resilience (3-4). A review (3) indicated that Resilience scale (RS) may be the best to use with the adolescent population. The original RS comprised 25 items (5) and subsequently, a shorter form was produced including only 14 items (RS-14). It is a self-administered questionnaire with a Likert scale of seven responses amounting to a total score between 14–98 (6). The internal consistency of RS-14 is reported to be excellent (α=0.93) and correlates strongly (r=0.97) with the original RS. The factor analysis of RS-14 demonstrates a strong, unidimensional factor structure (7). Testing of its internal structure and psychometric properties in diverse age and ethnic groups has also demonstrated good psychometric properties around the world (7-18). Among these, four studies have been conducted on adolescents (7-10).

Only two studies on resilience have been conducted in Sri Lanka (19-20). Munasinghe (20) translated the 25-Item RS into Sinhala language and tested its psychometric properties among adolescents aged 14-18 years. The author has claimed high internal consistency and test-retest reliability applying Cronbach alpha and Pearson's correlation coefficient, respectively. However, the construct validity was based on EFA which is not the accepted method for its evaluation. Although the study population was identical with regard to the age group, due to discrepancies of the two resilience scales, this study was not considered relevant for comparison purposes with the present study. The second study (19) was conducted among Tamil-speaking Muslim population aged ≥18 years of age who were displaced in 1990. The Cronbach alpha values of the translated Tamil versions used in the baseline and follow-up phases were 0.65 and 0.97, respectively. The EFA conducted on the two data sets produced one factor solutions. This study differed from the index study with regard to the age group and ethnicity of the study participants who had been subjected to a severe form of adversity. Both studies, as reported, had not conducted a robust evaluation of the psychometric properties of the cross-cultural versions of the resilience scales used. Further, confirmation of the factors generated also was lacking. These methodological gaps highlight the need for more rigorously validated Sinhala and Tamil versions of the RS-14.

In Sri Lanka, the General Certificate of Education (Ordinary level and Advanced level) examinations play a crucial role with regard to tertiary education opportunities and future employment prospects among adolescents. Consequently, they are subject to an enormous amount of stress at school and after school hours. As resilience is considered both a trait and a dynamic process, the resources and skills related to improving resilience can be fostered and practised (6). Therefore, it is imperative to screen vulnerable populations for prevention as well as to apply early interventional measures to those who are identified with low resilience. Thus, the objective of this study was to describe the translation of the English version of RS-14 into Sinhala language with

cultural adaptation followed by assessment of its psychometric properties and internal structure.

Methods

Translation and cultural adaptation of the RS-14 was conducted based on the WHO guidelines (21). Forward and backward translations to Sinhala and English versions were conducted by two pairs of independent bilingual experts. After minor revisions, it was subjected to a classic Delphi technique by a team of bilingual experts (two psychologists, one psychiatrist, one paediatrician, one sociologist, one educationist and one community physician) selected from different fields relevant to the research topic. Thereafter, pre-testing was conducted among 30 Grade 10 students purposively selected from a school in Colombo District. Debriefing, followed by pre-testing and cognitive interviewing were conducted and minor changes were corrected. The same panel of experts confirmed judgmental validity of the tool, after which the tool was named as 14-Item Sinhala Resilience Scale (14-Item SRS).

For the validation study, a descriptive cross-sectional study was conducted in Colombo District in eight Type 1AB schools purposively selected from the same educational zone of Colombo District due to logistical, financial and time constraints. From each school, two Grade 10 classes were selected by simple random sampling. The required sample size was determined based on the number of cases per variable principle (22). To target an optimum sample size, a ratio of 33:1 selected. After considering a non-response rate of 4%, the sample size was inflated to 496, which required selecting 31 adolescents randomly from each class. Those who responded (n=470) were randomly divided into the Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) groups, with 235 students in each group. The tool for data collection comprised personal information and the 14-Item SRS.

Data analysis

Normality of data related to the total resilience score was checked by standardized skewness and standardized kurtosis.

The EFA was conducted with SPSS version 22. The sample adequacy was assessed with Kaiser–Meyer-Olkin (KMO) test and Bartlett's test of sphericity. Factor extraction was conducted using Principal Component Analysis (PCA), Principal Axis Factoring (PAF) and Parallel Analysis (PA). Factor retention was assessed with Kaiser's criterion, Cattell's Scree test and PA (23-24). Oblimin rotation was applied for factor rotation.

The CFA was carried out with Linear Structural Relations (LISREL version 8.8) software. Robust Maximum Likelihood (RML) estimation method adjusted for the non-normality of data was used for the analysis. Goodness of fit was assessed using all three main types of fit indices.

Construct validity was confirmed determining the convergent and discriminant validity. Convergent validity was confirmed if the average variance extracted (AVE) had a value >0.5 for each construct (25). For discriminant validity, the square root of AVE of each construct should have an intraclass coefficient (ICC) between the pair of constructs analysed separately (26).

Test-retest reliability was assessed among 30 participants by re-administering the 14-Item SRS, two weeks following the initial round and analysed using Cohen's Kappa value. Internal consistency was determined by applying Cronbach's alpha. Composite reliability (CR) evaluated the proportion of true variance in terms of the observed variance, where AVE assessed the average of the total variance of the indicators captured by a construct (24).

Results

A total of 26 students were absent on the days the research was conducted, giving a non-response rate of 5.2%. Mean age of the students was 15.4 years (SD=0.32). The sample consisted of 268 females (57%); 459 Sinhalese (97.2%); and 417 Buddhists (88.7%).

Exploratory Factor Analysis

Correlation coefficients of all the 14 items were more than 0.3, indicating their factorability. The KMO was 0.81 and Bartlett's test was $p<0.001$, indicating appropriateness to proceed with factor analysis. Anti-image correlation matrix included 14 items, which were above the acceptable level of 0.5. All three techniques including PCA, PAF and PA, and Kaiser's criterion extracted two factors. The eigenvalues of the two factors disclosed by the latter method were 4.66 and 3.75. Results of the scree plots too confirmed the same (Figure 1). Total variance explained by two factors was 60%. Cross loadings were not observed. The two factors were labelled as 'Personal competencies' (eight items) and 'Personal characteristics' (six items), thus including all 14 items. Both subscales showed high internal consistency with Cronbach's alpha 0.822 and 0.881 exceeding the Nunnally's criteria of 0.7 (27) (Table 1).

Table 1: Factor loadings of individual items of 14-Item Sinhala Resilience Scale based on factors generated

Serial No.		Description of Items	Factor loadings (FL)	
Tool*	FL**		Factor 1	Factor 2
01.	06	I am determined	**0.947**	-0.025
02.	04	I am friendly with myself	**0.918**	0.023
03.	14	I can usually find my way out of difficult situations	**0.865**	-0.006
04	02	I feel proud I have accomplished things in my life	**0.855**	0.014
05.	11	My belief in myself gets me through hard times	**0.845**	-0.029
06.	10	I can usually find something to laugh about	**0.807**	0.019
07.	08	I have self-discipline	-0.05	**0.863**
08.	07	I can get through difficult times as I have prior experience	0.03	**0.751**
09.	05	I feel that I can handle many things at a time	-0.109	**0.703**
10.	01	I usually manage one way or another	0.134	**0.688**
11.	13	My life has a meaning	0.002	**0.632**
12.	03	I usually take things in stride	-0.002	**0.617**
13.	12	In an emergency, I am a person who could be relied upon	-0.135	**0.595**
14.	09	I keep interested in things	0.113	**0.593**

* SRS-14; **Factor loadings arranged in descending order

Confirmatory Factor Analysis

A random sample of bivariate scatter plots showed a linear relationship. No univariate outliers could be found in the data set. Having scrutinized the correlation matrix, evidence of multicollinearity was not observed as the highest correlation seen was 0.66 (threshold value >0.7) (28). The three models tested included all the 14 items, one was unidimensional, the second comprised five factors, and the third was the indexed model with two factors. The relevant statistical measures revealed accepted criteria for fit indices which were above the other two models (Table 2).

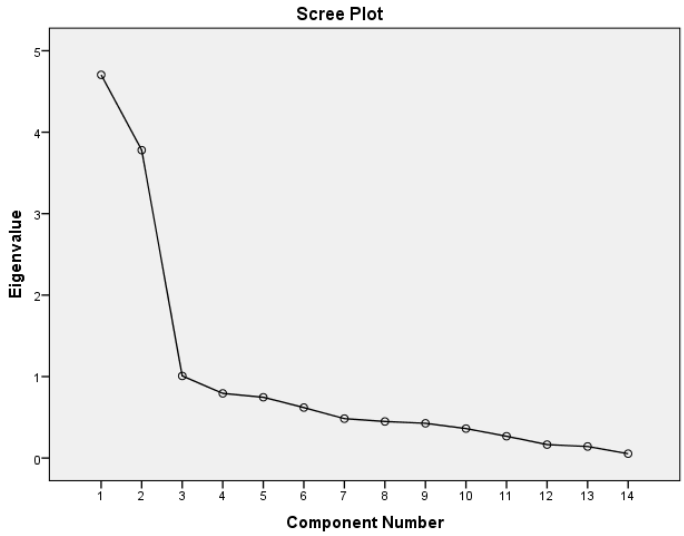

Figure 1: Scree plot for 14-Item Sinhala Resilience Scale

Table 2: Description of fit indices of the 14-Item Sinhala Resilience Scale by models tested

No.	Fit/ Misfit Indices	No. of factors included in the models tested		
		One	**Five**	**Two**
A.	**Absolute Fit Indices** [a]			
1.	**Model Chi-square (χ^2)**			
	Good fit > 0.05	$p < 0.001$	$p < 0.001$	$p < 0.001$
2.	**Root Mean Square Error of Approximation (RMSEA)**			
	Perfect fit: 0.0; Good fit: < 0.08	0.28	0.23	**0.06** [e]
3.	**Goodness of Fit Index (GFI)**			
	Perfect fit 1.0; Good fit ≥ 0.95	0.52	0.64	0.92
4.	**Adjusted Goodness of Fit Index (AGFI)**			
	Perfect fit 1.0; Good fit ≥ 0.9	0.35	0.44	0.89
5.	**Standardized Root Mean Square Residual (SRMR)**			
	Perfect fit .0.0; Good fit < 0.08	0.24	0.27	**0.045**
B.	**Relative Fit Indices** [b]			
6.	**Non-Normed Fit Index/Tucker Lewis Index (NNFI/TLI)**			
	Perfect fit: 1.0; Good fit: > 0.95	0.64	0.52	**0.97**
7.	**Comparative Fit Index (CFI)**			
	Perfect fit 1.0; Good fit ≥ 0.95	0.69	0.65	**0.97**
C.	**Parsimony Fit Indices** [c, d]			
8.	**Parsimony Goodness of Fit Index (PGFI)**			
	Expected > 0.5	0.38	0.41	**0.66**
9.	**Parsimony Normed Fit Index (PNFI)**			
	Expected: > 0.5	0.40	0.47	**0.79**

[a] Hu & Bentler (1999); Yaşlioğlu & Yaşlioğlu (2020); Sathanarayan & Thambimuthu (2024); Faster Capital (updated 2025), MacCullum (1996), Parry (updated 2024); [b] Yaşlioğlu & Yaşlioğlu (2020); Sathanarayan & Thambimuthu (2024), Parry (updated 2024); Newsom (2025); [c] Hooper et al. (2008); [d] No predefined cut-off values, Higher the better; [e] Results in bold font: Confirmed fit indices

Convergent validity was confirmed by deriving AVE values of >0.5 (29) for the two factors (0.53 and 0.63). Proof of discriminant validity for the two factors was determined by obtaining √AVE values which exceeded the computed ICC values. Accordingly, it was possible to establish construct validity for the two factors and thus for the 14-Item SRS (Table 3).

With regard to reliability of the final two factors, Cronbach's alpha values were 0.88 and 0.82. The composite reliability for the two factors was 0.9 and 0.91.

Table 3: Convergent and discriminant validity of the 14-Item Sinhala Resilience Scale

No.	Variable	Factor	
		Personal characteristics	**Personal competencies**
1.	**Convergent validity (CV)**		
	Sum of squared factor loadings ($\Sigma\lambda^2$)	3.7852	4.2643
	Average Variance Extracted (AVE)	3.7852/6 = 0.63	4.2643/8 = 0.533
	Criteria for CV confirmation: Obtaining an AVE value of ≥0.5		
2.	**Discriminant validity (DV)**		
	Square root of AVE (√AVE)	0.730094	0.794291
	Inter-construct correlation (ICC)	0.02	0.02
	Criteria for DV confirmation: √AVE>ICC	0.730094 > 0.02	0.794291 > 0.02
3.	**Final result: Based on the results depicted both CV and DV were confirmed for 14-Item SRS**		

Discussion

A two-factor structure was generated for the 14-Item SRS, eight items were loaded into Factor 1 (Personal competencies) and balance six items to Factor 2 (Personal characteristics). The two factors revealed favourable composite reliability and construct validity.

The findings of this study provide theoretical support for a two-factor structure of the 14-RS. This structure suggests that resilience can be understood as a multidimensional construct rather than a single unified trait. Personal competencies reflect an individual's abilities to effectively manage challenges, demonstrate perseverance and utilize problem-solving skills in the face of adversity. In contrast, personal characteristics represent inherent attributes such as self-confidence, determination and adaptability that enable individuals to maintain psychological strength during difficult circumstances. The identification of these two dimensions contributes to resilience theory by highlighting that resilience involves both developed capabilities and enduring personal attributes. Furthermore, the presence of these factors within the present context suggests that resilience may manifest through culturally relevant personal strengths that shape how individuals respond to adversity.

Factor loadings for the two factors ranged within 0.59-0.95. However, among the four studies conducted on adolescents (7-10), only one study (9) yielded a two-factor solution, while the other three studies (7-8, 10) resulted in a unidimensional factor. In addition, studies conducted on cancer patients (12) and university students (13) too generated two factor structures. This may be attributed to cultural differences.

A two-factor model, which includes two latent variables allows representation of the data with a fine distinction. This model represents multiple independent sources that may result in associations

among variables. It provides a better fit among items and therefore, is more complex than a one-factor solution. The latter model is simpler, easier to interpret and requires fewer parameters, but may fail to capture the complex relationships among variables similar to that of the two-factor model.

Rogers (30) mentions that sample sizes ranging from 50–1000 and *N:p* ratios from 5:1, 10:1 and 20:1 are frequently used in the literature. In the present study, *N:p* ratio was 16:1 fulfilling the sample size requirements. Several studies (22, 30) had recommended that a substantial number of correlation coefficients should exceed 0.3 to conduct EFA, which was achieved for all the 14 items in the present study. The factor loadings indicate the correlation between indicator and the factor. A factor loading of >0.3 is considered a moderate correlation (23). This was accomplished by the present study, where factor loadings >0.8 were observed for all the six items of Factor 1 and for one item of Factor 2. Also, when a factor consists of ≥4 items with loadings of >0.6, the factor/s are considered to be stable irrespective of the sample size (25). This requirement was fulfilled by both factors (all six items for Factor 1 and six out of eight items for Factor 2). Thus, although our sample size was relatively small, it did not impart a negative impact with regard to the reliability/stability of the factors.

Composite reliability (CR) is also a measure of internal consistency (≥0.7- acceptable; >0.8- good) (31). This is preferred to Cronbach alpha as the former weights the individual indicators based on their factor loadings, when the latter does not (23). The results obtained for each factor for CR was 0.9, which indicates high reliability, with an error variance likely to be of ≤10%. High CR values denote that the observed variables represent the latent constructs, strengthening the validity of the analysed model. For the present study, reliability was assessed applying Cronbach' alpha to the main tool (0.87) and both Cronbach's alpha (0.88 and 0.82) and composite reliability (0.9 and 0.91) to the two factors generated. Thus, both tests have fulfilled the criteria for assessment of reliability which is a strength of this study.

Cohen's Kappa coefficient (0.84) calculated on test-retest reliability (32) showed a 'near perfect' agreement (0.81-0.99). However, not applying intraclass Kappa may be considered a limitation of this study.

The study's KMO value of 0.81 indicates meritorious data (22) and exceeds the recommended cutoff of 0.7 (30), showing that the scale is highly suitable for factor analysis. Bartlett's test of sphericity was significant, confirming that the correlation matrix is appropriate for data reduction (33) through factor analysis. However, the authors acknowledge that not performing Levene's test is a limitation of the study.

Both PCA and PAF use the covariance matrix, however, PCA includes error variance, which may explain its higher factor loadings in this study. The study met the recommended criteria for factor analysis, with more than five variables per factor (34) and correlation coefficients above 0.5, supporting the strength and validity of the factor structure. Further, with regard to the present study, both Kaiser criterion and scree plot (Figure 1) generated two similar factors. However, Kaiser criterion and the scree plot are less reliable methods for determining the number of factors compared with PA. The Kaiser criterion rule can overestimate the number of factors by including error variance, while the scree plot is subjective because identifying the elbow point is often unclear and open to interpretation. Furthermore, for surveys with Likert-type scales, weighted least squares (WLS) with robust standard errors is recommended along with oblique rotation (35-36). Although two strong factors (eigenvalues 4.66 and 3.75) were retained, WLS was not attempted, which may be considered a limitation.

Assumptions related to maximum likelihood estimation (ML) include that the observed data should

be continuous with a multivariate normal distribution. Therefore, ML estimation is not an appropriate technique for analysis of ordinal data. With regard to the present study, CFA was conducted using RML, and therefore it is assumed that the validity of the factor structure generated is proven, which may be considered another strength of this study.

Absolute fit indices constitute indispensable elements of CFA, as these determine whether the hypothesized model sufficiently represents the data. For the present study, TLI/(N)NFI and CFI were the two relative fit indices evaluated, and both demonstrated good fit. It is crucial for all fit indices that reflect fit/misfit to be consistent in their conclusions. This alignment ensures a more accurate interpretation of the data, which was also achieved by the present study. Further, out of the nine indices computed, six fulfilled the requirements for good fit except model $\chi 2$ recommended and accepted by the scholars **(**Table 2**).**

Construct validity refers to the degree of item-factor association and the status of association between factors/latent constructs, which would result in either convergent or discriminant validity. Both these aspects are needed to confirm construct validity. Evidence for the latter can be determined through both EFA and CFA. High factor loadings demonstrate the impact of the construct on the observable items. The cutoff values for factor loadings range from 0.4 - 0.7.

Convergent validity measures how well a group of indicators represents and relates to the intended construct while remaining distinct from other constructs in the model. Both factors derived for the present study had an AVE value of >0.5 indicative of acceptable convergent validity. Discriminant validity ensures that each construct/factor is conclusively different from each other. It was assessed applying the Fornell-Larcker criterion by comparing the square root of AVE with interclass correlation values (ICC) of a pair of constructs. Both convergent and discriminant validities were positive and those two together proved the construct validity.

Although this study was conducted in 2017, to the best of our knowledge, it remains the first resilience assessment questionnaire validated in the Sinhala language. The relevance of the ideals derived from it has remained constant over time, even in the face of potential sociocultural and educational shifts. It is hoped that the ongoing educational reforms, along with advice from psychiatrists, psychologists and other relevant authorities, have taken steps to include a session on “resilience” in the revived curriculum. The values encompassed within psychological resilience are of paramount importance to humanity, irrespective of age, ethnicity, religion, educational status and profession/employment type.

Conclusions & Recommendations

The 14-item SRS was confirmed as a tool, in which all the 14 items were included within two factors. Each factor demonstrated high factor loadings, acceptable high values for Cronbach’s alpha and composite reliability. Further, construct validity was confirmed in terms of both convergent and discriminant validity. Both factors were theoretically meaningful. All the above results indicate high internal consistency reliability and positive construct validity, confirming internal validity. However, the external validity is affected due to application of non-probability sampling to select schools, thus the findings are applicable only to the chosen schools. However, within those schools, as classes and students were selected applying simple random sampling, the findings are applicable to all classes and students at the chosen schools. As future directions, this study will enable to conduct awareness programmes to enhance individual resilience levels at the population level. In addition, the psychiatrists should be able to utilize 14-Item SRS for clinical purposes for the treatment of mental disorders.

Public Health Implications

- There is a need to assess the 14-Item SRS among a wider population of adolescents to confirm its external validity.
- The study highlights the importance of obtaining support of the Education Department to prepare lesson plans, training teachers on the technique of handling the sessions and assessing the feasibility on conducting regular resilience enhancing sessions during school hours.
- Educators and clinicians can use the 14-Item SRS scale to evaluate the effectiveness of resilience-building interventions.

Author Declarations

Competing interests: The authors declare that they have no competing interests.

Ethics approval and consent to participate: Ethics clearance was granted by the Ethics Review Committee of the Faculty of Medicine, University of Kelaniya, Sri Lanka. Informed written consent was obtained from each participant prior to data collection.

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Author contributions: SM accepts full responsibility for the completed work and conduct of the study, had access to the data and was involved in conceptualization, data curation, formal analysis, visualization and writing original draft preparation; PJ was involved in conceptualization, review, editing and supervision; PG was involved in conceptualization.

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