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Development & Validation of the Adolescent Resilience Index

Introduction

Psychological resilience can be defined, broadly, as the capacity and dynamic process of withstanding breakdown and adapting in the face of adversity. Historically, resilience measures have been developed primarily in high-income countries (HICs) and/or have demonstrated limited or inconsistent applicability and utility in low- to middle-income countries (LMICs). In addition, existing measures tended to omit critical components like toxic stress (i.e. repeated exposure to traumatic events accompanied by experiencing a lack of control over those situations) and early-life stability (i.e. the perceived degree of instrumental, physical, and emotional support/security while growing up). These components are of particular importance in LMICs where exposure to toxic stress and adverse early life events are substantially higher compared to HICs. These limitations and omissions raised concerns in both the research and clinical communities regarding the validity and reliability of these measures particularly among under-represented populations residing in LMICs.

In an attempt to address some of these challenges, van Wyk et al. (2022) published the Resilience Index (RI). The development of the RI was based on 686 individuals residing in sub-saharan Africa. Statistical results revealed the emergence of three components that make up psychological resilience in this sample: *Positive Affect*, *Stress Mastery*, and *Early-Life* Stability. This new measure of resilience demonstrated excellent concurrent, convergent, and incremental validity and, importantly, that it is suitable to use in both LMICs and HICs. The Resilience Index has subsequently been validated in three yet unpublished follow-up studies across different populations (e.g., students and working adults), showing large-to-very-large correlations with different existing measures of resilience (evidencing concurrent validity) and various well-validated psychiatric measures (evidencing convergent validity).

While strides have been made to develop a valid, reliable, and inclusive measure of psychological resilience, there are other important populations that have received less attention. For example, adolescents – a particularly vulnerable population in society – are still under-represented in resilience research. In the context of assessing resilience in adolescents, there are concerns regarding existing resilience measures similar to those for adults – that is, limited utility in LMICs and the omission of critical components like toxic stress and early-life stability. In addition, the influence of cultural factors, like

language proficiency (e.g., in non-native English speakers), serve as additional critical barriers to developing a reliable and valid measure of adolescent resilience in LMICs specifically.

Consequently, there is a need to develop a new, reliable, and culturally appropriate measure of psychological resilience in adolescents that is valid to use in both LMICs and HICs. Developing such a measure is imperative in order to bridge the existing gap in understanding psychological resilience across the lifespan and in diverse socioeconomic contexts.

Scale Development

In developing the adolescent resilience measure, we drew upon the item and content structure of the adult Resilience Index (van Wyk et al., 2022). This is because despite the difference in developmental/life stages (between adolescents versus adults), there is significant overlap in terms of key demographic, cultural, and socio-economic factors between the two populations that were studied. In addition, and relatedly, there is strong support for the premise that critical components that have historically been omitted from previous resilience measures in adults (e.g., toxic stress and early-life stability) are likely also of importance in this adolescent population. Therefore, we surmised that including items reflecting these constructs is essential for reliable and valid scale development in this population.

To this end, we firstly based the items for the Adolescent Resilience Index (ARI) on the constructs and items contained in the original, published RI for adults. To ensure relevance and appropriateness for an adolescent population residing in an LMIC, an expert panel of psychologists formulated, reviewed, and refined suitable adaptations to the adult items until consensus was reached. Furthermore, based on existing scientific evidence and subject matter expertise, additional constructs were identified as likely playing a key role in psychological resilience in adolescents. Finally, community educators reviewed the final list of 53 items for comprehensiveness, cultural appropriateness, and sensitivity for this adolescent population.

The Sample

The sample consisted of 652 pupils enrolled at government schools in Cape Town, South Africa. The average age of the sample was 15 years with a range of 12 to 18. With regard to gender, 30% of the sample identified as boys/men, 67.78% as girls/women, 1.22% as non-binary, and 0.92% of participants elected not to disclose their gender identity.

Methods

Exploratory & Confirmatory Factor Analysis

Due to the relatively large sample size (652), the decision was made to randomly split the dataset in half and to perform exploratory factor analysis (EFA) on the first subset and confirmatory factor analysis (CFA) on the second subset. This is a robust approach in terms of determining and confirming a reliable and stable factor structure: By conducting EFA on one half of the dataset, one is able to explore the underlying factor structure without preconceived predictions, allowing the factors to emerge from the data mathematically. Subsequently, performing CFA on the other half of the dataset, by specifying the factor structure from EFA, enables one to statistically confirm whether the emergent factor structure replicates well in an independent dataset (i.e. the second, CFA subset). This approach also ensures homogeneity in terms of sample characteristics across the two datasets, since they were collected from the same population; however, the data points are, importantly, independent of one another and can therefore be used in separate, comparative analysis.

Data Preprocessing & Analysis

All data management and analyses were done using R Statistical Computing Software Version 2023.09.0+463. Due to the ordinal nature of the data (scores are derived from Likert scale responses), we computed a polychoric (as opposed to Pearson) correlation matrix. This was coupled with using the ordinary least squares (OLS) estimator with the minres method for extraction to further accommodate the ordinal nature of the data. A varimax rotation was applied to the EFA model. For CFA, we used diagonally weighted least squares (DWLS) as an estimator. The DWLS is a robust estimator typically used in CFA in the context of ordinal data and polychoric correlation matrices.

Results

Exploratory Factor Analysis

Examining the scree plot along with its associated eigenvalues revealed that a three-factor solution appears to be the most appropriate fit for the data. We also examined the factor loading for each item on its respective factor and implemented a 0.50 factor loading cut-off as a criterion for item inclusion, which is considered very robust. This resulted in the retention of 19 items. All inter-item correlations were ≤.70, indicating low, acceptable levels of multicollinearity between items. The loadings ranged from 0.50 to 0.78, while each item loaded clearly only on one factor. The cumulative variance explained was 50%. The Kaiser-Meyer-Olkin (KMO) statistic as a measure of

sampling adequacy was 0.83, which is considered very good. This result indicates that factor analysis was a suitable extraction method for this data.

Three-Factor Solution

The three-factor solution for the Adolescent Resilience Index (ARI) closely mirrors that of the adult Resilience Index (RI). More specifically, the first factor in the ARI, *Psychosocial Positivity* resembles the *Positive Affect* factor in the RI. For example, it includes constructs like gratitude, mastery motivation, altruism, with the addition of a more interpersonal focus related to positive affect. The second factor of both the ARI and RI is *Stress Mastery*, which is reverse-scored. This includes constructs related to toxic stress, learned helplessness, stress inoculation, and trait mindfulness. The third and final factor in the ARI, *Social Safety,* very closely resembles the third factor in the RI, *Early-Life stability.* The main difference between the two is that in the RI, adults are retrospectively rating the degree to which they felt they had emotional and instrumental support and felt protected whilst growing up, while the ARI measures adolescents' current perceived degree of support, safety, and stability within their family and social circles.

Reliability Analysis

We evaluated the internal consistency of each factor by computing Cronbach's α. We did this to evaluate the extent to which the items making up each latent factor actually measure the same underlying concept (e.g., *Stress Mastery*). Higher Cronbach's α values (which typically range from 0 to 1) indicate greater internal consistency, suggesting that the items are more reliably measuring the same underlying construct. The ideal range for Cronbach's α values, however, is between 0.70 and 0.90. Values below 0.70 are indicative of poor internal consistency and reliability, while values above 0.90 could be indicative of redundancy in the scale.

Results show the following:

Psychosocial Positivity: Cronbach's α = 0.80
Stress Mastery: Cronbach's α = 0.75
Social Safety: Cronbach's α = 0.80

Together, these results indicate that the ARI has very good reliability. Other metrics from reliability analysis support this: The corrected-item total correlations for all items on their respective factors were all large and well-above the cut-off of 0.30. Furthermore, results also show that Cronbach's α did not increase in the event of any of the items being deleted. This indicates that all the items included contribute to the reliability of their respective factors, while also eliminating possible concerns about scale redundancy.

Confirmatory Factor Analysis

We conducted confirmatory factor analysis on the three-factor solution derived from EFA. We specified the factors and their accompanying items: Factor 1, *Psychosocial Positivity,* consisted of 7 items; factor 2, *Stress Mastery,* consisted of 5 items; and factor 3, *Social Safety,* consisted of 7 items. We computed multiple fit indices to assess both absolute and incremental goodness-of-fit. More specifically, we report on the chi-square statistic and its associated significance level, as well as the chi-square statistic divided by the degrees of freedom (X^2/df). The latter was included in order to circumvent the potential confounding effects of sample size and multivariate non-normality on the chi-square results. Other absolute indices include the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Incremental fit indices include the comparative fit index (CFI) and the Tucker-Lewis Index (TLI). The a priori cut-offs for the various fit indices include p = <0.05 for the chi-square statistic, a value <5 for the X^2/df statistic, <0.06 for the RMSEA, <0.08 for the SRMR, and >0.95 for the CFI and TLI.

CFA Results

All items loaded significantly, strongly, and clearly on their respective factors with a range of 0.43 to 0.73. We calculated the participant-to-parameter ratio (PPR) as a measure of the complexity of the model relative to the amount of data available. A PRR between 5 and 10 is generally regarded as ideal. Results show that our PPR is 7.98, which is indicative of relatively stable parameter estimates and good model generalizability. We also calculated several fit indices in order to evaluate how well the model structure fits the data. Firstly, with regard to absolute fit indices, results show that the chi-square statistic was not statistically significant (X^2 = 163.80, p = 0.192), which indicates that the three-factor solution is a good fit for the data. This is supported by the X^2/df statistic, which yielded a value of 1.1 (cut off: <5). Secondly, the RMSEA, as another absolute fit index, shows that the model is a close fit for the data (0.040, CI lower = 0.031, CI upper = 0.050, p = 0.956; cut-off <0.06), while the SRMR provides additional evidence for the close fit of the three-factor solution (0.058; cut-off: <0.080). In addition, the incremental fit statistics also indicate that the model is a good fit for the data (CFI = 0.99; robust CFI = 0.970; TLI = 0.99; robust TLI = 0.960). The Kaiser-Meyer-Olkin (KMO) statistic as a measure of sampling adequacy was 0.87, which is considered very good. In addition, and importantly, the KMO statistics from EFA and CFA are very similar (0.83 and 0.87, respectively), which indicates that the shared variance among variables and the latent factor structure is similar in both data subsets. This also provides support for the generalizability of the factor structure across datasets.

Additional Validity Testing of the Adolescent Resilience Index

The ARI has good content and face validity based on the scale development methodology: The adolescent measure was based on the published adult Resilience Index, adapted, expanded, and refined by subject matter experts who also incorporated the latest scientific evidence. Finally, the measure was also reviewed by community educators for comprehensiveness, cultural appropriateness, and sensitivity for the study population. In addition, we tested for concurrent validity using an existing measure of adolescent resilience, the Child and Youth Resilience Measure (CYRM-R). Results showed a large to very large correlation between the two measures (r = 0.66), confirming that the ARI has strong concurrent validity with an existing measure of adolescent resilience. Studies to demonstrate additional forms of validity are ongoing.

Summary & Conclusion

We aimed to develop and validate a new, comprehensive, and inclusive measure of adolescent resilience that can reliably be used in both high and low- to middle-income countries. We achieved this by running exploratory factor analysis (EFA) on one subset of the data, and confirmatory factor analysis (CFA) on the other subset. Results from EFA revealed a three-factor solution closely resembling the factor structure of the adult Resilience Index. Furthermore, CFA confirmed the three-factor solution derived from EFA, while all absolute and incremental fit indices confirmed a good, close fit of the model. Taken together, these results provide convincing evidence for the reliability, stability, validity, and generalizability of the three-factor solution of adolescent resilience as measured by the 19-item ARI.