

Development and validation of the Stress Sensation Inventory (SSI) to measure stress among students aged 15 to 19 years in Sri Lanka

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Background

Despite the fact that stress may be associated with adverse psychological effects, there are no validated scales to measure stress among Sri Lankan adolescents.

Objectives

To develop and validate a scale (SSI) to measure stress among students aged 15 to 19 years in Sri Lanka.

Methods

In-depth interviews and focus group discussions were conducted among adolescents, in order to explore physical symptoms and thoughts experienced and their behavioural responses, when faced with challenging problems and situations. Following this, a brief, self-administered instrument, the Stress Sensation Inventory (SSI) was developed by a group of experts. The SSI was then validated among 127 school-going adolescents, and the scores were compared with the GHQ30 score and the clinical assessments carried out by a psychiatrist. The cut-off

point was determined using the receiver operator characteristic (ROC) curve.

Results

Cronbach's alpha reliability of the SSI score was 0.8319. The reliability of the psychological, psychosomatic, emotional, and cognitive subscales were 0.7931, 0.6323, 0.6389 and 0.7439 respectively. Measures of validity were satisfactory, with a sensitivity of 84%, specificity of 72%, positive predictive value of 62%, and negative predictive value of 90%. The Kappa agreement between the SSI and GHQ 30 was fair (0.35).

Conclusion

The SSI is an acceptable, easy to use instrument for measuring stress in school-going adolescents in Sri Lanka. It fulfils stringent criteria of reliability and validity.

Key words: stress, adolescent, psychiatry, Sri Lanka, students

SL J Psychiatry 2015; 6(1): 17-21

Introduction

Stress is an invariable factor in life. However, negative stress may cause responses ranging from tiredness to severe depression. If a situation is unpredictable and uncontrollable, the result is likely to be a stress response. Adolescents who are going through puberty, must meet the changing expectations of others and cope with new feelings (1). The way these challenges are negotiated has critical implications for long-term health and development (2).

Stress in adolescents could present in a myriad of ways, including psychosomatic and psychological features such as dizziness, feeling low, headache and stomach pains, fatigue, lack of appetite, and low level of school satisfaction (3-5). Although this is a common problem, there is no satisfactory method to measure stress among Sri Lankan adolescents. There are several instruments available internationally to measure stress among adolescents. The Perceived Stress Scale (PSS) is one such instrument which measures psychological stress related to specific situations (6). The PSS shows good reliability (Cronbach's alpha 0.67) and satisfactory concurrent validity when compared with the Hospital

Anxiety and Depression Scale-Anxiety (HADS-A) scale and Stress Likert Scale ($r=0.65$ and $r=0.54$ respectively) but it has not been validated for Sri Lanka (7, 8). The General Health Questionnaire-30 (GHQ-30) has been constructed for the assessment of the presence of any mental disorder, but since it identifies anxiety, minor depressive illness and transient situational disturbances (e.g., such as feelings of incompetence in coping) it has been used in Sri Lanka to measure psychological aspects of stress (9-11). Thus none of these scales comprehensively evaluate the effects of stress. Although there are other international scales that measure stress, adaptation is a challenge due to logistic unfeasibility. Therefore there is a need for a method of measuring stress among Sri Lankan adolescents. Thus, the aim of this study was to develop and validate a scale (the Stress Sensation Inventory) to measure stress among students aged 15 to 19 years in Sri Lanka.

Methods

Designing of the SSI

In designing the Stress Sensation Inventory (SSI), several scales, namely the PSS, measures used for the

World Health Organization's cross national survey "Health Behaviour in School-Aged Children" (HBSC) and the GHQ-30 validated for Sri Lanka were studied and relevant items were modified and adapted (6, 11, 12).

Twenty seven in-depth interviews and four focus group discussions (FGDs) were conducted among 15 to 19 year-old school going adolescents. The interviews and discussions explored physical symptoms and thoughts experienced by these students, and their behavioural responses, when faced with challenging problems and situations. In order to maintain homogeneity among members of the focus groups, male and female students in the Ordinary Level and Advanced Level classes were categorised into the four groups.

Recurrent themes that emerged from the interviews and discussions included physical symptoms and thoughts commonly experienced during stressful events, and the ways in which these adolescents behaved at times of stress. Based on these themes, individual and informal group discussions were conducted with experts to identify symptoms related to stress. After preliminary discussions, the principal investigator drafted a list of symptoms. Clarity, appropriateness and suitability of the items were judged by a group of experts including psychiatrists, psychologists, community physicians, educationalists and sociologists. The final items were categorised into different domains and sub-domains.

Development of the composite score for SSI

For each item an un-weighted minimum value of 0 was given to the response "never" and a maximum value 3 to the response "always". Responses to positively stated items were reverse scored. The total score was calculated by adding individual scores of each item. A higher value indicated an increased likelihood of having experienced stress, while lower values indicated a lesser likelihood of having stress. Based on this, arbitrary cut-off values were calculated, with the highest value range indicating severe stress and the lowest value range indicating presence of minimum or no stress. Thus depending on the level of stress experienced the SSI score was divided into three categories, namely severe (total score 64-96), moderate (total score 32-63) and no stress (total score 00-31).

Validation of the SSI

Study sample and methodology

The SSI was pretested on 35 school going adolescents in the Gampaha district, in order to determine acceptance, feasibility, understanding and interpretation of questions, and assess logistical problems. Based on the results, a few changes were made in the wording and sequence of items in the scale. Thereafter the validation of the SSI was conducted in a school with Advanced Level classes, situated in the Gampaha District of Sri Lanka. Female and male students in the age group 15-19 years were included in the study. Non-Sinhala speaking students

were excluded and adolescents with learning disability, hearing or visual impairment, and history of stroke, head trauma, psychotic illness or depression were also excluded.

The sample size was calculated using the desirable lowest sensitivity and specificity. As this was a screening instrument, sensitivity was required to be high and specificity had to be acceptable. Hence, 80% sensitivity and 80% specificity were used to calculate the sample size (13). Accordingly the minimum sample size required was 124. Convenient sampling was used and all the students who were in the age group of 15 to 19 years in the selected school were recruited for the study.

Reliability of the instrument

Internal consistency of the responses to questions coming under each sub-domain was measured by calculating Cronbach's alpha using the statistical software package SPSS (14).

Face validity of the SSI

The face validity was ascertained during the discussions with experts and during the stage of pretesting.

Content validity

The content validity was established by obtaining information from in-depth interviews and FGDs with adolescents, discussions with experts, review of other scales, and obtaining the agreement of the expert panel using the Delphi Method (15).

Construct validity

Stress is associated with mental disorders as well as suicide (16, 17). The GHQ-30 measures the probability of having a mental disorder and has been validated for use in Sinhalese in Sri Lanka to measure stress (10, 11). Thus, it was decided to use the GHQ-30 to assess the construct validity of SSI. The cutoff value for the GHQ-30 was taken as 5/6 (10), where a score of 6 indicated psychological distress. The Pearson correlation coefficient was used to measure the correlation between the scores of the two instruments. Kappa agreement was used to detect the agreement between the two instruments.

Criterion validity

Criterion validity was assessed by comparing the SSI results with the gold-standard for identifying stress. Since there is no absolute 'gold standard' for assessment of stress, the clinical judgment of a consultant psychiatrist was considered as the 'gold standard'. All participants were invited to complete the SSI. Subsequently, on the same day, participants were interviewed by a psychiatrist who was blind to the results of the SSI. To ensure uniformity of the interviews, the psychiatrist developed and used a structured guide. The

criteria used for diagnosing stress by the psychiatrist included physical symptoms, cognitive symptoms e.g. concentration difficulties, emotional symptoms, self-perceptions and coping. Based on the psychiatrist interviews, the participants were categorized into three categories – namely those suffering from severe, moderate and no stress.

The cut-off point for the SSI was determined using the receiver operator characteristic (ROC) curve. Various cut-off points were selected and sensitivity and specificity at each point was determined. Then sensitivity as a function of specificity was graphed.

Ethical clearance was obtained from Ethical Review Committee of the Faculty of Medical Sciences, University of Sri Jayewardenepura and informed written consent was taken from all parents/legal guardians of the participants.

Results

A total of 127 adolescents were included, of whom 56% were males. The mean age was 16.1 years (SD=1.0). Two third were 15 to 16 year olds. The group comprised mainly of Sinhalese (94%) and Buddhists (91%) and the majority belonged to social class II.

Reliability

Cronbach’s alpha values for the different domains of the SSI are given in Table 1.

Instrument	Domains	Subdomains	Cronbach’s alpha
SSI			0.8319
		Psychosomatic	0.6323
		Psychological	0.7931
		Emotional	0.6389
		Cognitive	0.7439

Construct validity: Comparison with GHQ-30 questionnaire

Table 2 shows the results of the comparison of the GHQ-30 and the SSI. The Kappa agreement was 0.35 and Pearson correlation coefficient was 0.38 (P < 0.001).

SSI	Mental wellbeing by GHQ 30					
	Affected		Not affected			
	No.	%	No.	%	No.	%
Stress +	28	77.8	32	36.0	60	48.0
Stress -	08	22.2	57	64.0	65	52.0
Total	36	100.0	89	100.0	125	100.0

Criterion validity

The level of stress based on the SSI score and judged by the psychiatrist interview was compared to determine criterion validity (Table 3). The criterion validity of the SSI was further assessed by calculating the sensitivity, specificity, positive and negative predictive values and false positive and false negative rates (13).

The sensitivity and specificity were calculated using different cut off points of scores of the SSI. The optimal cut off point was obtained using the receiver operating characteristic (ROC) curve (Figure 1). At a cut-off point of 31.5, the sensitivity was 84.1% and specificity was

According to SSI	Psychiatrist’s interview							
	Severe stress		Moderate stress		No stress		Total	
	No	%	No	%	No	%	No	%
Severe stress	02	100	01	2.4	00	00	03	2.4
Moderate stress	00	00	34	81.0	23	27.7	57	44.9
No stress	00	00	07	16.7	60	72.3	67	52.8
Total	02	100	42	100*	83	100	127	100*

*Rounding off effect

72.3%, which provided the best discrimination between students who were suffering from stress, and those who were not affected by stress.

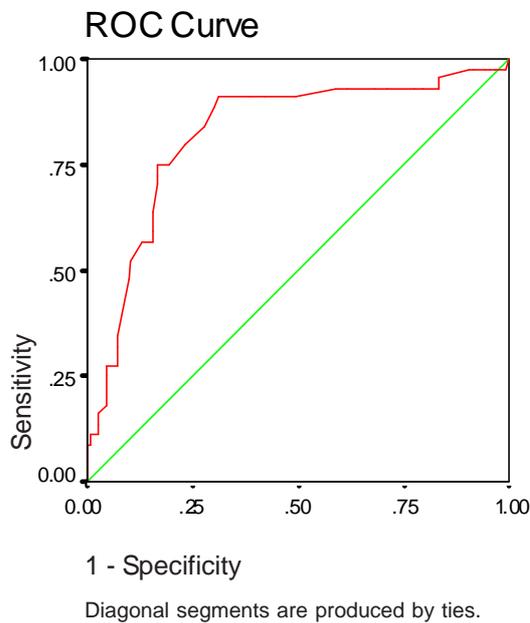


Figure 1. Receiver Operating Characteristic curve of the SSI

The positive likelihood ratio was 3.0 and the negative likelihood ratio was 0.22. The SSI had a Positive Predictive Value (PPV) of 61.7%, whereas the Negative Predictive Value (NPV) was 90.0%. The false positive rate was 27.7% and the false negative rate was 15.9%.

Discussion

Stress can be defined as a condition occurring when there is an “imbalance between demands and resources” or when “pressure exceeds one’s perceived ability to cope” and (18). The stress response has different domains. The SSI clearly identified these different domains namely ‘psychosomatic’ and ‘psychological’, which is an advantage when compared to tools which measure stress in only one domain. This is particularly important since the presentation of stress among students in Sri Lanka is not equally distributed among these domains, as was identified during FGDs and in-depth interviews. Thus the SSI was developed to cover all the domains of the stress response.

The reliability of the SSI, as assessed by the Cronbach’s alpha, was 0.8 for the total score and was more than 0.6 for all the sub-domain scores. A Cronbach’s alpha value of above 0.6 is considered satisfactory and above 0.7 is considered excellent (19-22).

Face validity of the SSI was ascertained during pre-testing. A comprehensive literature review, formal and

informal discussions with experts, in-depth interviews and FGDs with students were carried out to obtain a high content validity. Assessment of construct validity revealed a Kappa agreement of 0.35 between the GHQ-30 and the SSI scores. According to Altman this indicates a fair level of agreement between the SSI and GHQ-30 (23). Although the strength of the agreement was not strong, the Pearson correlation coefficient indicated a significant correlation between SSI and GHQ-30 ($p < 0.001$). The GHQ-30 has been primarily constructed to assess the probability of having a mental disorder and is not comprehensive for stress assessment (9-11). This may be the reason why the Kappa agreement was not highly satisfactory. However, the correlation between the two tools was significant and the reason for this could be that the two instruments measured similar psychological features to some extent.

Criterion validity in the context of SSI is the ability of the instrument to correctly distinguish those who were stressed from those who were not. This was assessed by comparing the SSI results with the “gold-standard” for identifying stress, which was considered to be the clinical judgement of a consultant psychiatrist. Ideally, a screening test should have a high sensitivity and a high specificity; however there is a trade-off between the sensitivity and specificity. A balance of specificity and sensitivity is placed at the cut-off point between the decision of arbitrary normal and abnormal values (24). Using the receiver operator characteristic (ROC) curve, a cut-off point of 31.5 was chosen for the SSI, which gave a sensitivity of 84.1% and specificity of 72.3%. These results are acceptable for a screening tool. The PPV and NPV of SSI were 62% and 90% respectively. The PPV and NPV are the proportions of positive and negative results in the tool which are true positive and true negatives (25). The PPV value for SSI is low. The predictive values depend on the prevalence and specificity and to a lesser extent, on the sensitivity. Even with high sensitivity and specificity, if the prevalence is low, the PPV may be low (26). On the contrary, likelihood ratios (LR) are not affected by the prevalence. The LR of a result is the probability of that result being present in patients with a condition divided by the probability of the same result being present in patients without the condition (27). The likelihood ratio can be used to assess how good a diagnostic test is and to help in selecting appropriate diagnostic tests (27). Further, according to this study results, the false positive rate of the SSI was 28% and the false negative rate was 16%. The positive likelihood ratio was 3.0 and negative likelihood ratio was 0.22. Having a positive likelihood ratio of 3.0 means that a student identified as having stress via SSI is three times more likely to be from the group of students who truly have stress than from the group of students who does not have stress.

Limitations of this study include the fact that the study was carried out in an urban setting in the Gampaha district of Sri Lanka. The socio cultural factors operating in more

rural settings could be different to the factors in this urban area. Furthermore the criterion for this study was the clinical judgement of a consultant psychiatrist. Although it would have been better if the concurrence of two psychiatrists was used as the criterion this was not feasible due to logistic issues.

In conclusion, the SSI is a promising new instrument for measuring stress in school going Sinhalese speaking adolescents aged 15 to 19 years. It is easy to use, culturally appropriate, and acceptable to students. It covers different domains of the stress response and fulfils stringent criteria for reliability and validity. Its use in other contexts and with different age and ethnic groups requires further validation.

Acknowledgements

This study was supported by a grant from 'Basic Needs', a Non-Governmental Organization in Sri Lanka. The authors would like to acknowledge the technical assistance of Dr. Sudath Samaraweera, of the Epidemiology Unit, Ministry of Health, Sri Lanka.

Declaration of interest

None declared

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