RESEARCH ARTICLE

Development of a Self Report Stress Scale Using Item Response Theory-I: Item Selection, Formation of Factor Structure and Examination of Its Psychometric Properties

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ABSTRACT

Introduction: Due to the absence of Turkish psychometric devices assessing stress, in the present study it was aimed to develop a stress scale, and examine its basic psychometric properties.

Methods: Current study included two processes, formation of item pool and examination of psychometric properties of the selected items through three studies. In the first study, 611 individuals aged between 18 and 77 responded to 130 selected items. In the second study, 2223 individuals aged between 18 and 68 responded to 80 items. In the third study, 1969 individuals aged between 18 and 79 responded to the final form of 36 items. Further, in study 3 for criterion related validity 163 individuals completed the Coopersmith Self-Esteem Inventory, 113 individuals completed the Beck Anxiety Inventory, 104 individuals completed the Hospital Anxiety and Depression Scale, 107 individuals completed the Beck Depression Inventory, and 265 individuals completed the Perceived Stress Scale. Moreover, in the investigation of test-retest reliability, 119 individuals took the final form of the test after 2 weeks, and 111 individuals took the final form of the test after 3 weeks.

Results: In the first study, out of 130 items, 54 that showed item-total score correlations below 0.30 were excluded from the scale. Fifty-seven items were preserved exactly, and 19 items' sentence structures

were changed. Furthermore, by adding 4 new items, 80 were prepared for the second study. In the second study, two factors structure namely "Physiological Reactions/Strain" and "Psychological/Cognitive Appraisals" sub-dimensions were identified, and 36 items were selected via Item Response Theory representing these sub-dimensions. In study 3, exploratory factor analysis provided strong support for our hypothesized two factors structure. Confirmatory factor analysis indicated hypothesized model had a better fit to the data. Internal consistency coefficients were 0.94 for the entire scale, 0.90 for Physiological Reactions/Strain sub-dimension, and 0.91 for Psychological/Cognitive Appraisals sub-dimension. Correlation coefficients between the entire scale and other criterion scales ranged from 0.22 to 0.63. Test-retest correlation coefficients between the first administration of the scale, and the administrations at two and three week intervals were 0.88.

Conclusion: Results showed that the scale has basic psychometric requirements provided that the scale will be supported by validity studies.

Keywords: Stress scale, strain, cognitive appraisals, biopsychosocial model, item response theory

INTRODUCTION

Although it has been studied for almost a century, it has been stated that a satisfactory and consensus based definition of stress is difficult to reach; and that theory based measurement is not possible (1–5). Thus, related studies reveal multiple definitions and efforts for a definition based on a wide range of disciplines such as anthropology, physiology, endocrinology, sociology, and psychology. On the other hand, it was indicated that different definitions and approaches result a chaotic situation, and cause hardships to conceptualize the connections between these approaches (6). Case oriented approaches or conceptualization efforts are based on different criteria. One approach has three main headings; named as "response" related with somatic processes, "stimulus" related with peripheral stimuli and external demands, and "transactional" related with psychological and cognitive processes (7–10). Another approach, on the other hand, consolidates these three headings into two, named as "biological" and "psychosocial". "Biological" approach is based on physiological and endocrinological responses, while "psychosocial" approach includes stimulus and transactional concepts (11–14). Biopsychosocial model (BPS), on the other hand, presented as a frame which unifies these two headings (15–19).

According to the studies based on biological approach, the results, especially related with sympathetic nervous system indicate that stress cause physiological changes. In order to restore internal balance which is destroyed by these changes, organism is prepared for a response process (20–22). Psychosocial model, on the other side, conceptualizes stress as a

reaction of organism against non physical stressors. Cognitive processes play an important role for the formation and modulation of emotional states (23, 24), and either increase or decrease the effect and perception of stressors (6).

Forty years ago, BPS model was introduced as a new framework for application, education, and research in the field of health (25–30). Later, it was defined as unqualified as a model and criticized for limitations such as being non-testable, being too general and not having well defined operational criteria for individual patients (19, 31, 32). The studies, in which the model was used, indicated the limitations of the model, but it was also emphasized that social, biological and psychological factors were interacted for the analysis of diseases (28, 33, 34), and similarly results were revealed on how these factors affected physical health altogether (15, 25).

Currently, the model is considered a more valid approach compared with the past (35–37), and as the best way of explaining stress (38). It is also emphasized that more and more studies based on the model are being done for understanding stress (36, 39). On the other hand, it was claimed that scientific details of the model are not fully revealed, and that there are still unanswered questions and important deficiencies (16, 40). The relationship between external stimuli and stress response based on this model is shown in Figure 1.
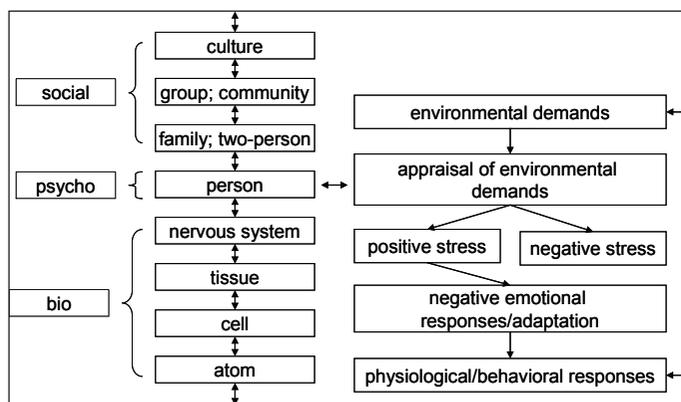
Figure 1. Biopsychosocial Model and Explanation Schema of Stress*
   *Taken from Engel (26), Smith et al. (19), Wright (10), and Wright et al. (128) and combined.

The Measurement of Stress

The efforts for conceptualizing stress basics as "stimulus", "response", and "transaction" also indicate the direction of measurement process. In order to achieve this, measurement efforts are focused on the definition of stress as: a) external demands, peripheral stimuli or external stress sources as "peripheral factors/stressors"; b) "physiological reaction/tension" related with somatic processes, biological reactions and/or feelings; and c) "psychological/cognitive processes" which indicate the interaction between person and environment such as the effect size of stressors, or personal capacity for management (7–9, 41). Another classification for measurement ignores conceptualization, and consolidates these three components into two as: a) "external demands" instead of stimulus approach; and b) "somatic reactions" to external demands depending upon general arousal, by combining response and transaction phases (42).

Among the previous studies related with the measurement of stress, one of the aforementioned approaches mainly focused on environmental factors/stressors, or stress reactions and coping with stress (43–47). This kind of stress measurement has to emphasize the frequency of stressors, and the efforts of coping with stress are individualistic (9). Nevertheless, it was strongly emphasized that cognitive appraisal for severity of stressors

(transactionally based processes) must be included in the measurement of stress (9, 48). Moreover, it was also indicated that "transactionally" based evaluations will be the preferred method of stress measurement for future studies (49). As previously mentioned, efforts for measuring perceived stress transactionally, as evaluation of personal psychological/cognitive processes are noticed in newer studies (50).

It is indicated that the measurement of stress includes three conceptual and psychometric problems, namely: a) structural versus individual measures of the impact of stress; b) objective versus subjective assessments of stress due to prejudice; and c) major events versus daily hassles (51). It is also indicated that better measurement would be achieved by specifying daily hassles, and include them for assessment instead of emotion/event assessment based on more general or major components. Moreover, it is emphasized that the source and the content of stress such the specification of daily hassles should be taken into consideration, and that this is more important than the level of the source, or the content (3). In addition, two major points are underlined for the measurement of stress. Firstly, self-report type stress tests should take into consideration personality trait components which are usually ignored. Secondly, it is strongly suggested that stress should be measured multidimensionally instead of unidimensionally (52).

Since the perception of stressors or related environmental events/stimuli is based upon subjective personal evaluation instead of an objective one, assessment is dependent on the individual's evaluation of his or her resources, goals, and past experiences (3, 9, 53). Thus, the measurement or evaluation of stress, whether done as self-reported or based on physiological parameters, reveals analysis and measurement just based on subjective perception. Methodologically, the evaluation of stress is not structured, and has important limitations since it is a subjective variable (51). It is also indicated that the stressors and the outcome of stress are confused due to its subjectivity, and that this confusion cause both components to affect each other creating a vicious cycle (43, 46). Thus, it is claimed that it is inevitable for the measurement of stress to include both overt and latent confounding variables (9). It is emphasized that the presence of confounding variables or other problems that interfere with the measurement, especially for the measurement of cognitive processes, should be assumed (3, 48). It is also emphasized that the most appropriate way of measuring stress is to reveal how social, environmental, and/or psychological factors affect an individual biologically and psychologically (7).

Although, the subject of stress had been studied for a considerably long time (4), there is still a need for more studies for it to be understood completely. Since, the better measurement is directly linked with the conceptualization of the phenomenon, novel and repeating studies are required. On the other hand, it is indicated that the individual assessment of stress could be based on the biopsychosocial model (54). At the same time, in spite of limitations, some evidences were claimed that self-report type assessment could be used for general health and physical status (55–57). In this study, it is aimed to develop a new scale due to aforementioned reasons, and the limitedness of such tools in Turkish. Thus, the aim of this study is develop a multidimensional assessment tool, and to investigate its psychometric aspects, based on the need indicated in the contemporary literature.

METHODS

This study consisted of two processes, and three studies; first process was creation of the item pool, and reviewing the items (1st study); second process was examination of psychometric properties of the created and selected items/form (2nd and 3rd study). The study was carried out by the approval of ethical committee of FSM Vakıf University. Participants were

selected by convenience sampling, and identifying information was not received. Subjects filled out a form stating that they voluntarily accepted to participate in a scientific study.

Study 1

Generation of Item Pool/Creation of Item Pool

Researches created 130 items considering the items in the previous stress scales (44–46, 58–65), definition of the concepts and components in the related literature, and related variables (3, 9, 10, 41, 43, 48, 52, 66–73). Self-report items were answered on a 5-point Likert scale, between completely agree=1, and never agree=5.

Participants

Item pool was administered to a total of 611 individuals, age range was between 18 to 77 years (mean=31.91±13.51years), 343 females (% 56.1), 263 males (43.0) and 5 individuals (% 0.8) who did not specify their gender.

Procedure

The participants answered the 130-item form of the A Stress Scale which is being developed, and a socio-demographic data form. The study was completed within one academic term in İstanbul.

RESULTS

The data of item pool were examined by reliability and item analysis and 54 items which had similar contents and/or weak associations with the whole scale, item-scale correlations below 0.30, were excluded; 57 items were not changed. Nineteen items were changed because their wording and sentence structure were not sufficiently clear (e.g., instead of "I live in solitude." "I feel lonely.") In addition, 4 new items were added to the second administration form; these were the scant items or the items that were not sufficiently represented in the item pool, and they were related to family relations. Thus, a new item pool of 80 items was created for the second administration.

According to the results of Exploratory Factor Analysis (EFA) performed on the 130-item scale, before the items of the item pool were eliminated, two-factor solution obtained considering eigenvalue (factor properties were given in the second study) explained 34.99% of the total variance. Internal consistence coefficient of this item was found as 0.98. After the items were eliminated or changed, EFA results of the remaining 57 items explained 42.68% of the total variance in two-factor solution. Internal consistency coefficient for these items was obtained as 0.97.

Study 2

Procedure

Participants were administered 80-item form of the A Stress Scale and a socio-demographic data form. The study was carried out in Istanbul within a period of one year.

Participants

The participants were a total of 2223 individuals, between the ages of 18–68 years (mean=34.38±10.49 years), 906 were females (408%), 1242 were males (55.9%) and 75 individuals (3.4%) did not specify their gender. There were 776 singe (44.9%), 1255 married (56.5%), 23 widows (1.0%), 49 divorced (2.2%) individuals, and 120 (5.4%) not specified the marital status. Their educational levels were as follows: 191 individuals (8.6%) primary school, 229 individuals (10.3%) secondary school, 681 individuals (30.6%) high school, 992 individuals (44.6%) university graduates, and 130 individuals (5.8%) did not specify the educational level. For the economic status, 169 individuals (7.6%) assessed income as low, 1378 individuals (62.0%) assessed income as middle, 454 individuals (20.4%) assessed income as high, and 222 individuals (10.0%) did not specify income level.

RESULTS

For the analysis of data, EFA, Confirmatory Factor Analysis (CFA), Item Response Theory (IRT) and Reliability-Item Analysis were carried out in item selection process. CFA was calculated with AMOS v.21.0 programme, for IRT Parscale v.4.1 programme was used, and other procedures were performed with SPSS v.21.0 programme. Results for the selected items are given under the heading of reliability and validity.

Construct Validity

The results of EFA of 80 items, considering eigenvalue, revealed two factor-solutions, nevertheless, different factor solutions, one factor to ten factors, were examined. All factor structures obtained, considering eigenvalue and percentage of variance explained, were compared with fit indexes of CFA. The results of CFA comparisons showed that two-factor structure gave the best fit index in accordance with the results of EFA in all factor solutions.

According to EFA results, the suitability of data for factor analysis (Kaiser-Meyer-Olkin Measure of Sampling Adequacy=0.959; Bartlett's Test of Sphericity (630)=26750.13; p<0.001) was seen, and two-factor structure explained 36.51% of the total variance. Considering the contents of the items, two factors were named as "Physiological Reactions/Strain (PR/S)" sub-dimension (e.g., I am having shortness of breath recently.), and "Psychological/Cognitive Appraisals (P/CA)" sub-dimension (e.g., I feel like I'm trapped.) (Table 1).

According to the results of CFA, Goodness of Fit Index (GFI), Comparative Fit Index (CFI), Normed Fit Index (NFI), and Root Mean Square Residual (RMR) showed good fit; Adjusted Goodness of Fit Index (AGFI) showed acceptable fit; Root Mean Square Error of Approximation (RMSEA), and Chi-Square/DF ratios were higher than acceptable fit value for two-factor solution (74) (see Table 2).

Item Selection Procedure

First of all, 80-item form was examined by IRT. IRT provides more information than classical test theory (75, 76). In this study, Two Parameter Logistic Model (2PLM) was used to examine the items. Calculated "a" and "b" item parameters are shown in Table 3 and Table 4. Letter "a" shows item discrimination, letter "b" shows item difficulty. Item discrimination makes it possible to distinguish individuals with high and low stress levels (75, 77). As for item difficulty, it points out where the item is functional on the stress level. High "b" value shows that the item is functional on individuals with high stress levels; on the other hand low "b" level is functional on individuals with low stress levels (65, 78–80).

Items that showed low discrimination in IRT, and items which had item-scale correlations below 0.30 were not included in the scale. Afterwards, among the items with different contents, items with high and low difficulty levels were chosen to represent different levels of stress measured in the scale. In this phase, items which showed low factor loadings in EFA analysis, as well as items which had similar loadings on both factors were eliminated. In the last phase, a total of 36 items were selected out of 80 items, 18 items for the PR/S and 18 items for the P/CA sub-dimension.

Reliability Results

The results of reliability analysis showed internal consistency coefficients of 0.93, 0.88, 0.90 respectively for the whole scale, for PR/S, and P/CA sub-dimensions. Split-half correlation coefficient for the whole scale was obtained as 0.84. Spearman-Brown and Guttman Split-Half coefficients for internal consistency of the first and second halves of the scale had similar results (see Table 5).

Table 1. Results of exploratory factor analysis of the A Stress Scale

Item Numbers According to 2nd/3rd Study Design	2nd Study Psychological/ Cognitive Appraisals Sub-Dimension	3rd Study Psychological/ Cognitive Appraisals Sub-Dimension	2nd Study Physiological Reactions/ Strain Sub-Dimension	3rd Study Physiological Reactions/ Strain Sub-Dimension
item 7/2	0.46	0.60	0.40	0.33
item 20/4	0.41	0.39		
item 35/10	0.51	0.61	0.42	0.36
item 37/8	0.52	0.57	0.32	0.27
item 39/28	0.44	0.46		
item 44/30	0.53	0.54	0.24	0.22
item 46/32	0.47	0.50	0.34	0.28
item 47/26	0.43	0.54	0.32	0.23
item 51/36	0.61	0.58	0.26	0.29
item 52/6	0.64	0.63		
item 57/12	0.57	0.62		
item 59/14	0.65	0.65		
item 60/16	0.63	0.66		
item 62/18	0.65	0.69	0.24	0.27
item 63/20	0.65	0.71		
item 65/22	0.63	0.58		0.22
item 68/24	0.72	0.71	0.21	0.22
item 70/34	0.67	0.64		
item 1/1			0.57	0.59
item 6/15		0.22	0.46	0.55
item 8/5			0.55	0.59
item 11/7			0.61	0.61
item 12/21	0.38	0.46	0.49	0.50
item 14/31			0.67	0.69
item 16/13	0.20	0.30	0.62	0.55
item 18/3	0.23	0.35	0.40	0.36
item 23/17			0.47	0.47
item 27/19			0.57	0.63
item 30/9	0.22	0.27	0.63	0.64
item 41/25	0.21	0.25	0.44	0.45
item 43/23	0.31	0.33	0.41	0.44
item 53/35			0.56	0.61
item 55/11	0.34	0.46	0.56	0.51
item 64/29	0.35	0.43	0.55	0.55
item 66/33	0.20	0.26	0.60	0.64
item 67/27	0.23	0.33	0.41	0.41
Eigenvalues	10.75	12.06	2.40	2.27
Explained Variance (%)	29.85	33.50	6.67	6.30

*Factor loadings below 0.20 are not shown.

Table 2. Results of confirmatory factor analysis of the A Stress Scale for two-factor solution

Model Fit Summary	2nd Study	3rd Study
n	2223	1969
Chi-square	39.09	49.78
DF	1	1
p	0.000	0.000
Chi-square/DF	39.09	49.78
Goodness of Fit Index (GFI)	0.99	0.98
Adjusted Goodness of Fit Index (AGFI)	0.93	0.90
Comparative Fit Index (CFI)	0.97	0.95
Normed Fit Index (NFI)	0.97	0.95
Root Mean Square Residual (RMR)	0.01	0.02
Root Mean Square Error of Approximation (RMSEA)	0.13	0.16

Table 3. Item parameter estimates according to item response theory for the whole A Stress Scale

Item Numbers According to 2nd/3rd Study Design (n=2223)	Slope (a)	S. E.	Location (b)	S. E.
item 1/1	0.930	0.017	0.255	0.037
item 6/15	1.190	0.027	1.906	0.036
item 7/2	1.701	0.034	1.116	0.026
item 8/5	1.162	0.023	1.419	0.034
item 11/7	1.122	0.022	0.782	0.033
item 12/21	1.614	0.031	0.760	0.025
item 14/31	1.224	0.024	0.453	0.031
item 16/13	1.313	0.024	0.221	0.029
item 18/3	1.152	0.024	1.738	0.034
item 20/4	0.772	0.014	0.797	0.041
item 23/17	0.985	0.021	1.766	0.039
item 27/19	0.946	0.019	0.705	0.038
item 30/9	1.573	0.032	1.057	0.027
item 35/10	1.791	0.034	0.572	0.024
item 37/8	1.492	0.028	0.800	0.026
item 39/28	1.061	0.023	2.218	0.037
item 41/25	0.970	0.018	0.357	0.034
item 43/23	1.161	0.023	0.860	0.031
item 44/30	1.317	0.024	1.094	0.029
item 46/32	1.417	0.027	0.838	0.028
item 47/26	1.295	0.024	0.673	0.029
item 51/36	1.705	0.033	1.231	0.025
item 52/6	1.426	0.032	1.638	0.031
item 53/35	1.176	0.023	0.921	0.032
item 55/11	1.687	0.032	0.296	0.025
item 57/12	1.500	0.028	1.221	0.028
item 59/14	1.547	0.031	1.297	0.028
item 60/16	1.505	0.029	0.898	0.027
item 62/18	2.217	0.049	1.356	0.023
item 63/20	1.804	0.037	1.282	0.026
item 64/29	1.985	0.041	1.181	0.024
item 65/22	1.408	0.029	1.290	0.029
item 66/33	1.460	0.030	0.834	0.028
item 67/27	1.227	0.025	1.375	0.033
item 68/24	2.050	0.043	0.982	0.024
item 70/34	1.470	0.030	1.429	0.030

Study 3

Procedure

Participants completed 36-item final form of the scale, and a socio-demographic form with few questions. Also, for criterion validity the Coopersmith Self-Esteem Inventory (CSEI), the Beck Anxiety Inventory (BAI), the Hospital Anxiety and Depression Scale (HADS), the Beck Depression Inventory (BDI), and the Perceived Stress Scale (PSS) were administered to different groups of participants. For test-retest study, a group of participants completed 36-item final form of the scale within two weeks and another group completed the same scale within three weeks time. The study was carried out within two years in İstanbul.

Data Collection Tools

Coopersmith Self-Esteem Inventory: The inventory developed by Coopersmith has two forms (81, 82). The short-form used in this study consists of 25 items, and binary choices rated between 0 and 4 (83).

Beck Anxiety Inventory: The inventory was developed by Beck et al. (84), consisting of 21 items rated between 0 and 3. Higher scores indicate

Table 4. Item parameter estimates according to item response theory for sub-dimensions of the A Stress Scale

Item Numbers According to 2nd/3rd Study Design (n=2223)	Slope (a)	S. E.	Location (b)	S. E.
Physiological Reactions/Strain Sub-Dimension				
item 1/1	1.126	0.027	0.125	0.042
item 6/15	1.125	0.035	2.010	0.049
item 8/5	1.254	0.034	1.242	0.041
item 11/7	1.400	0.038	0.524	0.037
item 12/21	1.362	0.036	0.857	0.038
item 14/31	1.612	0.044	0.289	0.034
item 16/13	1.538	0.041	0.156	0.035
item 18/3	1.082	0.031	1.747	0.049
item 23/17	1.149	0.033	1.606	0.046
item 27/19	1.126	0.031	0.560	0.043
item 30/9	1.843	0.054	0.917	0.032
item 41/25	0.949	0.024	0.373	0.047
item 43/23	1.075	0.028	0.834	0.044
item 53/35	1.294	0.035	0.856	0.040
item 55/11	1.511	0.039	0.201	0.035
item 64/29	1.844	0.053	1.156	0.034
item 66/33	1.660	0.045	0.637	0.034
item 67/27	1.107	0.031	1.480	0.048
Psychological/Cognitive Appraisals Sub-Dimension				
item 7/2	1.362	0.036	1.252	0.039
item 20/4	0.849	0.021	0.533	0.052
item 35/10	1.552	0.041	0.633	0.035
item 37/8	1.474	0.038	0.730	0.036
item 39/28	1.153	0.033	2.138	0.048
item 44/30	1.388	0.035	1.034	0.038
item 46/32	1.402	0.038	0.835	0.038
item 47/26	1.238	0.031	0.647	0.041
item 51/36	1.825	0.049	1.138	0.033
item 52/6	1.690	0.050	1.572	0.038
item 57/12	1.561	0.041	1.174	0.037
item 59/14	1.760	0.049	1.207	0.035
item 60/16	1.744	0.046	0.808	0.034
item 62/18	2.175	0.066	1.406	0.032
item 63/20	1.927	0.053	1.176	0.034
item 65/22	1.541	0.042	1.235	0.037
item 68/24	2.354	0.069	0.927	0.030
item 70/34	1.797	0.049	1.322	0.036

Table 5. Results of reliability analysis for the whole A Stress Scale and its sub-dimensions

	2nd Study (n=2223)			3rd Study (n=1969)		
	A Stress Scale	Physiological Reactions/Strain Sub-Dimension	Psychological/ Cognitive Appraisals Sub-Dimension	A Stress Scale	Physiological Reactions/Strain Sub-Dimension	Psychological/ Cognitive Appraisals Sub-Dimension
k	36	18	18	36	18	18
Alpha	0.93	0.88	0.90	0.94	0.90	0.91
Part 1-k	18	9	9	18	9	9
Part 1-Alpha	0.87	0.79	0.81	0.89	0.81	0.84
Part 2-k	18	9	9	18	9	9
Part 2-Alpha	0.88	0.80	0.86	0.89	0.82	0.83
Correlation Between Forms	0.84	0.76	0.74	0.88	0.81	0.85
Spearman-Brown Coefficient-Equal Length	0.91	0.86	0.85	0.94	0.90	0.92
Guttman Split-Half Coefficient	0.91	0.86	0.85	0.94	0.90	0.92
Test-Retest Study						
Administration After Two Weeks (n=119)						
r				0.88	0.86	0.87
Alpha				0.95	0.92	0.93
Administration After Three Weeks (n=111)						
r				0.88	0.84	0.86
Alpha				0.95	0.91	0.93

higher anxiety on this inventory, and reveal scores for Subjective Anxiety/Panic and Somatic Symptoms sub-dimensions besides a total score (85).

Hospital Anxiety and Depression Scale: The scale which was developed by Zigmond and Snaith (86), and adapted to Turkish by Aydemir et al. (87) consists of 14 items. The odd-numbered 7 items constitute Anxiety sub-dimension, and even numbered 7 items constitute Depression sub-dimension. Items are rated between 2 and 3.

Beck Depression Inventory: The inventory developed by Beck et al. (73, 88) has been translated into Turkish by two different studies (89). In this study, the form translated by Hisli (90, 91) was used. This twenty-one item scale is rated between 0 and 3.

Perceived Stress Scale: The scale was developed by Cohen et al. (92), and adapted to Turkish by Eskin et al. (93). This fourteen-item scale is rated between 0 and 4.

Participants

Participants were between the ages of 18–79 years (mean=32.80±10.89 years), 1076 females (54.6%), 892 males (45.3%), and gender not specified 1 individual (0.1%); a total of 1969 individuals. There were 993 singe (50.49%), 914 married (46.4%), 26 widowed (1.3%), 33 divorced (1.7%) individuals, and 3 individuals (0.2%) did not specified the marital status. Their educational levels were as follows: 60 individuals (3.0%) primary school, 80 individuals (4.1%) secondary school, 537 individuals (27.3%) high school, 1289 individuals (65.5%) university graduates, and 3 individuals (0.2%) did not specify the educational level. For the economic status, 126 individuals (6.4%) assessed income as low, 1252 individuals (63.6%) assessed income as middle, 577 individuals (29.3%) assessed income as high, and 14 individuals (0.7%) did not specify income level.

The participants for the criterion validity study were as follows: a total of 163 individuals, 83 females and 80 males, between the ages of 18–26 years, most of them students, completed CSEI; a total of 113 individuals, 58 females, 55 males, between the ages of 22–60 years completed BAI; a total of 104 individuals, 51 females, 53 males, between the ages of 19–63 years completed HADS; a total of 107 individuals, 56 females, 51 males, between the ages of 23–65 years completed BDI; a total of 265 individuals, 121 females, 144 males, between the ages of 18–64 years completed PSS.

Participants in the test re-test study conducted after two weeks, were a total of 119 individuals, 45 females and 74 males, between the ages of

Table 6. Correlation coefficients between the whole A Stress Scale and its sub-dimensions, and other scales

	n	Alpha	A Stress Scale	Physiological Reactions/ Strain Sub-Dimension	Psychological/ Cognitive Appraisals Sub-Dimension
Coopersmith Self-Esteem Inventory	163	0.70	-0.62***	-0.53***	-0.66***
Beck Anxiety Inventory	113	0.89	0.63***	0.57***	0.64***
Beck Anxiety Inventory-Subjective Anxiety/Panic Sub-Dimension	113	0.84	0.60***	0.54***	0.62***
Beck Anxiety Inventory-Somatic Symptoms Sub-Dimension	113	0.80	0.59***	0.54***	0.59***
Hospital Anxiety and Depression Scale-Anxiety Sub-Dimension	104	0.59	0.34***	0.31***	0.34***
Hospital Anxiety and Depression Scale-Depression Sub-Dimension	104	0.56	0.22*	0.21*	0.21*
Beck Depression Inventory	107	0.76	0.53***	0.47***	0.54***
Perceived Stress Scale	265	0.80	0.58***	0.48***	0.60***

*p<0.05; ***p<0.001

22–61 years; 111 individuals participated in the test-retest study after three weeks, 46 females and 65 males, between the ages of 23–68 years.

RESULTS

Construct Validity
EFA results showed that the data was convenient for factor analysis (KMO=0.961; Bartlett's Test of Sphericity (630)=28546.30; p<0.001) and considering eigenvalue two-factor structure explained 39.80% of the total variance. Similar to the results of previous administrations, items were located in their own factors without substitution between factors (Table 1).

In this study, CFA results, like the results of EFA, were very similar to the results of the second study, and GFI, CFI, NFI and RMR showed good fit, AGFI showed acceptable fit, RMSEA and Chi-square/DF ratios were slightly higher than acceptable fit for two-factor solution (Table 2) (74).

Criterion-Related Validity
The Pearson's correlation coefficients calculated were as follows: the correlation between CSEI and the whole stress scale was -0.62, for PR/S and P/CA it was -0.53 and -0.66; the correlation between general total of BAI and the whole stress scale was 0.63, for PR/S and P/CA it was 0.57 and 0.64; the correlation between Subjective Anxiety sub-dimension of BAI and the whole stress scale was 0.60, for PR/S and P/CA it was 0.54 and 0.62; the correlation between Somatic Symptoms sub-dimension of BAI and the whole stress scale was 0.59, for PR/S and P/CA it was 0.54 and 0.59; the correlation between Anxiety sub-dimension of HADS and the whole stress scale was 0.33, for PR/S and P/CA it was 0.31 and 0.32; the correlation between Depression sub-dimension of HADS and the whole stress scale was 0.21, for PR/S and P/CA it was 0.22 and 0.19; the correlation between BDI and the whole stress scale was 0.51, for PR/S and P/CA it was 0.45 and 0.53; the correlation between PSS and the whole stress scale was 0.58, for PR/S and P/CA it was 0.48 and 0.60 (Table 6).

The internal consistency of these scales were calculated as 0.70 for CSEI, 0.89 for BAI, 0.84 for Subjective Anxiety sub-dimension of BAI, 0.80 for Somatic Symptoms of BAE, 0.59 for Anxiety sub-dimension of HADS, 0.56 for Depression sub-dimension of HADS, 0.76 for BDI, and 0.80 for PSS respectively (see Table 6).

Reliability Results
According to the results of reliability and item analysis, internal consistency coefficients were 0.94 for the whole scale, 0.90 for the sub-dimension of PR/S, and 0.91 for the P/CA sub-dimension (see Table 5).

Split Half Reliability
The correlation coefficient between two halves was calculated as 0.88 for the whole scale, 0.81 for the PR/S sub-dimension, and 0.85 for the P/CA sub-dimension. The first and the second half Alpha internal consistency coefficient of the scale was 0.89, Spearman-Brown and Guttman Split-Half Reliability Coefficients were also found in similar levels (see Table 5).

Test-Retest Reliability
Between first administration and second administration of the scale after two weeks the correlation coefficient was 0.88 for the whole scale, 0.86 for PR/S sub-dimension, 0.87 for P/CA sub-dimension; the correlation coefficient after three weeks was 0.88 for the whole scale, 0.84 for PR/S sub-dimension, and 0.86 for P/CA sub-dimension. In both administrations after two and three weeks, internal consistency coefficient of 0.95 for the whole scale, and 0.93 for P/CA sub-dimension were obtained. As for PR/S sub-dimension, internal consistency coefficient was 0.92 after two weeks, and 0.91 after three weeks (see Table 5).

DISCUSSION

Various models or approaches are suggested to explain and evaluate stress (7, 12–14). Moreover, it was also indicated that cognitive processes must be included (9, 48), and that the best measurement should cover all components such as the BPS model (7, 38). The model itself, is presented as novel framework to unite all efforts to explain stress (15, 17, 19).

It is required to reveal how an individual is affected biologically and psychologically for stress assessment procedure (7). In order to achieve this, this study includes the assessment of physical/physiological signs of stress. Thus, assessments which are based on "biological" and "psychological" approaches (11–14) are represented in two sub-dimensional scales.

In this study, contrary to measurement methods which were used in various studies, and were based on measurement of coping styles and rating of stressors (43–47); assessment of psychological/cognitive processes related with "transaction" based individual perception is aimed as recommended previously (49), and assumed to be the best method (50) of stress measurement. In order to do this, P/CA sub-dimension is included along with the other sub-dimensions of the scale. In this sub-dimension, it is aimed to measure cognition related with social relations such as family, work environment, and stressors.

It was suggested that proper physiological parameters should be used to avoid the limitations of self report type assessment (94–96). It has been revealed that, although some physiological measurements are almost identical to psychological structures, other physiological reactions have limitations for their similarities or proper coupling (97). Moreover, although physiological measurements provide some promising opportunities, it is practically disadvantageous due to its high cost, and the need for highly trained staff. Along with this, physiological measurement results seem to be affected by multiple factors such

as age, sex, or the intake of caffeine or similar substances before the measurement (7, 98, 99). On the other hand, it has been indicated that the relationship between physiological stress responses and self report type measurement is not yet fully revealed. In accordance with this, self report type measurements which provide high validity and reliability are preferred for the measurement of stress instead of neurophysiological assessments (100). In this study, measurements are based on self reports instead of physiological measurements, in accordance with the recommendations emphasized in the contemporary literature.

It is indicated that stress scale items are generally related with a combination of stressor frequency, stressor intensity, and one or more coping mechanisms (9). Life events such as job changes, economic difficulties, diseases, and the death of a loved one, indicate environmental factors as stressors and related coping mechanisms (101, 102) On the other hand, a psychosocial stressor such as a job loss, or a physical stressor such as a disease may trigger a biological stress response as psychological reaction (41, 102). It was aimed to represent physical signs as a result of biological stress responses by the scale items in one of the sub-dimensions of this study. Thus, PR/S sub-dimension include numerous physical signs such as back pain, chest and joint pain, headache, palpitations, heartburn, shortness of breath, and muscle tension; all which have been indicated as stress-related signs.

In the related literature, it is suggested that stress should not be measured unidimensionality (52). This study reveals that both pool items (1st and 2nd study) and selected items (3rd study) clearly differentiate two factor groups namely transaction based psychosocial factors, and physical/physiological signs. On the other hand, CFA fit indexes of two-factor solution is clearly observed in both studies. Although, RMSEA shows low model fit according to CFA results, other fit indexes are at high level. These results were quite satisfactory not only for the presentation of two-factor structure, but also for the confirmation of this structure.

Internal consistency coefficient higher than 0.81 has been qualified as very good for psychological assessment tools (103, 104). The reliability scores for the scale which is introduced in this study is found to be fairly high compared with similar assessment tools for the whole test, and for the two halves of the test. Considering the big size and the heterogeneity of the contributing groups, resulting internal consistency coefficients become more meaningful. Moreover, considering the 2nd and 3rd studies, similar results were obtained in different groups. Likewise, similar internal consistency coefficients were derived even for the very small subgroups of all the participants during the test-retest study of the scale. All these results indicate that the internal consistency level of the scale is stable as well as high.

Considering the results of the 2nd study, PR/S sub-dimension was formed of odd number items, and PC/A sub-dimension was formed of even number items of the 36 item version of the 3rd study. Thus, a more heterogeneous structure related with item distribution was achieved for the two halves of the test. In accordance with this design, internal consistency coefficient differences for the first and second half of P/CA sub-dimension of the 3rd study was eliminated, and the correlation between the two halves was found to be higher.

Correlation coefficients were found to be similar after two- and three-week intervals both for the sub-dimensions, and for the whole scale. Since the concept of stress is affected by time lapses, test-retest correlations might be expected to be weaker. In spite of this, significantly high correlation coefficients in this study along with the same correlations between the first and consecutive administrations indicate the timewise stability of the scale.

Since the concept of stress had been studied for a long time (3–5), the relationship between stress and other variables had also been investigated. In this study, self esteem (105–107), anxiety (108–110), and depression (111–115) were chosen as the most investigated variables. For criterion-related validity, it was observed that the scale had the expected relationship between the related variables. P/CA sub-dimension of the A Stress Scale had higher correlation coefficients with the related variables compared with the PR/S sub-dimension. Total correlation coefficient of the whole scale is the mean of these two sub-dimensions as expected. Naturally, the P/CA subscale had higher correlation coefficient because of the fact that depression, self esteem, and anxiety included a cognitive evaluation processes due to self-report measurement. Different correlation coefficients for different anxiety and depression assessments were thought to be related with different common variance of the assessment tools. Correlation coefficients between the constructs being in the expected direction but weak enough as not overlapping seemed to be a powerful proof for the validity of the scale.

Higher correlation coefficient of P/CA sub-dimension with evaluated variables compared with PR/S sub-dimension was also seen with PSS. The fact that, PSS is based on stress perception may naturally cause this scale to have a higher correlation coefficient with P/CA sub-dimension. The difference in the correlation coefficients of the two sub-dimensions of this scale and PSS could be considered a proof for the structural differences of the sub-dimensions. Moreover, this should be considered as another proof for the structural validity of the A Stress Scale. On the other hand, correlation coefficients between this scale and criterion (PSS) indicate the similarity level between the two. These results are also a proof for the validity of the newly developed scale.

The correlation coefficients between the sub-dimensions of the developed scale and PSS not being very high are in the expected direction. However, the correlation coefficient of 0.58 between the total score of the A Stress Scale and PSS indicates structural differences between the two. This situation, on the one hand, shows that the two scales assess different aspects of stress, and reflects the difficulty of measuring stress as a whole. The important point in terms of this study, the developed scale has contributed to literature by covering a different area of measurement from PSS.

The criteria for criterion-related validity study were selected from other stress scale development studies in the literature (60–62, 116–121). The correlation coefficients of the developed A Stress Scale with these selected constructs are in the expected direction. Negative correlation coefficients between stress level and one of these constructs, namely self esteem has been reported, ranging between 0.30 and 0.66 in different studies, and in different groups (106, 122–126). For this study, the correlation coefficient is obtained between the specified values (r=-0.62).

The correlation coefficient between the A Stress Scale and BDI was found to be 0.53; it was 0.63 for the total score of BAI in this study. In the elderly patient group, it was reported that the correlation coefficient between the stress sub-dimension of the Depression, Anxiety, Stress Scale and BDI-II was 0.62, and the correlation coefficient was 0.59 for the total score of BAI (116). The correlation coefficient between the developed A Stress Scale and the total score of BAI was 0.63, and for the anxiety sub-dimension of HADS it was 0.34; similarly, for BDI it was 0.53, and for the depression sub-dimension of HADS it was 0.22. The reason for the higher correlation coefficients between the developed A Stress Scale, and BAI and BDI, lower correlation coefficients between the new scale and the sub-dimensions of HADS seems to be on HADS. The internal consistency coefficients of the sub-dimensions of this scale are lower than BAI and BDI in this study. It was reported that the internal consistency coefficient of the depression sub-dimensions of HADS was between 0.73 and 0.83 and the anxiety sub-dimension of HADS was between 0.77 and 0.85 in

different ages and groups (127). Internal consistency coefficient of the Turkish translation of HADS was 0.77 for depression sub-dimension and 0.85 for anxiety sub-dimension. Besides, it was indicated that the internal consistency coefficient was higher in physically ill subjects than healthy ones (87). For this reason, the internal consistency of HADS being low and the low correlation coefficient between the A Stress Scale and HADS in this study was in the expected direction.

It has been reported that World Health Organization accepts BPS model as theoretical framework (15), and this model has been presented as the best approach to explain stress (38). Even though it has been studied for a considerably long time, there is a need for further studies on the subject of stress (1–5). The scale which we would like to introduce should be regarded as an effort in this direction. Further uses of this scale should be regarded as validity studies to reflect theoretical structure and application practice. It has been indicated that the model of BPS, and the assessment of stress trough this model requires further investigation (16, 40). Since the assessment of stress is based on subjective/individual perception rather than being objective/structural (51), it is recommended that perceived stress should be evaluated by considering individual psychological/cognitive processes (50). The scale which is presented in this study is a result of an effort to achieve this target through these recommendations.

The fact that the scale is not supported by clinical signs is an important limitation of this study. It seems necessary that norm values should be determined, and it should be tested to see if it is suitable for clinical purposes besides being a screening tool. Moreover, using this scale as a test tool in more homogeneous groups such as certain professions would contribute for a better understanding of its qualifications. Since the development of a scale is an ongoing process, these ideas should also be regarded as recommendations for further studies.

Since the 3rd study included a more homogeneous set of selected items, and it had a shorter structural format, it revealed slightly better analysis results compared to the 2nd study. On the other hand, while both studies included different participant groups, very similar results were obtained for both studies, and this fact should be regarded as positive for the scale. Overall evaluation of the results clearly indicates that, the scale had the basic psychometric qualifications for further uses.

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