

# Development of the Stress Response Inventory and Its Application in Clinical Practice

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**Objective:** The purpose of this study was to develop the Stress Response Inventory (SRI), which includes emotional, somatic, cognitive, and behavioral stress responses, and then to use the scale in clinical practice. **Methods:** First, a preliminary survey was conducted using 109 healthy adults to obtain 75 response items. Second, the preliminary questionnaire was completed by 215 healthy subjects. Third, stress responses were compared among 242 patients (71 with anxiety disorder, 73 with depressive disorder, 47 with somatoform disorder, and 51 with psychosomatic disorder) and the 215 healthy subjects. **Results:** Factor analysis yielded seven subscales: tension, aggression, somatization, anger, depression, fatigue, and frustration. Reliability was computed by administering the SRI to 62 healthy subjects during a two-week interval. Test-retest reliability for the seven subscale scores and the total score was high, ranging between 0.69 and 0.96. Internal consistency was computed, and Cronbach's  $\alpha$  for the seven subscales ranged between 0.76–0.91 and 0.97 for the total score. Convergent validity was computed by correlating the seven subscales and the total score of the SRI with the total score of the Global Assessment of Recent Stress (GARS) scale, the Perceived Stress Questionnaire (PSQ), and the subscale scores of the Symptom Checklist-90-Revised (SCL-90-R). The correlations were all at significant levels. The sensitivity of the SRI was 0.57, specificity 0.74, and the predictive value positive (PVP) was 0.71. The patient group also scored significantly higher on the six subscale scores and the total score than the control group, with the exception being the aggression subscale. The depressive disorder group was highest in total scores on the SRI among the four patient groups, and showed significantly higher total scores than the anxiety disorder and psychosomatic disorder groups. In total scores on the SRI, female subjects scored significantly higher than males. **Conclusions:** These results indicate that the SRI is highly reliable and valid, and that it can be utilized as an effective measure of stress for research in stress-related fields. The depressive disorder group showed more prominent stress responses than the anxiety and psychosomatic disorder groups. **Key words:** Stress Response Inventory, reliability, validity, depressive disorder, anxiety disorder, somatoform disorder, psychosomatic disorder.

DSM-IV = Diagnostic and Statistical Manual of Mental Disorders, 4th edition; GARS = Global Assessment of Recent Stress; GSI = Global Severity Index; MMPI = Minnesota Multiphasic Personality Inventory; PSDI = Positive Symptom Distress Index; PST = Positive Symptom Total; PSQ = Perceived Stress Questionnaire; PVP = Predictive Value Positive; SCL-90-R = Symptom Checklist-90-revised; SRRS = Social Readjustment Rating Scale; STAI = State-Trait Anxiety Inventory.

There has been continued attention to the study of the relationship between stress and illness in psychosomatic medicine. In this regard, various attempts have been made to measure stress in a quantifiable manner. To date, stress has been measured in three

aspects: stressors, stress response, and individual characteristics (personal resources, behavior pattern, coping style). These varying aspects of stress measures are important in planning treatment and evaluating treatment effects (1). The methods used to measure stress include interview format, paper-and-pencil measures, and direct observation. Each of these methods has its own strengths and limitations (1). Despite being criticized for their subjectivity, self-rating scales have been a primary modality for stress measurement (2).

Most studies have measured the frequency and quality of stressors or the degree of life changes. The Social Readjustment Rating Scale (SRRS) (3) is one of the best-known life event scales, and its total score is known to have some predictive value in terms of anticipating disease or illness. However, the scale has also been criticized for its limited clinical utility and for having a low predictability of illness.

The majority of preexisting stress measures arise from clinical research in psychopathology. Therefore, self-rating scales for psychopathology, including mood, have been utilized most prominently as presumptive measures of stress to date (4). Among these measures are the Minnesota Multiphasic Personality Inventory (MMPI) and the Symptom Checklist-90-Revised (SCL-90-R) (5), which measure various psychopathologies, and the Beck Depression Inventory (6) and the State-Trait Anxiety Inventory (STAI) (7),

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which measure unidimensional syndromes, such as depression and anxiety.

Regarding the effect of stressors on health and the progress of illness, more emphasis has recently been given to an individual's cognitive appraisal, coping ability, illness behavior, and social support than to recent life changes (8–10). In particular, cognitive processes (eg, appraisal, coping) and emotional states (eg, anxiety, depression) are considered central to the definition of stress (2).

The efficiency of cognitive function decreases under stress; in particular, severe stress or chronic stress leads to overall depression of intellectual functioning, including cognitive distortions, misinterpretation of situations, unproductive and ineffective thought patterns, and indecisiveness (1). Beck (11) observed the tendency of making one-sided and extreme judgments by those who are vulnerable to stress. This tendency may be explained by the individual's personality or by stress.

In Korea, some stress measures used to date include the Holmes and Rahe's SRRS (3), the Korean version (12–14) of Paykel's scale (15) which modified the SRRS, and the Korean version (16) of the Global Assessment of Recent Stress (GARS) scale (17) which evaluates stress perception of recent life changes. In this study we developed the Stress Response Inventory (SRI) which includes emotional, somatic, cognitive, and behavioral stress responses, and then to use the scale in clinical practice.

## METHODS

### Subjects and Procedures for Preliminary Survey

The subjects included 109 normal adults (56 men, 53 women); 20 years of age or older (mean  $\pm$  SD, 41.6  $\pm$  11.0 years). Their mean (SD) length of education was 14.1 (3.3) years, and their mean (SD) monthly income was \$2485 (730) dollars. 83 subjects were married, and 22 were single. They were sent a letter of consent and the questionnaire along with a written explanation of the study. All but six subjects responded to the questionnaire and returned it to the authors. They were asked how they respond to stressful situations (eg, emotionally, cognitively, somatically, or behaviorally), and to write 10 responses to stressful situations, from the most common, along with demographic characteristics.

The responses obtained from these 109 subjects were subgrouped according to similarity in content and expression, and the frequencies were checked for each response item. It was found that 75 responses were repeated more than five times. In addition to these 75 response items, other items were added by the research team of psychiatrists and psychologists, mostly based on their clinical experience and review of the charts relevant to psychiatric outpatients. More than five members of the research team had to agree to include any of these added items. In total, the preliminary questionnaire contained 104 items, each of which was arranged in a Likert-type format: 'Not at all' (0 point), 'Somewhat' (1 point), 'Moderately' (2 points), 'Very much' (3 points), or 'Absolutely' (4 points).

The research team, consisting of 10 psychiatrists and clinical psychologists agreed to subgroup the 104 response items as four different types of stress responses: emotional, somatic, cognitive, and behavioral. The result was that 18 items were emotional type of response, 37 were somatic, 25 were cognitive, 21 were behavioral, and 3 had a mixture of cognitive and emotional elements. The questionnaire of 104 response items was then administered to 215 healthy subjects whose sociodemographic characteristics are de-

TABLE 1. Sociodemographic Characteristics of Subjects

	Normal (N = 215) N (%)	Abnormal (N = 242) N (%)	Statistics	df	p
Sex					
Men N (%)	108 (50.2)	118 (48.8)			
Women N (%)	107 (49.8)	124 (51.2)	$\chi^2=.098$	1	.75
Age (yrs)					
Mean (SD)	41.7 (10.4)	39.5 (12.6)	$t=2.02$	455	.04
Duration of education (yrs)					
Mean (SD)	14.2 (3.0)	12.9 (3.6)	$t=4.00$	446	.0001
Duration of illness (mon)					
Mean (SD)		31 (42)			
Religion (N = 440)					
Present	135 (65.2)	174 (74.7)			
Absent	72 (34.8)	59 (25.3)	$\chi^2=-4.69$	1	.03
Marital status (N = 422)					
Married	161 (77.8)	155 (72.4)			
Single	46 (22.2)	59 (27.6)	$\chi^2=1.54$	1	.22
Occupation (N = 266)					
Professional	58 (36.2)	27 (25.5)			
Nonprofessional	102 (63.8)	79 (74.5)	$\chi^2=3.40$	1	.07
Income (dollars/mon)					
Mean (SD)	2517 (704)	2273 (864)	$t=3.31$	445	.001

scribed below (Table 1). The 42 most commonly mentioned items (those repeated more than nine times) were selected to make a preliminary questionnaire.

## Subjects and Procedures for Preliminary Questionnaire

The preliminary questionnaire of 104 response items was completed by 215 healthy subjects (108 men, 107 women), 20 years of age and older (mean  $\pm$  SD, 41.7  $\pm$  10.4 years). Their other sociodemographic characteristics are described in Table 1. As described above, however, only 42 of the 104 response items were selected and statistically analyzed. The control group of healthy subjects included hospital employees, family members of medical students, and family members of general ward patients. They were sent a letter of consent and the questionnaire along with a written explanation of the study. All but 11 subjects responded to the questionnaire and returned it to the authors.

The comparison group for the discriminant validity test was composed of patients included from the Departments of Psychiatry at Severance Hospital and Yongdong Severance Hospital, with diagnoses of anxiety disorder, depressive disorder, somatoform disorder, or psychosomatic disorder. These kinds of patients were serially selected and interviewed, and given verbal and written explanation on the outline of the study. Only those patients who consented to the study completed the questionnaires.

The psychosomatic disorder group was composed of 31 outpatients and 20 inpatients who were found with a psychological stressor precipitating illness or aggravating symptoms. The anxiety disorder group was composed of 45 patients with panic disorder, 13 with generalized anxiety disorder, 9 with phobic disorder, and 4 with obsessive-compulsive disorder (40 men and 31 women in total). Their mean (SD) age was 37.9 (11.6) years, the mean (SD) length of education was 13.8 (2.8) years, and the mean (SD) monthly income was \$2485 (730) dollars. 49 were married, and 16 were single. The depressive disorder group included 45 patients with major depression and 28 with dysthymic disorder (32 males, 41 females). Their mean (SD) age was 38.3 (12.3) years, the mean (SD) length of education was 13.4 (3.6) years, and the mean (SD) monthly income was \$2236 (954) dollars. 44 were married, and 20 were single.

The somatoform disorder group included 22 patients with undifferentiated somatoform disorder, 8 with somatization disorder, 11 with pain disorder, 3 with hypochondriasis, 2 with conversion disorder, and 1 with body dysmorphic disorder (26 men and 21 women in total). Their mean (SD) age was 37.3 (13.1) years, the mean (SD) length of education was 12.2 (4.0) years, and the mean (SD) monthly income was \$2006 (802) dollars. 26 were married, and 14 were single. The psychosomatic disorder group included 17 patients with tension headache, 4 with migraine, 7 with chronic gastritis, 19 with diabetes mellitus, 1 with duodenal ulcer, 2 with tinnitis, and 1 with essential hypertension (20 men and 31 women in total). Their mean (SD) age was 45.4 (12.8) years, the mean (SD) length of education was 11.9 (3.5) years, and the mean (SD) monthly income was \$2310 (867) dollars; 36 were married, and 9 were single. Diagnoses were made by psychiatrists based on the DSM-IV (18) criteria. Dually-diagnosed patients were excluded from this study.

All 215 healthy subjects completed the other measures at the same time, such as the Korean version (19) of the SCL-90-R (5), the Korean version (16) of the GARS (17), and the Perceived Stress Questionnaire (PSQ) (20). The SCL-90-R is a 90-item self-rating instrument for assessing psychopathology during the last week, and constitutes nine subscales and three general indices. The GARS is a

self-rating instrument developed for assessing the severity of recent stressors in seven areas and one overall area during the last week. The PSQ is a 30-item self-rating instrument designed to assess perceived stress during the last month, and constitutes seven subscales such as harassment, overload, irritability, lack of joy, fatigue, worries, and tension.

The test-retest reliability of the preliminary questionnaire was calculated by the first and second testings during a 2-week interval by 62 randomly-selected subjects from the original 215 subjects. Factor analysis was conducted and factors were labeled.

## Data Analysis

Factor analysis was conducted using oblimin oblique rotation after maximum-likelihood factor analysis, yielding seven subscales with an eigen value greater than one. Student's *t* test was used to compare the subscale scores and the total score of the SRI between the patient and control groups. Analysis of variance was conducted to compare the subscale scores and the total score between each of the disorder groups and the control group. Scheffe test was then used as a posthoc test, considering differences in the number of patients in each subgroup.

Convergent validity of the subscale scores and the total score of the SRI was calculated with the total scores of the GARS scale, total scores of the PSQ scale, and subscale scores of the SCL-90-R using Pearson's correlation. Test-retest reliability of the subscale scores and the total score of the SRI was calculated using Pearson's correlation on the first and second testing. Internal consistency of the subscales and the total score were calculated using Cronbach's  $\alpha$ .

A comparison of the subscale scores and the total score by sociodemographic characteristics (gender, occupation—either professional or nonprofessional, marital status—married vs. single, and religion—present or absent) was made using the Student's *t* test, whereas the relationship of age, education, income, and duration of illness with the scores was tested by Pearson's correlation. Multiple regression analysis was computed to determine the effect by the sociodemographic variables, with the dependent variable being the total score and the independent variables being those sociodemographic characteristics confirmed as significantly influencing the total score.

## RESULTS

### Sociodemographic Characteristics of the Subjects

The healthy group had significantly higher scores than the patient group by age, education level, and income, whereas the patients were more likely to be religious than the healthy subjects (Table 1). No significant differences were found between the two groups with respect to gender, marital status, or occupation. As described earlier, the psychosomatic disorder patients were significantly older than the other patients ( $F = 5.41$ ,  $df = 3$ ,  $p = .000$ ; Scheffe test  $p < .05$ ), but no significant difference was found with respect to gender among the patient groups ( $\chi^2 = 5.13$ ,  $df = 3$ ,  $p = .27$ ).

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TABLE 2. Factor Analysis of Stress Response Inventory

Items	Tension	Aggression	Somatization	Anger	Depression	Fatigue	Frustration
30. I talk less than I used to.	<b>.55</b>	.16	-.13			.17	
17. My body trembles.	<b>.47</b>	.30	-.37				-.12
37. My face looks rigid.	<b>.44</b>			.22	.19		-.34
2. I don't feel like talking.	<b>.42</b>	.17	-.26	.11	.11		-.26
16. I feel tense.	<b>.35</b>		-.31	.15	-.17		
31. My head hurts or it feels heavy.	<b>.34</b>			-.12	.10		
18. I feel like hitting someone.	<b>.76</b>				.17		
33. I feel like killing someone.	<b>.70</b>			.22			-.18
29. I feel like breaking something.	<b>.67</b>					-.12	.13
28. I act violently (such as reckless driving, cursing, fighting).	<b>.51</b>					.27	
* I start arguing or quarreling easily.	-.27	.27	-.17	.17	.15		-.19
6. I suffer from indigestion.		-.11	-.82				
7. My stomach hurts.			-.73				
10. I feel dizzy.			-.35				
24. I hate someone.			.12	<b>.62</b>	.27		-.34
26. My voice is louder than it usually is.	-.18	.22	-.33	<b>.54</b>	-.21	.16	-.20
27. I easily get impatient.	.18	-.13	-.11	<b>.48</b>	.12	.34	
25. I can't get that thought out of my head.	.34			<b>.41</b>		.19	
34. My face gets flushed or it feels hot.	.18	.33	-.11	<b>.35</b>	.21	.13	-.14
4. I feel angry.			-.13	<b>.34</b>	.23	.12	-.13
* I feel mistreated and resentful.	.16	.19	-.15	.24	<b>.67</b>		
38. I am useless (or unworthy).		.28			<b>.66</b>		
22. I have no future in my current work.				.22			
35. I feel bored.		.12	-.25		<b>.47</b>		
39. I don't like moving any part of my body.	.17	.13	-.15		<b>.42</b>	.19	-.15
15. I have lost my self-confidence.	.28				<b>.37</b>	.12	-.25
23. I often stare blankly.	.23		-.24	.23	<b>.35</b>		
5. I feel agitated and restless.		.17	-.14		<b>.35</b>	.24	-.22
19. I have lost incentive to do anything.	.34	-.18			.27		-.23
* I feel lonely.	.27			.17	.20		-.22
12. I have distracting thoughts.			-.27		.16	<b>.58</b>	
14. I feel totally exhausted.	.24		-.11			<b>.42</b>	
36. I have lost my patience.	.21	.28	-.16			<b>.41</b>	-.23
1. I make many mistakes at work.		.15	-.21			<b>.36</b>	-.29
13. I am easily fatigued.		-.14				<b>.31</b>	-.79
8. I feel like screaming.		.15				.10	-.65
9. I often sigh.			-.12			.14	-.47
20. I feel like crying.	.12			.28	.21	-.14	-.47
11. Everything bothers me.	.20				.30	.22	-.41
3. My chest feels tight.					.10	-.14	-.41
32. My heart throbs.	.29	.21	-.14	.17		-.22	-.33
21. I feel on edge.	.22			.22	.12		-.33
Eigen value (explained proportion %)	18.95 (45.1)	2.31 (5.5)	1.64 (3.9)	1.60 (3.8)	1.29 (3.1)	1.08 (2.6)	1.01 (2.4)

\* items removed from factors because of factor loading lower than .3.

**Bold** figures indicate items greater than .3 of factor loading.

### Factor Analysis of the SRI

Factor analysis was conducted on 42 response items, using oblique rotation after a maximum-likelihood factor analysis, yielding seven factors with an eigen value greater than one. Among them, 39 items with factor loading greater than 0.3 were extracted. The response items with factor loading less than 0.3 were removed from the questionnaire. For those items with factor loading greater than 0.3 on more than one factor at the same time, the greatest one was extracted.

The first factor, labeled 'tension,' was found with an eigen value of 18.95, and explained the proportion of 45.1%. The second factor, labeled 'aggression,' was found with an eigen value of 2.31, and explained the proportion of 5.5%. The third factor, labeled 'somatization,' was found with an eigen value of 1.64, and explained the proportion of 3.9%. The fourth factor, labeled 'anger,' was found with an eigen value of 1.60, and explained the proportion of 3.8%. The fifth factor, labeled 'depression,' was found with an eigen value of 1.29, and explained the proportion of 3.1%. The sixth factor, labeled 'fatigue,' was found with an eigen value of 1.08, and explained the proportion of 2.6%. The seventh factor, labeled 'frustration,' was found with an eigen value of 1.01, and explained the proportion of 2.4%. Each response item's factor loading is listed in Table 2.

As a result, the SRI was finalized with a total of 39 response items under the seven subscales. There were 6 items under the tension subscale, 4 items under the aggression subscale, 3 items under the somatization subscale, 6 items under the anger subscale, 8 items under the depression subscale, 5 items under the fatigue subscale, and 7 items under the frustration subscale. Of the total items, 8 were emotional type of responses, 11 were somatic, 8 were cognitive, 9 were behavioral type of responses, and 3 had a mixture of cognitive and emotional elements. Of the 8 response items of the cognitive type, 4 items were under the depression subscale, 2 were under frustration, 1 was under tension, and 1 was under the fatigue subscale.

Regarding the fitness of the number of factors, the authors inspected the scree plot and used the FITMOD program. On the scree plot, it seemed that the number of factors could be reduced. Using the FITMOD program, however, it was found that root mean square error of the approximation (RMSEA) index and expected cross-validation index (ECVI) of the seven factors were lower than any other number of factors (the RMSEA index of two, three, four, five, six, and seven

factors was 0.078, 0.072, 0.067, 0.061, 0.058, and 0.054, respectively, and the ECVI of two, three, four, five, six, and seven factors was 9.50, 8.83, 8.27, 7.84, 7.59, and 7.39, respectively). These results suggested that seven factors originally extracted from factor analysis are likely to be more fit than any other number of factors.

### Reliability of the SRI

*Test-retest reliability.* Test-retest reliability of the seven subscale scores and the total score was computed by a first and second testing. It was fairly high, ranging between 0.69 and 0.96 (Table 4).

*Internal consistency.* Cronbach's  $\alpha$  was computed for the seven subscale scores and the total score of the 215 subjects, and it was significant, ranging between 0.76 and 0.91 for each of the seven subscales and 0.97 for the total score (Table 4).

*Correlations of SRI subscales.* Correlations between each of the subscale scores and the total score, as well as correlations between the subscales, were all at significant levels, ranging between 0.44 and 0.91 (Table 5).

*Item-subscale total correlations.* The response item scores of the seven subscales correlated significantly with the subscale total score of the SRI (Table 3).

### Validity of the SRI

1. *Convergent validity.* Convergent validity of the SRI was computed by correlating the scale scores with preexisting measures, such as the GARS, PSQ, and SCL-90-R. The seven subscale scores and the total score of the SRI correlated significantly with the total scores of the GARS and the PSQ, and with each of the subscale scores of the SCL-90-R (Table 6).

2. *Discriminant validity.* To assess the discriminating ability of the SRI, the sensitivity, specificity, and predictive value positive (PVP) were measured using a cutoff score (mean score of the total subjects: 82.0). The sensitivity was 0.57, the specificity was 0.74, and the PVP was 0.71.

Discriminant validity was also computed by comparing the scores of the patient group with those of the control group, and by comparing the scores of each disorder group with those of the control group. The patient group scored significantly higher than the control group on the tension subscale ( $14.7 \pm 6.1$  vs.  $10.4 \pm 4.2$ ,  $t = 8.89$ ,  $df = 429$ ,  $p = .000$ ), somatization subscale ( $6.5 \pm 2.9$  vs.  $4.9 \pm 2.2$ ,  $t = 6.83$ ,  $df = 443$ ,  $p = .000$ ), anger subscale ( $14.4 \pm 5.7$  vs.  $11.0 \pm 4.2$ ,  $t = 7.33$ ,  $df = 439$ ,  $p = .000$ ), depression subscale ( $19.3 \pm 8.2$  vs.  $13.6 \pm 5.6$ ,  $t = 8.71$ ,  $df = 427$ ,  $p = .000$ ), fatigue subscale ( $13.7 \pm 4.8$  vs.  $9.5 \pm 3.2$ ,  $t = 11.07$ ,  $df = 426$ ,

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**TABLE 3. Item-Total Correlation of Stress Response Inventory**

Items	Tension	Aggression	Somatization	Anger	Depression	Fatigue	Frustration
30. I talk less than I used to.	.68						
17. My body trembles.	.67						
37. My face looks rigid.	.67						
2. I don't feel like talking.	.68						
16. I feel tense.	.62						
31. My head hurts or it feels heavy.	.63						
18. I feel like hitting someone.		.68					
33. I feel like killing someone.		.73					
29. I feel like breaking something.		.66					
28. I act violently (such as reckless driving, cursing, fighting).		.56					
6. I suffer from indigestion.			.62				
7. My stomach hurts.			.68				
10. I feel dizzy.			.49				
24. I hate someone.				.62			
26. My voice is louder than it usually is.				.58			
27. I easily get impatient.				.69			
25. I can't get that thought out of my head.				.65			
34. My face gets flushed or it feels hot.				.56			
4. I feel angry.				.59			
38. I am useless (or unworthy).					.70		
22. I have no future in my current work.					.70		
35. I feel bored.					.65		
39. I don't like moving any part of my body.					.70		
15. I have lost my self-confidence.					.75		
23. I often stare blankly.					.70		
5. I feel agitated and restless.					.68		
19. I have lost incentive to do anything.					.68		
12. I have distracting thoughts.						.68	
14. I feel totally exhausted.						.67	
36. I have lost my patience.						.50	
1. I make many mistakes at work.						.56	
13. I am easily fatigued.						.56	
8. I feel like screaming.							.75
9. I often sigh.							.79
20. I feel like crying.							.79
11. Everything bothers me.							.73
3. My chest feels tight.							.67
32. My heart throbs.							.65
21. I feel on edge.							.68

Item-total correlation ( $p < .05$ ).

$p = .000$ ), frustration subscale ( $19.2 \pm 7.9$  vs.  $13.2 \pm 5.6$ ,  $t = 9.49$ ,  $df = 432$ ,  $p = .000$ ), and the total score of the SRI ( $94.1 \pm 33.6$  vs.  $68.5 \pm 23.4$ ,  $t = 9.52$ ,  $df = 430$ ,  $p = .000$ ). However, no significant differences were found on the aggression subscale ( $6.3 \pm 3.5$  vs.  $5.9 \pm 2.4$ ,  $t = 1.45$ ,  $df = 425$ ,  $p = .15$ ) between the patient and control groups.

The patient group was subdivided into anxiety disorder group, depressive disorder group, somatoform disorder group, and psychosomatic disorder group. The subscale scores of each disorder group

were compared with those of the control group, and all four disorder groups scored significantly higher on the tension, fatigue, and frustration subscales than the control group. The anxiety disorder group, depressive disorder group, and somatoform disorder group scored significantly higher than the control group on the somatization subscale, anger subscale, depression subscale, and the total score of the SRI. The depressive disorder group scored significantly higher than the control group on the aggression subscale. The psychosomatic disorder group scored sig-

**TABLE 4. Test-Retest Reliability and Internal Consistency of the SRI**

	Test-Retest Correlation (n = 62) <i>r</i> *	Internal Consistency (n = 215) Cronbach's $\alpha$ **
Tension	.69	.86
Aggression	.82	.83
Somatization	.87	.76
Anger	.92	.84
Depression	.92	.90
Fatigue	.87	.81
Frustration	.93	.91
Total	.96	.97

*r*: Pearson's correlation coefficient.

\*:  $p < .0001$ ; \*\*:  $p < .01$ .

nificantly higher on the tension subscale, fatigue subscale, and frustration subscale than the control group (Table 7).

The depressive disorder group scored significantly higher than the somatoform disorder group on the depression subscale only ( $p = .003$ ), and also scored significantly higher than the anxiety disorder group on the tension subscale ( $p = .001$ ), anger subscale ( $p = .02$ ), depression subscale ( $p = .000$ ), fatigue subscale ( $p = .000$ ), frustration subscale ( $p = .01$ ), and the total score of the SRI ( $p = .000$ ), but there were no significant differences between the two groups on the other subscales. The depressive disorder group scored significantly higher than the psychosomatic disorder group on the tension subscale ( $p = .001$ ), aggression subscale ( $p = .03$ ), anger subscale ( $p = .006$ ), depression subscale ( $p = .000$ ), fatigue subscale ( $p = .000$ ), frustration subscale ( $p = .000$ ), and the total score of the SRI ( $p = .000$ ). No significant differences were found on the seven subscales or the total score of the SRI between the somatoform disorder group and the anxiety group, or between the somatoform disorder group and the psychosomatic disorder group (Table 7).

Each of the subscales in common from the SRI (ten-

sion, somatization, aggression or anger, depression) and SCL-90-R (anxiety, somatization, hostility, depression) was compared between each of the patient groups and the control group. On the depression and somatization subscales of the two scales, the anxiety disorder, depressive disorder, and somatoform disorder groups scored significantly higher than the control group. In addition, on each of the aggression subscales of the SRI and the hostility subscale of the SCL-90-R, the depressive disorder group scored significantly higher than the control group. On the tension subscale, however, the anxiety disorder, depressive disorder, somatoform disorder, and psychosomatic disorder groups scored significantly higher than the control group, while on the anxiety subscale, the anxiety disorder, depressive disorder, and somatoform disorder groups scored significantly higher than the control group. On the anger subscale, the anxiety disorder, depressive disorder, and somatoform disorder groups scored significantly higher than the control group, whereas on the hostility subscale, only the depressive disorder group did.

#### Relationship Between Sociodemographic Variables and the SRI Scores

For the healthy group, the several significant relationships between the sociodemographic variables and the SRI scores were found. When compared by gender, females scored significantly higher on the total SRI score than males ( $64.8 \pm 20.9$  vs.  $72.1 \pm 25.4$ ,  $t = -2.31$ ,  $df = 213$ ,  $p = .02$ ). Income level had a significantly negative correlation with the total score, but its correlation coefficient was very low ( $r = -0.16$ ,  $p = .02$ ). Age ( $r = -0.08$ ,  $p = .24$ ) and education level ( $r = -0.12$ ,  $p = .08$ ) had no significant correlation with the total score. No significant differences were found for marital status (married vs. single,  $65.7 \pm 20.9$  vs.  $73.3 \pm 27.4$ ,  $t = -1.75$ ,  $df = 61$ ,  $p = .09$ ), occupation (professional vs. nonprofessional,  $64.5 \pm 22.2$  vs.  $68.4 \pm 24.2$ ,  $t = -1.03$ ,  $df$

**TABLE 5. Correlation of the SRI Subscales**

	Tension	Aggression	Somatization	Anger	Depression	Fatigue	Frustration	Total
Tension	1.00	.57*	.70*	.73*	.76*	.67*	.78*	.89*
Aggression	.57*	1.00	.44*	.55*	.56*	.47*	.50*	.66*
Somatization	.70*	.44*	1.00	.60*	.68*	.60*	.62*	.76*
Anger	.73*	.55*	.60*	1.00	.73*	.69*	.76*	.87*
Depression	.76*	.56*	.68*	.73*	1.00	.68*	.79*	.91*
Fatigue	.67*	.47*	.60*	.69*	.68*	1.00	.70*	.81*
Frustration	.78*	.50*	.62*	.76*	.79*	.70*	1.00	.91*
Total	.89*	.66*	.76*	.87*	.91*	.81*	.91*	1.00

\*  $p < .01$ .

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TABLE 6. Correlation of the SRI Subscale Scores With the SCL-90-R Subscale Scores, Total Score of PSQ, and GARS

	Tension	Aggression	Somatization	Anger	Depression	Fatigue	Frustration	Total
SCL-90-R								
Somatization	.59*	.42*	.59*	.49*	.50*	.40*	.51*	.59*
Interpersonal sensitivity	.61*	.50*	.51*	.63*	.63*	.48*	.64*	.69*
Obsessive-compulsive	.64*	.45*	.56*	.66*	.67*	.59*	.68*	.74*
Anxiety	.71*	.53*	.61*	.65*	.68*	.57*	.70*	.76*
Depression	.68*	.45*	.56*	.67*	.72*	.55*	.75*	.77*
Hostility	.59*	.67*	.52*	.60*	.61*	.49*	.62*	.69*
Phobia	.52*	.51*	.50*	.46*	.51*	.36*	.46*	.56*
Paranoid ideation	.65*	.53*	.59*	.63*	.66*	.48*	.62*	.71*
Psychoticism	.61*	.53*	.57*	.57*	.62*	.45*	.60*	.67*
GSI	.69*	.54*	.62*	.66*	.69*	.54*	.69*	.76*
PSDI	.58*	.30*	.48*	.55*	.58*	.42*	.59*	.62*
PST	.64*	.63*	.60*	.63*	.65*	.56*	.65*	.74*
PSQ	.68*	.37*	.55*	.65*	.69*	.63*	.71*	.75*
GARS	.46*	.39*	.41*	.47*	.53*	.47*	.45*	.54*

\*  $p < .01$ .

SCL-90-R, Symptom Checklist-90-revised; GSI, Global Severity Index; PSDI, Positive Symptom Distress Index; PST, positive symptom total; PSQ, Total scores of Perceived Stress Questionnaire; GARS, Global Assessment of Recent Stress Scale.

= 158,  $p = .31$ ), or religion (present vs. absent 70.1  $\pm$  25.4 vs. 65.0  $\pm$  19.6,  $t = 1.59$ ,  $df = 179$ ,  $p = .11$ ) on the total score of the SRI.

Since a significant difference was found in the total score between the patient and the healthy group, and also in some of the sociodemographic variables, multiple regression analysis was conducted with the dependent variable being the total score of the SRI, and independent variables being the group (patient vs. control), gender, age, education level, income, marital status (married vs. single), and occupation (professional vs. nonprofessional). It was discovered that regardless of sociodemographic variables, the patient group scored significantly higher than the healthy group in the total score of the SRI ( $R^2 = 0.23$ ,  $F = 19.01$ ,  $p = .000$ ;  $\beta = 0.36$ ,  $t = 8.50$ ,  $p = .000$ ).

For the patient group, a significantly positive correlation was found for the somatoform disorder group between the duration of illness and the somatization subscale score ( $r = 0.34$ ,  $p = .02$ ), whereas a significant negative correlation was found for the psychosomatic disorder group between the duration of illness and the tension subscale score ( $r = -0.28$ ,  $p = .048$ ). However, no significant correlation was found for any disorder group between the duration of illness and the total score of the SRI (anxiety disorder group  $r = -0.18$ ,  $p = .13$ ; depressive disorder group  $r = 0.06$ ,  $p = .61$ ; somatoform disorder group  $r = 0.07$ ,  $p = .63$ ; psychosomatic disorder group  $r = -0.17$ ,  $p = .25$ ).

### DISCUSSION

Seven subscales (tension, aggression, somatization, anger, depression, fatigue, and frustration)

were identified after factor analysis for all response items of the SRI. Most of them represented four types of stress response: emotional, somatic, cognitive, and behavioral.

The factor analysis results could be characterized in three ways. First, the response items identified for the depression subscale ( $N = 8$ ) were most common, followed in descending order by items for the frustration subscale ( $N = 7$ ), items for the tension subscale ( $N = 6$ ) and items for the anger subscale ( $N = 6$ ). Second, the somatic type of stress response was found to have the greatest number of items, but four different types of stress response were similarly distributed in proportion. Third, most response items of the cognitive type belonged to the depression ( $N = 4$ ) subscale.

Test-retest reliability was high, as was internal consistency for each subscale and the total score. The correlations between each of the seven subscales and the total score, as well as the correlations between each of the response items and the subscale scores, were all at significant levels. These results indicated that the SRI is highly reliable and stable.

The convergent validity was checked by correlating it with the following three preexisting measures: The Korean version of the SCL-90-R (19) has been widely used in the study of stress; the Korean version of the GARS scale (16) is another measure of perceived stressors used in the study of psychosomatic medicine in Korea; and PSQ (20) is another measure of stress assessment developed for the study of psychosomatic disorder. The convergent validity was significant, with high correlations between the seven subscale scores or the total score,

TABLE 7. Scores of SRI, SCL-90-R, PSQ in Each of Patient Groups and Normal Group

	Anxiety disorder (N = 71) Mean ± SD	Depressive disorder (N = 73) Mean ± SD	Somatoform disorder (N = 47) Mean ± SD	Psychosomatic disorder (N = 51) Mean ± SD	Normal control (N = 215) Mean ± SD	F	df	p
SRI								
Tension	13.4 ± 5.4*	17.2 ± 6.2*	14.8 ± 6.4*	13.1 ± 5.4*	10.4 ± 4.2	26.6	452	.0001
Aggression	6.0 ± 3.7	7.2 ± 3.8*	6.1 ± 3.4	5.4 ± 2.6	5.9 ± 2.4	3.4	451	.009
Somatization	6.3 ± 2.6*	6.7 ± 3.0*	7.1 ± 3.2*	6.0 ± 2.5	4.9 ± 2.2	12.7	452	.0001
Anger	13.5 ± 5.0*	16.4 ± 6.1*	13.8 ± 5.4*	13.0 ± 5.4	11.0 ± 4.2	18.2	452	.0001
Depression	17.4 ± 7.6*	23.9 ± 8.5*	18.8 ± 7.9*	15.8 ± 5.4	13.6 ± 5.6	34.1	452	.0001
Fatigue	12.6 ± 4.4*	15.7 ± 5.0*	13.9 ± 4.6*	12.0 ± 4.0*	9.5 ± 3.2	39.5	452	.0001
Frustration	18.1 ± 7.6*	22.2 ± 8.1*	19.4 ± 7.7*	16.7 ± 7.0*	13.2 ± 5.6	28.6	452	.0001
Total	87.1 ± 31.6*	109.2 ± 34.8*	94.1 ± 32.5*	82.0 ± 27.3	68.5 ± 23.4	32.0	452	.0001
SCL-90-R								
Somatization	53.6 ± 10.9*	56.5 ± 14.9*	56.8 ± 16.5*	52.7 ± 11.0	47.9 ± 10.2	11.1	452	.0001
Interpersonal sensitivity	51.5 ± 11.6	57.4 ± 15.0*	51.8 ± 13.2	47.9 ± 10.6	47.6 ± 10.1	10.5	452	.0001
Obsessive-compulsive	52.8 ± 12.3*	58.2 ± 13.6*	51.5 ± 12.8*	48.9 ± 11.7	45.0 ± 9.4	21.4	452	.0001
Anxiety	57.5 ± 14.2*	61.6 ± 15.3*	57.4 ± 14.3*	52.7 ± 13.5	47.9 ± 9.9	21.3	452	.0001
Depression	52.9 ± 12.7*	63.5 ± 14.4*	56.1 ± 14.7*	51.7 ± 11.8	46.4 ± 10.2	29.6	452	.0001
Hostility	49.0 ± 11.6	54.4 ± 13.5*	49.6 ± 12.3	47.2 ± 10.2	46.9 ± 8.6	7.2	452	.0001
Phobia	60.7 ± 16.6*	58.7 ± 18.2*	56.4 ± 17.7	52.4 ± 12.3	50.2 ± 12.6	9.5	452	.0001
Paranoid ideation	50.0 ± 13.1	54.8 ± 14.9*	51.0 ± 14.5	48.7 ± 12.0	47.8 ± 10.6	4.5	452	.001
Psychoticism	52.5 ± 13.5	59.5 ± 13.6*	54.2 ± 13.6*	51.5 ± 11.3	48.0 ± 10.4	13.6	452	.0001
GSI	53.8 ± 12.7*	60.6 ± 14.5*	55.0 ± 14.6*	50.8 ± 12.1	46.7 ± 11.1	19.4	452	.0001
PSDI	52.7 ± 12.9*	61.5 ± 14.9*	56.3 ± 15.1*	50.9 ± 11.1*	44.0 ± 8.4	37.4	452	.0001
PST	53.0 ± 9.1	55.1 ± 9.2*	51.6 ± 9.1	49.9 ± 10.6	48.7 ± 13.5	5.0	452	.001
PSQ	44.6 ± 16.4*	52.3 ± 17.7*	45.7 ± 15.2*	39.8 ± 16.0	36.6 ± 12.5	17.6	452	.0001

\* Significantly higher in scores of each subscale than normal controls ( $p < .05$ ; Scheffe test).

SRI, Stress Response Inventory; SCL-90-R, Symptom Checklist-90-revised; GSI, Global Severity Index; PSDI, Positive Symptom Distress Index; PST, Positive Symptom Total; PSQ, Total scores of Perceived Stress Questionnaire.

and total scores for each of the GARS and the PSQ, or each of the subscales of the SCL-90-R.

The discriminant validity was determined by measuring the sensitivity, specificity, predictive value positive (PVP). It was found that the sensitivity was relatively low compared with the specificity and PVP of the SRI. These results suggest that this scale has some limitation in detecting abnormal cases, although it yields few false positives. Such low sensitivity of the scale may be relevant to the heterogeneity of the disorder groups. For example, the patients with psychosomatic disorders who had lower scores on the SRI than those with other disorders were included in the abnormal group.

The patient group scored significantly higher than the control group on six of the seven subscale scores, except for the aggression subscale. Among the patient subgroups, the anxiety, depressive, somatoform, and psychosomatic disorder groups scored significantly higher than the control group on the tension, fatigue, and frustration subscales. In addition, the depressive disorder, anxiety disorder, and somatoform disorder groups scored significantly higher than the control group on the somatization, anger, and depression sub-

scales, and on the total score of the SRI. These results could also contribute to the discriminant validity of this instrument.

Regarding the relationship between gender and scale scores in the healthy subjects, females scored significantly higher than males in the total score, which indicated that women perceive stress more intensely than men. A number of studies have found that women are more likely to become depressed than men (21–23). It was also found that women experience more negative life events than men (24).

Clinical application of the SRI showed that the depressive disorder group scored the highest on the total score of the SRI, followed in descending order by the somatoform disorder group, anxiety disorder group, psychosomatic disorder group, and the control group. The depressive disorder group also scored significantly higher than any other group on the total score of the SRI, and scored significantly higher on the subscales of tension, anger, depression, fatigue, frustration, and the total score of the SRI than the anxiety disorder group. The depressive disorder group scored significantly higher on the

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subscales of tension, aggression, anger, depression, fatigue, frustration, and the total score of the SRI than the psychosomatic disorder group. Compared with the somatoform disorder group, the depressive disorder group scored significantly higher only on the depression subscale. These results indicated that the somatoform disorder group might have a higher stress response than the anxiety or psychosomatic disorder groups. However, since the somatoform disorder group was not significantly different from the anxiety or psychosomatic disorder groups on the seven subscales and the total score of the SRI, the depressive disorder group showed the most prominent stress response of all the disorder groups.

It was interesting to discover that in a few of the subscales in common from the SRI and SCL-90-R, the results of the disorder groups and control group differed with respect to the relative scores of each subscale. For example, a significant difference was found on the tension subscale of the SRI between the psychosomatic disorder group and the control group, whereas on the anxiety subscale of the SCL-90-R, no significant difference was found between the two groups. In addition, on the anger subscale of the SRI, the anxiety disorder and somatoform disorder groups scored significantly higher than the control group, whereas on the hostility subscale of the SCL-90-R, there was no significant difference between each of the patient groups and the control group. These results indicated that the SRI might be helpful in discriminating more diagnostic categories of patients than the SCL-90-R (eg, on the tension and anger subscales).

Some may wonder why the anxiety disorder patients did not obtain the highest scores on the tension subscale, despite the fact that the scores of the tension subscale had the highest correlation with the scores of the anxiety subscale on the SCL-90-R in the healthy subjects. As shown in Table 7, however, the depressive disorder patients had the highest scores on the anxiety subscale of the SCL-90-R as well as on the tension subscale of the SRI. That is, the anxiety disorder patients did not have the highest scores on the anxiety subscale of the SCL-90-R. These findings indicated the possibility that the depressive disorder patients have more tension or anxiety than the anxiety disorder patients.

In conclusion, the SRI was found to have a significantly high reliability and validity. Future studies will examine the validity of the scale for English-speaking people, as well as additional samples in Korea.

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## REFERENCES

1. Cotton DHG. Stress Management: An Integrated Approach to Therapy. New York: Brunner/Mazel, 1990.
2. Derogatis LR, Coons HL. Self-report measures of stress. In: Goldberg L, Breznitz S, editors. Handbook of Stress-Theoretical and Clinical Aspects, 2nd ed, New York: The Free Press; 1993. p. 200–33.
3. Holmes TH, Rahe RH. The Social Readjustment Rating Scale. *J Psychosom Res* 1967;11:213–8.
4. Selye H. The physiology and pathology of exposure to stress. Montreal; Acta 1950.
5. Derogatis LR, Rickels K, Rock AF. The SCL-90 and MMPI: a step in the validation of a new report scale. *Br J Psychiatry* 1976;128: 280–9.
6. Beck AT, Ward C, Mendelson M, Mock J, Erbaugh J. An inventory for measuring depression. *Arch Gen Psychiatry* 1961;4: 53–63.
7. Spielberger CD, Gorsuch RC, Lushene RE. Manual for the State-Trait Anxiety Inventory. Palo Alto, CA: Consulting Psychologists Press; 1970.
8. Lazarus RS. Psychological stress and coping in adaptation and illness. In: Lipowski ZJ, Lipsitt DR, Whybrow PC, editors. Psychosomatic Medicine: Current Trends and Clinical Applications. New York: Oxford Univ. Press; 1978. p. 14–26.
9. Sarason IG, Sarason BR, Potter EH, Antoni MH. Life events, social support, and illness. *Psychosom Med* 1985;47: 156–63.
10. Wilder JF, Pluchik R. Stress and psychiatry. In: Kaplan HI, Sadock BJ, editors. Comprehensive Textbook of Psychiatry, 4th Ed. Baltimore: Williams & Wilkins; 1985. p. 1198–203.
11. Beck AT. Cognitive therapy and the emotional disorders. New York: Times-Mirror; 1976.
12. Ko BH, Shong OH, Shin YO. A preliminary study on life events of the Koreans - scale of life events. *J Korean Neuropsychiatr Assoc* 1981;20:62–78.
13. Choi TJ, Kang BJ. A preliminary study for standardizing social readjustment from stress for Korean society. *J Korean Neuropsychiatr Assoc* 1981;20:131–46.
14. Hong KE, Jeong DW. Construction of Korean social readjustment rating scale: a methodological study. *J Korean Neuropsychiatr Assoc* 1982;21:123–36.
15. Paykel ES, Prusoff BA, Uhlenhuth EH. Scaling of life events. *Arch Gen Psychiatry* 1971;25:340–7.
16. Koh KB. Stress perception of patients with psychosomatic disorders. *J Korean Neuropsychiatr Assoc* 1988;27:514–24.
17. Linn MW. A global assessment of recent stress (GARS) scale. *Int J Psychiatry Med* 1985;15:47–59.
18. American Psychiatric Association (APA). Diagnostic and Statistical Manual of Mental Disorders, 4th Ed., Washington DC: Am Psychiatric Assoc; 1994.
19. Kim KI, Kim JH, Won HT. Korean manual of symptom checklist-90-revision. Seoul: Chung Ang Aptitude Publishing Co; 1984.
20. Levenstein S, Prantera C, Varvo M, Scribano L, Berto E. De-

- velopment of the perceived stress questionnaire: a new tool for psychosomatic research. *J Psychosom Res* 1993;37:19–32.
21. American Psychiatric Association (APA). *Diagnostic and Statistical Manual of Mental Disorders*, 3rd Ed., Washington DC: Am Psychiatric Assoc; 1980.
  22. Kaplan GA, Roberts RE, Camacho TC, Coyne JC. Psychosocial predictors of depression: prospective evidence from the human population laboratory studies. *Am J Epidemiology* 1987;125:206–20.
  23. Slack D, Vaux A. Undesirable life events and depression: the role of event appraisals and social support. *J Soc Clin Psychology* 1988;7:290–6.
  24. Turner RJ, Avison WR. Gender and depression: assessing exposure and vulnerability to life events in a chronically strained population. *J Nerv Ment Dis* 1989;177:443–55.