Applied Psychophysiology and Biofeedback, Vol. 29, No. 4, December 2004 (© 2004)
DOI: 10.1007/s10484-004-0386-1

Paradoxical Results of Psychophysiological Stress Profile in Functional Somatic Syndrome: Correlation Between Subjective Tension Score and Objective Stress Response

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Mind–body interactions are important in functional somatic syndromes (FSS). Therefore, in the assessment of the psychophysiological stress response in patients with FSS, both subjective feelings and psychophysiological activity should be simultaneously measured. In this study, "Objective Tension Score" (OTS) was defined as an objective parameter of tension; it consisted of surface electromyography and skin conductance level as indicators of muscle and mental tension, respectively. "Subjective Tension Score" (STS) was defined as a subjective parameter of tension. Changes in OTS and STS in response to the stress task were investigated in 30 FSS patients and 28 controls. Objective tension was significantly hyporeactive to the stress task and STS was significantly higher in the patient group than in the control group. There was a significant negative correlation between OTS response and STS in the patient group, but no significant correlation in the control group. Our results suggested the existence of dissociation between subjective and objective responses in FSS patients. This may indicate that FSS patients had difficulty with the awareness of bodily feelings, thus supporting the concept of "alexisomia" or "escaped bodily feelings" in FSS patients.

KEY WORDS: psychophysiological stress profile; functional somatic syndrome; subjective assessment; alexisomia; bodily feelings.

INTRODUCTION

Somatic symptoms of medically unknown origin are common in the community and most clinical settings. The group of diseases manifested by these symptoms is generically called "functional somatic syndromes" or "functional somatic symptoms" (Escobar, Rubio-Stipec, Canino, & Karno, 1989; Kellner, 1985; Kirmayer & Robbins, 1991b). Functional somatic syndromes (FSS) include various disease names in every medical specialty; for example, irritable bowel syndrome, fibromyalgia, noncardiac chest pain, chronic fatigue syndrome, tension-type headache, and multiple chemical sensitivity. However, the patients

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who are diagnosed with these diseases have many symptoms, characteristics, and other clinical conditions in common (Barsky & Borus, 1999; Wessely, Nimnuan, & Sharpe, 1999).

In the United States, the diagnosis of psychosomatic disease is based on the presence of psychological problems as physical signs, but FSS are understood on the basis of the concept of somatization. Although psychosomatic theory is concerned with disease causation, somatization focuses attention on the experience and expression of illness (Kirmayer & Robbins, 1991a). Moreover, somatization is properly viewed from the aspect of illness behavior (Lipowski, 1988).

The concepts of FSS are still controversial with problems of overlap, co-occurrence, and diagnostic criteria (Nimnuan, Rabe-Hesketh, Wessely, & Hotopf, 2001; Wessely et al., 1999). However, an in-depth discussion about the concepts of FSS is beyond the scope of this paper. In the present study, the following definition of FSS was used. "Functional somatic syndrome refers to several related syndromes that are characterized more by symptoms, suffering, and disability than by disease-specific, demonstrable abnormalities of structure or function" (Barsky & Borus, 1999).

"Symptoms" are the patients' subjective experience of changes in their bodies. "Diseases" are objective abnormalities in the body (Wessely et al., 1999). The discrepancy between medical assessment of symptoms and subjective experience presents difficulties. Moreover, in many patients with FSS, maladaptive thinking patterns amplify and maintain physical symptoms through mind–body interactions (Barsky & Borus, 1999). Therefore, it is important to assess the presence of interaction or dissociation between psychophysiological estimation and subjective estimation. Wickramasekera (1988) describes a marked discrepancy between the verbal report measure and physiological activity measured from the frontalis muscles by electromyogram in patients with chronic stress-related disorders such as headache and back pain. This discrepancy might also be observed in other physiological measurements.

It is already known that patients with psychosomatic diseases and somatization tend to have alexithymia (Bach & Bach, 1996; Bach, Bach, Bohmer, & Nutzinger, 1994; Shipko, 1982; Sifneos, 1973). Alexithymia refers to a difficulty in the awareness and expression of emotional feelings. Ikemi and Ikemi (1986) expand the concept of alexithymia to include difficulty in the awareness and expression of bodily feelings; they establish the concept of "Alexisomia," where there is a difficulty in the awareness and expression of bodily sensations. A concept of alexithymia is important in psychosomatic diseases focusing on psychological aspects, whereas awareness of bodily feelings is important in functional somatic syndromes focusing on physical and behavioral aspects. To our knowledge, there are no scientific studies of alexisomia. On the other hand, some investigators report that perceptual factors such as somatosensory amplification are the important factors to be considered in somatization or somatoform disorders (Barsky, 1992). Nakao, Barsky, Kumano, and Kuboki (2002) suggested that somatosensory amplification was related to alexithymia in patients treated at a Japanese psychosomatic clinic. Furthermore, it is reported that psychophysiological arousal and cortisol levels are elevated in patients with somatization syndrome (Rief, Shaw, & Fichter, 1998). Even though these results are inconsistent, they provide a clue to help clarify the pathology of somatization or functional somatic syndromes from the aspect of mind–body interactions. These findings suggest the existence of a discrepancy between objective assessment and subjective feelings in FSS.

The purpose of our study was to investigate the concept of alexisomia with a long-range goal of understanding pathologic conditions and exploring therapeutic approaches in patients with FSS. As a first step, we hypothesized that the relationship between psychophysiological response and bodily feeling in patients with FSS would differ from that in healthy participants.

To verify our hypothesis, Psychophysiological Stress Profiling (PSP; Stoyva & Budzynski, 1993; Wickramasekera, 1988) was conducted in patients with functional somatic syndromes (FSS) and healthy participants. When performing PSP, "Subjective Tension Score" (STS) was recorded to investigate the correlation between objective estimation and subjective bodily feelings. PSP is a method of estimating responses to stress or psychophysiological characteristics by measuring psychophysiological parameters before and after loading by stress, based on the concept of "Autonomic Response Specificity" (ARS; Lacey, Bateman, & VanLehn, 1953; Wenger, Clemens, Coleman, Cullen, & Engel, 1961). In ARS, there exist stable and reproductive reaction profiles in the response of the autonomic nerve system to stress load.

In this study, subjective and objective indicators of tension were assessed. It is thought that subjective feelings of tension include two components: mental tension and muscle tone, therefore, skin conductance level (SCL) and surface electromyography (SEMG) were chosen as indicators of the two components. SCL is one of the methods for directly measuring electrodermal activity (EDA), and assessing psychologically induced sweating from the palm of the hands. There is a close correlation between bursts of sympathetic nerve activity and EDA (Wallin, 1981) because EDA is controlled predominantly by the sympathetic nerve system (Shields, MacDowell, Fairchild, & Campbell, 1987). Moreover, it is known that EDA reflects general states of arousal and alertness as reported in, for example, Dawson, Schell, & Filion, (2000). The feelings of psychologically induced sweating, tension of sympathetic nerve activity, and excessive arousal may be subjectively the closest to the tension of feeling. Thus SCL measurement is appropriate as a physiological measurement for mental tension. On the other hand, a physiological measurement that indicates muscle tone is electromyography (EMG). The surface EMG records the electrical activity, which occurs prior to and during muscle contraction. EMG is obviously related to the tension created in the muscle (Lippold, 1952).

On the basis of the arguments above, SEMG and SCL were used as indicators of objective tension, and objective tension score (OTS) was calculated using the standardized values of these two parameters (standardization of the value is described in the Methods section). Because mental and muscle tension have a complementary relationship, OTS is thought to indicate tension more comprehensively.

Thus, in this study, the stress response was investigated using OTS as an objective parameter and STS as a subjective parameter of feelings of tension; their relationships were investigated in the context of the concept of alexisomia in patients with FSS and healthy controls.

METHODS

Participants

The participants were 30 patients (12 males and 18 females) between the ages of 24 and 56 years (mean $\pm$ standard deviation [*SD*]: 35.2 $\pm$ 9.1 years) who visited the Department of

Psychosomatic Medicine (Shinryo-Naika) of Kansai Medical University Hospital in Osaka. They were diagnosed as having FSS, according to the definition of FSS described in the Introduction section, by certified physicians specializing in psychosomatic medicine by the Japanese Society of Psychosomatic Medicine.

The presence of somatic symptoms was determined using a subjective symptom rating score based on a visual analogue scale (0 was minimum and 10 was maximum). The patients who had very severe symptoms or conditions and could not sit quietly in a chair, and those who had few symptoms and whose subjective symptom score was smaller than 3 were excluded from the study. The participants had medical treatment as inpatients or outpatients. For the inpatients, the assessments for this study were completed before starting psychosomatic treatment. For outpatients, the examination was completed before the behavioral approaches were begun. Thus the assessments were not confounded by treatment, level of severity, or past experience with relaxation. The distribution of the patients' main symptoms is as follows: musculoskeletal symptoms in 10 cases, gastrointestinal symptoms in 8 cases, headache in 4 cases, cardiovascular symptoms in 3 cases, and others (e.g., dizziness, chronic cough, general fatigue, nonspecific pain, oral pain) in 5 cases.

Twenty-eight healthy participants (14 males and 14 females) aged 23–59 years (mean $\pm$ *SD*: 33.2 $\pm$ 8.3 years) participated in the study as controls. They were recruited through public announcement; participants who received regular medical care or had somatic symptoms were excluded. They were paid $50 each for their participation.

Table I shows the characteristics of the participants. No significant differences were observed between the patient and control groups in the mean age ($F(1, 56) = 0.773$, $p = .383$) according to one-way ANOVA, or the male–female ratio (chi-square test, $\chi^2 = .586$, $p = .444$).

Procedure

Data collection and psychological testing were performed in an examination room of the hospital. The room temperature was kept at 23–26°C. The Profile of Mood States (POMS) test (McNair, Lorr, & DroppLemn, 1971) was performed after explanation of the physiological measurement and prior to applying electrodes. The POMS, a 65-item scale that assesses six affective dimensions, has been widely used in the assessment of temporary mood states. The subscales consist of Tension-anxiety (TA), Depression-dejection (D; depressive mood or discouragement), Anger-hostility (A; bad mood, irritation, fury, and aggression), Vigor-activity (V; activity, liveliness, and happiness/physical or mental strength), Fatigue-inertia (F; remaining inactive), and Confusion-bewilderment (C). The POMS scales have shown high internal consistency; reliability coefficients are near 0.90 and test–retest coefficients near 0.70 (McNair, Lorr, & DroppLemn, 1992). Subsequently, PSP was examined using MultiTrace™ (Stens Corp., Oakland)/ProComp+™ (Thought

Table I. Characteristics of Participants

Group	*N*	Female (%)	Age (years)
Control	28	50	35.20 (9.12)
Patient	30	60	33.18 (8.34)

Note. Data are presented as mean (*SD*).

Technology Ltd., Montreal) biofeedback system connected to a computer. All the following indices were measured using ProComp+ standard electrodes: surface electromyography (SEMG), skin temperature (TEMP), skin conductance level (SCL), blood volume pulse (BVP), and respiration (RESP). Among these indices, analysis was performed using only SCL and SEMG. SCL was recorded from the middle phalanx of second and third fingers of a nondominant hand. Electrodes used were 1 cm^2 circular Ag–AgCl standard. SEMG was recorded from the frontal muscle just above both eyebrows (Lippold, 1967), with a bandpass of 20–500 Hz. Electrodes used were pre-gelled Ag–AgCl single standard.

The participants were seated in a chair with their eyes closed during the measurements. After a 5-min adaptation period and a 2-min preparation period, the assessment was performed in the following three steps (5 min each, a total of 15 min). (1) Baseline resting period: Participants were instructed to relax and make themselves comfortable. (2) Stress period (mental arithmetic): Participants were required to subtract 7 serially from 1,000 as accurately and as fast as possible. If a subject stopped the arithmetic task for more than a minute, the examiner told the subject the last number they answered. However, it turned out that no participants of this study stopped the task for more than a minute. (3) Post-stress period: Participants were again instructed to relax.

After all measurements, the patients were asked to estimate the degrees of subjective tension experienced during each period. STS was quantitatively estimated using a visual analogue scale from 0 to 10; scores were determined to one decimal point. All measured data were processed by MultiTrace™ systems on the computer. Data analysis was done as follows.

Data Analysis

The mean value for the last 1 min of the baseline rest period was regarded as a baseline value to minimize the influence of the rather short pre-stimulus resting period. The assumption was that the data in the latter half of the rest period would reach the stable baseline values. Values recorded during the initial 30 s of the stress period and the post-stress period were deleted, and the mean value for residual 4 min and 30 s were obtained. These procedures were performed using the waveform data analysis program DADiSP/PRO v. 4.1™ (DSP Development Corp., Newton).

To standardize the variables (SCL, SEMG, and STS), t-score transformation (standardizing scores using a mean of 50 and a standard deviation of 10) of each variable across all samples and periods was performed to control for the difference in scales of each variable (e.g., Foerster, Schneider, & Walschburger, 1983). Objective tension score (OTS) was determined as the mean value of standardized SCL and standardized SEMG value. Finally, the total physiological stress response, which was called "objective stress response (OSR)" in the present paper, was determined by subtracting OTS of the baseline period from the OTS of the stress period.

To compare OTS and STS in the two groups, a two-way multivariate analysis of variance (ANOVA) with "period" (three levels: resting, stress, and post-stress periods) as within-participants factor and "group" (two levels: control and patient groups) as between-participants factor was used. Spearman rank correlation tests (two-tailed) were carried out to investigate the relationship between STSs and OSRs in each group. Partial correlations

Table II. POMS Scores in Patient and Control Groups

Group	TA	D	AH	V	F	C
Control	46.35 (7.12)	48.31 (6.83)	49.31 (8.67)	52.69 (9.22)	47.81 (6.92)	48.81 (7.52)
Patient	58.43 (12.38)	60.90 (12.50)	51.77 (9.65)	42.00 (9.20)	55.80 (12.07)	56.60 (11.54)
p	<.001	<.001	.379	<.001	.015	.009

Note. Data are presented as mean (*SD*). Subscales of POMS; TA: tension/anxiety; D: depression; AH: anger/hostility; V: vigor; F: fatigue; C: confusion.

were used to assess the relationship between the above two variables while controlling for baseline values of OTS and STS.

Statistical analyses were performed using SPSS 11.5J for Windows™ (SPSS Inc., Chicago). The alpha level was fixed at .05.

RESULTS

Scores on the POMS tension/anxiety (TA), depression (D), vigor (V), fatigue (F), and confusion (C) were significantly higher in the patient group than in the control group (Mann–Whitney U test; $p < .001$ in TA, D, and V; $p = .015$ in F; $p = .009$ in C). There were no significant differences between the groups in anger/hostility (A; $p = .379$; see Table II).

Mean values and standard deviations of SCL, SEMG, and STS during each period are shown in Tables III, IV, and V, respectively. SCL of the post-stress period did not reach the level of the baseline resting period, but EMG approximated the level. This finding suggested that SCL recovered more slowly than EMG.

Figure 1 shows the changes of OTS and STS (t score) during each period. The two-way multivariate ANOVA showed a significant group effect, $F(2, 55) = 4.744$, $p = .013$. The period effect was significant, $F(4, 53) = 62.24$, $p < .001$. The period-group interaction was also significant, $F(4, 53) = 2.93$, $p = .029$. In a univariate test, the period effect for both OTS and STS was significant, $F(1.40, 78.46) = 101.00$, $p < .001$; and $F(1.80, 100.6) = 52.87$, $p < .001$, respectively.[3] The period–group interaction was significant, $F(1.40, 78.46) = 4.72$, $p = .021$, and the group effect was not significant, $F(1, 56) = 1.26$, $p = .266$, in OTS, whereas the period–group interaction was not significant, $F(1.80, 100.60) = 2.45$, $p = .097$, and the group effect was significant in STS, $F(1, 56) = 7.38$, $p = 0.009$; see footnote 3.

Figure 2 shows histograms of the objective stress response (OSR) in the patient and control groups. The histograms show the difference in distributions of OSR between the two groups. The mean value of OSR in the patient group was significantly less than that in the control group by one-way ANOVA, $F(1, 56) = 5.59$, $p = .022$. Thus objective tension was significantly hypo-reactive for the stress task and STS was significantly higher in the patient group than in the control group.

To investigate the relationship between STS and the objective stress response, the correlation between STS and OSR was estimated. A significant negative correlation between STS and OSR was observed in the patient group (Spearman $r = -.545$, $n = 30$, $p = .002$;

[3]Greenhouse–Geisser test.

Table III. Skin Conductance Level (μS) at Each Period

	Resting		Stress		Post-Stress	
Group	Mean	*SD*	Mean	*SD*	Mean	*SD*
Control	4.060	2.752	13.909	4.403	8.314	3.678
Patient	6.310	6.858	14.603	8.966	9.495	7.190
All	5.224	5.367	14.268	7.085	8.925	5.750

Fig. 3), but not in the control group (Spearman $r = -.031$, $n = 28$, $p = .876$, *ns*; Fig. 4). A significant correlation was also observed between OSR and STS while controlling for baseline values of OTS and STS in the patient group (partial correlation coefficients; $pr = -0.414$, $n = 30$, $p = .028$). There was no significant correlation in the control group ($pr = .012$, $n = 28$, $p = .953$, *ns*).

DISCUSSION

In this study objective tension score (OTS) was used as the objective indicator for tension, which consisted of SEMG and SCL as parameters of muscle and mental tension. In addition, subjective tension score (STS) was used as a subjective measure of tension. Analysis indicated that objective tension was hyporeactive for the stress task and STS was higher especially during the baseline resting and post-stress periods in the patient group compared to the control group. These findings suggest that FSS patients tended to have hypofunctional psychophysiological responses to the stress task, but subjectively stronger sensations of tension. This was comparable to the results of the psychological test, which showed higher POMS TA score in the patient group than in the control group.

On the basis of the results of the psychological test, the patient group tended to have high tension, anxiety, decreased vigor, and fatigue and were in a depressive and confused state, compared to the control group. These findings are similar to previous reports of the association of FSS with psychological state by others (Henningsen, Zimmermann, & Sattel, 2003).

Okifuji and Turk (2002) reviewed studies on physiological reactivity to stress in patients with fibromyalgia syndrome (FMS), and suggest that the results of these studies support the hypothesis that hypofunctional stress systems have an important role in the pathophysiology of FMS. Hyporeactive objective tension and high subjective tension might be one of the characteristics of FSS.

There were two possibilities: (1) objective tension was consistently hyporeactive in patients and (2) both hyporeactive and hyperreactive patients existed and the number of

Table IV. Electromyography Level (μV) at Each Period

	Resting		Stress		Post-Stress	
Group	Mean	*SD*	Mean	*SD*	Mean	*SD*
Control	4.981	3.830	7.964	6.341	5.669	4.155
Patient	3.792	2.666	4.599	2.652	3.978	2.597
All	4.366	3.305	6.223	5.050	4.794	3.512

Table V. Subjective Tension Score at Each Period

	Resting		Stress		Post-Stress	
Group	Mean	*SD*	Mean	*SD*	Mean	*SD*
Control	2.54	2.69	6.40	1.94	2.50	2.19
Patient	4.38	2.78	6.90	2.89	4.40	2.53
All	3.49	2.87	6.66	2.47	3.48	2.54

Note. The scores were estimated by using a visual analogue scale from 0 to 10.

hyporeactive patients was larger in the present study as observed in the histogram of OSR (Fig. 2). However, the verification of this assumption will require a larger number of participants and further research.

The use of change scores in scientific research may be a problem. The law of initial values (LIV; Wilder, 1967), concerning the relationship of the size of response to the pre-stimulus level, may confound the results. A few methods for neutralizing the LIV have been proposed. However, most psychophysiologists have found that skin conductance usually does not follow LIV (Stern, Ray, & Davis, 1980). With regard to EMG, we investigated the relationship between the baseline value and the stress response of SEMG using the present data, and found no significant correlation. Moreover, partial correlations were used to assess the relationship between the subjective and objective variables while controlling for baseline values.

There was a difference in the correlation between STS and OSR in the patient and control groups. STS indicates the sensible tension of participants, and may be positively correlated with OSR under normal conditions. The reason why there was no significant correlation between STS and OSR in the control group might be that most participants showed moderate OSR and moderate feelings of tension (STS) as shown in Fig. 4. On the other hand, most of the patients did not show moderate OSR or STS as shown in Fig. 3. There was a significant negative correlation between STS and OSR in the patient group. The subjective tension felt during the stress period decreased in the patients who had higher OSR, whereas it increased in those who had lower OSR.

A possible explanation for this paradoxical result might be that many patients showed low OSR and high STS, and the patients who had lower objective stress responses, in other words hypofunctional stress responses, could not cope with the stress properly and felt higher subjective tension because of their feelings of insufficiency. On the other hand, it might be that the patients who had normal or hyper-objective stress responses, a functional stress system, felt normal or experienced lower subjective tension.

Hyporeactive objective tension patients had low psychophysiological responses to the stresses, but subjectively felt high tension, which indicated that their bodily feelings might be "hypersensitive" to the physiological responses. Hyporeactive objective tension may be related to somatosensory amplification. On the other hand, hyperreactive objective tension patients had high psychophysiological responses, but could not feel it. Their bodily feelings might be "hyposensitive" to the physiological responses.

Furthermore, multivariate test results illustrated significant differences in OTS and STS between the patient and control groups. In a univariate test, although OTS was significantly hyporeactive in the patient group than in the control group, STS was significantly larger in the patient group than in the control group. These results, combined with the aforementioned

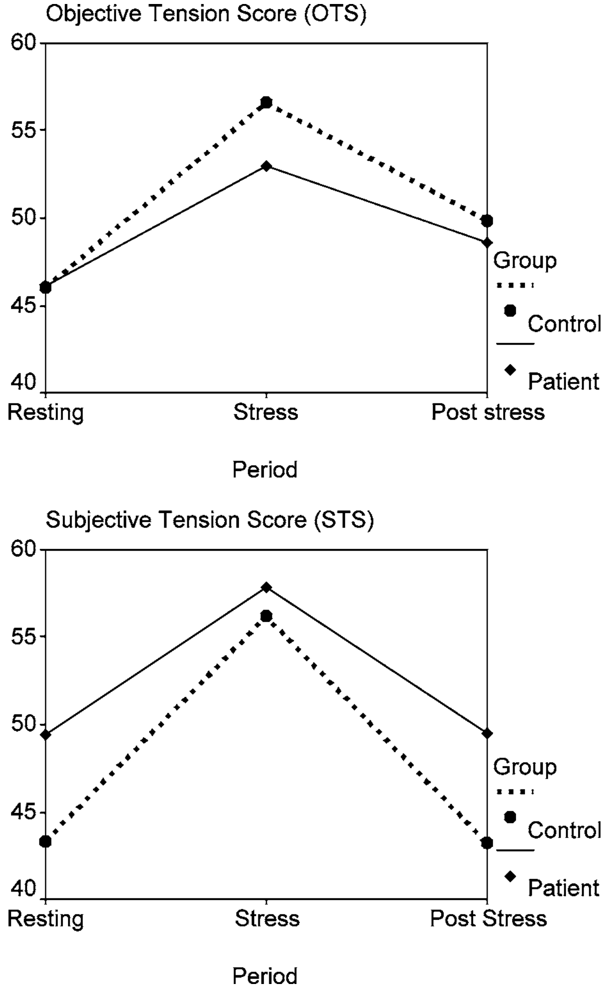

Fig. 1. Objective Tension Score (OTS) and Subjective Tension Score (STS; *t* score) during each period. The solid diamond and solid lines indicate OTS and STS, respectively, in the patient group, and the solid circles and dotted lines in the control group. Regarding OTS, period–group interaction was significant, $F(1.40, 78.46) = 4.72$, $p = .021$, and the group effect was not significant. Regarding STS, group effect was significant, $F(1, 56) = 7.38$, $p = .009$, and period–group interaction was not.

difference in the OSR histogram and a negative correlation between STS and OSR in the patient group, might suggest a different relationship between STS and OTS responses during the stress task between the patient and control groups. It is generally expected that physiological data and subjective scores differ in parallel between the patient and control groups, which was not indicated by our results. Our results suggested that there was a difference in the relationship between physiological data and subjective scores between

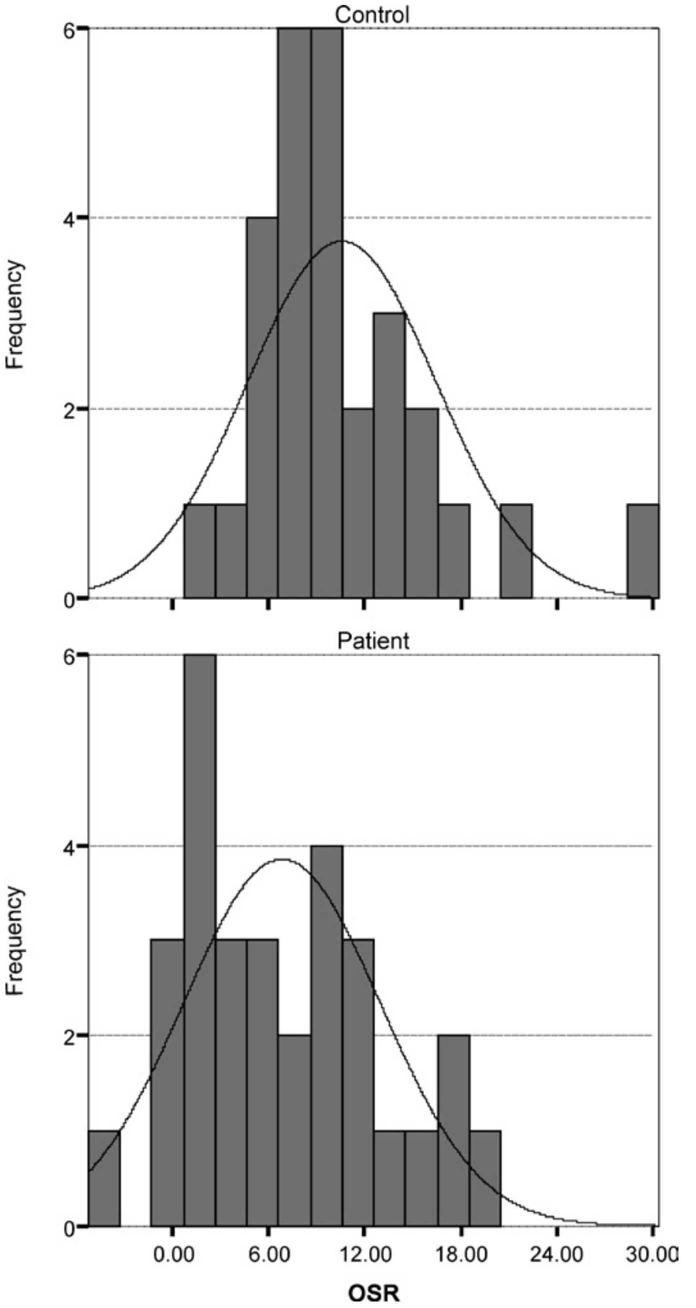

Fig. 2. Histograms in each group and normal curves of Objectives Stress Responses (OSR). *SD* = 5.90, mean = 10.56, and $n = 28$ in the control group; *SD* = 6.17, mean = 6.80, and $n = 30$ in the patient group. Mean value of OSR in the patient group was significantly less than that in the control group by one-way ANOVA, $F(1, 56) = 5.59$, $p = .022$. The distribution of OSR response in the patient group differs from that in the control group.

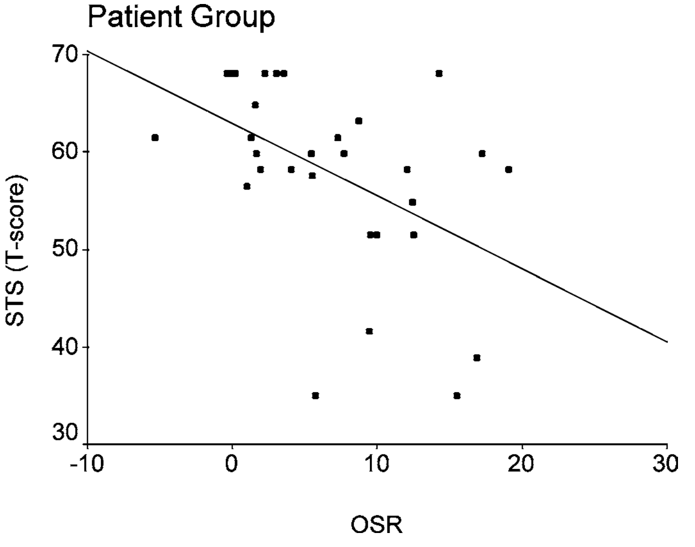

Fig. 3. Correlation between Subjectives Tension Score (STS) and Objective Stress Response (OSR) in the patient group. x axis: SCL response during the stress period; y axis: STS during the stress period. Regression line: $y = -0.744x + 62.88$; $n = 30$. A significant negative correlation was observed between STS and OSR according to Spearman rank correlation tests; Spearman $r = -.545$, $p = .002$.

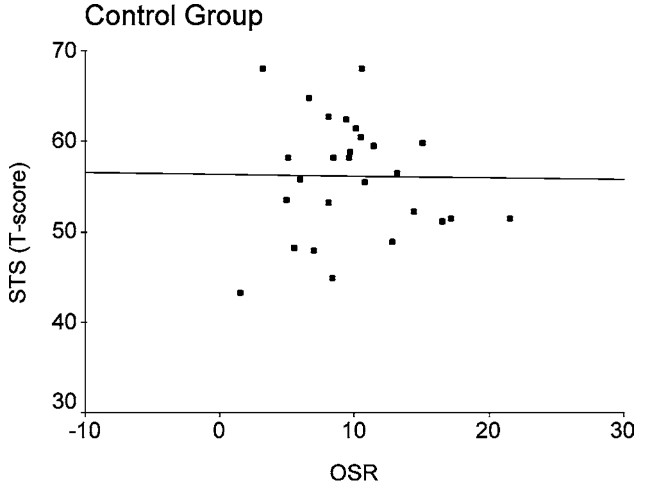

Fig. 4. Correlation between STS and OSR in the control group. x axis: SCL response during the stress period; y axis: STS during the stress period. Regression line, $y = -0.018x + 56.35$; $n = 28$. No significant correlation was observed between STS and SCL response according to Spearman rank correlation tests; Spearman $r = -.031$, $p = .876$, *ns*.

these groups. These results tentatively supported our hypothesis about the existence of dissociation between subjective scores and objective response in FSS patients.

Ikemi and Ikemi (1986) describe "alexisomia" as the tendency to be unaware of bodily feelings. However, our results suggested that the patients with FSS could be subdivided into two types; those who had "hypersensitive bodily feelings" and those who had "hyposensitive bodily feelings." Thus patients with both types of bodily feelings could be said to have "escaped bodily feelings." "Escaped bodily feelings" indicated the state in which bodily feelings (subjective tension score in the present study) markedly deviate from what was expected from objective assessment (objective tension score). The contradiction described in the Introduction section (i.e., alexisomia and somatosensory amplification) could be explained by using this concept. Lipowski (1988) implies a discrepancy between subjective and objective health in somatization, which suggests that "escaped bodily feelings" might be involved as one of the causes of medically unexplained symptoms in FSS patients.

Papciak, Feuerstein, and Spiegel (1985) compared the changes in physiological activity and POMS score before and after stress load in alexithymic participants and nonalexithymic controls. They reported no difference in physiological activity between these two groups during stress. However, POMS tension was higher in the alexithymic participants before stress load, and in the nonalexithymic controls after stress load. These results tentatively support the existence of a decoupling phenomenon following a stressor in patients with alexithymia. The participants in their study were asymptomatic students, in contrast to these in our study. However, the decoupling phenomenon was thought to be closely related with the dissociation between subjective score and objective response observed in our study.

Ikemi (1990) maintains that alexithymia is caused by dissociation between the cerebral level responsible for cognition and the limbic level responsible for emotion, and that alexisomia is caused by dissociation between the cerebral level and the brainstem level receiving bodily feelings. Alexithymia and alexisomia are caused by dissociation at the emotional and bodily feeling level, respectively. However, these two might coexist in many patients. In further studies, the relation of alexithymia with "escaped bodily feelings" or alexisomia should be investigated.

Treatment approaches for FSS include antidepressants (O'Malley et al., 1999), psychological therapy, and cognitive behavioral therapy (Wessely et al., 1999). Our results suggest the potential value of biofeedback because awareness and self-control of bodily feelings are encouraged through feedback. Ikemi and Ikemi (1986) suggest that a process of "body-thinking" in biofeedback can open up the "wisdom of the body."

In addition, we suggest that treatment of FSS patients can be improved by changing therapeutic approaches depending on the types of patients; that is, encouraging the awareness of bodily feelings for the patients with "hyposensitive bodily feelings," and reducing excessive sensation for those with "hypersensitive bodily feelings." This hypothesis should be verified in future studies.

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