Gender Difference of Subjective Symptoms of Fatigue among Japanese Adolescents

Hidetsugu KOBAYASHI¹, Shinichi DEMURA² and Yoshinori NAGASAWA³

¹Fukui National College of Technology, Fukui, Japan

²Faculty of Education, Kanazawa University, Ishikawa, Japan

³Akita Prefectural University, Akita, Japan

Abstract

Objectives: The purpose of this study was to quantitatively and qualitatively examine a gender difference of subjective symptoms of fatigue (SSF) in healthy students.

Methods: The subjective fatigue scale for young adults (SFS-Y) consisted of the following 6 subscales: concentration thinking difficulty, languor, reduced activation, reduced motivation, drowsiness and feeling of physical disintegration. The SFS-Y was administered to 5,435 students aged 15 to 20 yr.

Student's t test was used to examine quantitative gender differences for items and factor scores. The qualitative gender difference was examined by comparing factor structures obtained from confirmatory factor analysis.

A similarity in the factor structure was evaluated from: 1) interpreted factor names, 2) factor loadings, 3) degree of fit, and 4) congruence coefficient.

Results: A complaint of SSF shows gender differences, but the difference is not remarkable. The factor structure of SSF in males and females is suggested to be the same, because six factors with the same name were interpreted in both groups and the similarity of factor structure was very high.

Conclusion: There are some qualitative gender differences in SFS, but no qualitative gender differences in factor structure.

Key words: fatigue, youth, students, gender difference

Introduction

Evaluating various stresses and fatigue is important for a healthy life with the rapid progress to an advanced information society (1). Stress management for people living in modern society is strongly needed (2). With such a social background, the effectiveness of subjective symptoms of fatigue (SSF) is pointed out as an index of health in the daily life of adolescents, and many studies on health evaluation by subjective fatigue scale (SFS) have been reported (3–6). It is expected that the SFS presents an opportunity of self-evaluation of physical state for students, and offers the knowledge and practice for coping and establishing a lifestyle to mitigate fatigue.

The SSF reflects an individual's unique life situations and

it is influenced by many factors. There have been various reports on gender differences. For example, Monden (7) reported that females in a high school complained of higher SSF than males, especially with the symptom of difficulty with concentrated attention. Kobayashi et al. (8) reported the existence of a gender difference in complaints of SSF in adolescents at a cognitive level. Females tended to evaluate SSF as high compared with males. Similar studies examining adolescent SSF suggest the existence of a gender difference, and reported that SSF in females was higher than that in males.

However, these studies look at quantitative differences based on complaint rates and there have been few studies on the qualitative differences in the structure of SSF. Qualitatively and quantitatively clarifying the gender differences will give useful knowledge in examining work loads, environmental factors, etc. which affect the complaint of SSF.

We developed a subjective fatigue scale for adolescents (SFS-Y) (9). However, in this scale, gender differences were not quantitatively and qualitatively examined (10).

The purpose of this study was to examine the gender differences in SSF for quantitative differences in items and

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Reprint requests to: Hidetsugu KOBAYASHI

Fukui National College of Technology, Geshi, Sabae, Fukui
916-8507, Japan

TEL/FAX: +81(778)62-8228

E-mail: hkoba@fukui-nct.ac.jp

factor scores, and qualitative differences in the factor structure during adolescence from 15 to 20 years old.

Methods

1. Survey and subjects

First, a survey request was sent to all high schools, junior colleges, colleges and universities in Fukui Prefecture, Japan. Moreover, we arbitrarily selected five institutions from Hokkaido, Akita, Ishikawa, Miyagi, and Fukuoka Prefectures and requested cooperation with the survey. As a result, consent was obtained from 24 institutions (16 high schools, 4 junior colleges, 1 college and 3 universities), and students from two classes in each institution were chosen from each grade at random. The questionnaire surveyed 5,622 males and females aged between 15 and 20 years. Students 21 years old or older were excluded. In addition, the subjects were checked for critical illness with a regular medical check-up and fatigue grade by P.S.: Performance Status (Japanese Society of Internal Medicine).

The survey was conducted in July, 1998, avoiding times immediately before an examination and after physical education.

Prior to the survey, teachers explained the following to the subjects: 1) The purpose of this survey was to determine the actual status of various symptoms of fatigue in daily life. 2) It was not necessary for subjects to write their own name. 3) The survey would not relate to the subjects schoolwork. 4) Collected data will be statistically analyzed and there would be no invasion of privacy.

The questionnaire consisted of personal characteristics (school name, grade, course, age, gender and the response time), SFS-Y (9) and lifestyle questions.

Finally, 5,435 effective replies were obtained (valid response rate was about 97%, see Table 1).

The SFS-Y consists of 24 items representing six subscales of “difficulty with concentrated thinking (F1),” “languor (F2),” “reduced motivation (F3),” “reduced activity (F4),” “drowsiness (F5)” and “feeling of physical disintegration (F6)” (9). Each item was assessed on a 7-point scale (1=not at all to 7=very much so). Before examining the gender difference, Pearson’s product correlation coefficient between each sub-scale and age was calculated. The coefficients were low in males (0.083–0.018) and in females (0.086–0.028.) It was confirmed that there was little influence of age, as reported in a previous study (11), using SFS-Y questionnaire items.

2. Statistical analyses

The gender difference in this study was examined based on cross-sectional data.

Student’s *t* test and the ES (effect size) (equation 1) were used to examine gender differences in the means for items and factor scores. The statistical significance level was controlled

using the method of Bonferroni ($\alpha=0.0004=0.01/24$).

$$ES=(Me-Mc)/SD \quad \dots 1$$

$$SD=\sqrt{((Ne-1)SD^2e+(Nc-1)SD^2c)/(Ne+Nc-2)}$$

Me: Mean of experimental group

Mc: Mean of control group

The qualitative gender difference was examined by factor structures obtained from confirmatory factor analysis. Factor analysis by the maximum likelihood method and Promax rotation was applied to each correlation matrix in males and females, and the correlation between factors and the fit index (GFI: good fit index, AGFI: adjusted good fit index) were calculated. The fit index is an estimate measure of the model using the structure equation. It was judged that the closer the fit index is to 1.0, the better the fit of the model.

The congruence coefficient (CC) (12) was used to examine the similarity between factors interpreted in males and females (equation 2).

$$\phi_{ik}=(\sum C_{ij} \cdot C_{ik})/(\sum C_{ij}^2 \cdot \sum C_{ik}^2)^{1/2} \quad \dots 2$$

ϕ_{ik} =CC of between *j* dimension and *k* dimension

C_{ij} : coordinates of *i* item on *j* dimension

n: number of items

The similarity of the factor structure in this study was judged from 1) interpreted factor names, 2) factor loadings, 3) degree of fit, and 4) CC.

These analyses were performed with computer programs written in Fortran and S-languages.

Results

Table 2 shows the test results of the gender differences for 24 items and 6 factors (sub-scales) of SSF. Significant differences were found in 21 items (about 88%) except for 3 items of Nos. 6, 7 and 11 in Table 2. Their mean differences were in a range of 0.15–0.79. Females had higher scores than males in 19 items except for Nos. 9 and 10. The ES of the former 21 items were in the range of 0.11–0.40. There were significant gender differences in five factors except for F3, showing a high value in females. The mean differences and ES were in the range of 0.94–1.60 (0.24–0.40 per item) and 0.17–0.29, respectively.

Tables 3 and 4 show the results of confirmatory factor analysis for males and females, i.e., the factor pattern matrix, the correlations between factors, and the fit index. Cumulative contributions of six factors were similar, but the size of factor loadings of several items showed a difference in some items. “Feel a depressed mood” showed the highest loading to F1 (0.312) in males and F3 (0.370) in females. However, “Feel a depressed mood” to load F1 (male: 0.312, female: 0.250) and F3 (male: 0.259, female: 0.370) factors was not significantly different between both genders. Three items of “become taciturn”, “want to sit down” and “feel strain in the neck”, are the main items defining respective F3, F4, and F6 factors, respectively, in both genders, while their loadings (0.322–0.437) in males were lower than those (0.626–0.850) in females. On

Table 1 Sample size

Age (years)	15	16	17	18	19	20	Total
Male	509	1179	659	376	296	225	3244
Female	274	690	379	239	363	246	2191
Total	783	1869	1038	615	659	471	5435

Table 2 Mean and standard deviation of subjective fatigue symptoms score for males and females, result of t test of gender difference

			Male		Female		difference	t-value	p-value	ES
			mean	SD	mean	SD				
Variables	1	Lack concentration	4.2	1.72	4.5	1.54	-0.28	-6.04	0.000	-0.168
	2	Thinking power weakens	3.7	1.77	4.1	1.59	-0.36	-7.58	0.000	-0.211
	3	Difficulty in thinking	3.6	1.70	3.8	1.55	-0.19	-4.15	0.000	-0.115
	4	Lack patience	3.7	1.75	4.0	1.61	-0.36	-7.69	0.000	-0.214
	5	Fatigue of the legs	3.2	1.74	3.4	1.66	-0.25	-5.33	0.000	-0.148
	6	Fatigue of the arms	2.9	1.65	3.0	1.58	-0.11	-2.51	0.012	-0.070
	7	Fatigue of the whole body	3.5	1.78	3.7	1.67	-0.15	-3.19	0.001	-0.089
	8	Feel heavy in the body	3.4	1.78	3.9	1.65	-0.42	-8.77	0.000	-0.244
	9	Become taciturn	3.2	1.71	3.0	1.65	0.19	4.09	0.000	0.114
	10	Become weary of talking	2.6	1.52	2.4	1.42	0.18	4.46	0.000	0.124
	11	Lack of vigor	3.4	1.72	3.4	1.62	-0.01	-0.26	0.794	-0.007
	12	Feel a depressed mood	3.8	1.83	4.2	1.73	-0.39	-7.79	0.000	-0.217
	13	Feel lazy	3.3	1.76	3.8	1.67	-0.51	-10.62	0.000	-0.295
	14	Want to sit down	3.8	1.82	4.2	1.72	-0.38	-7.59	0.000	-0.211
	15	Difficult to stand	3.3	1.74	3.6	1.67	-0.25	-5.36	0.000	-0.149
	16	Want to do nothing	3.4	1.95	3.8	1.90	-0.43	-8.01	0.000	-0.223
	17	Yawn	4.7	1.57	4.9	1.44	-0.17	-4.13	0.000	-0.115
	18	Become drowsy	5.1	1.72	5.3	1.53	-0.26	-5.70	0.000	-0.158
	19	Want recreation	5.0	1.97	5.5	1.65	-0.48	-9.37	0.000	-0.261
	20	Want to lie down	4.7	1.91	4.9	1.74	-0.26	-5.14	0.000	-0.143
	21	Feel strained in the eyes	4.2	1.85	4.5	1.74	-0.27	-5.40	0.000	-0.150
	22	Feel stiff in the shoulders	3.5	1.95	4.3	1.99	-0.79	-14.46	0.000	-0.402
	23	Become bleary-eyed	3.4	1.85	3.6	1.84	-0.23	-4.40	0.000	-0.122
	24	Feel strain in the neck	3.0	1.76	3.3	1.85	-0.32	-6.32	0.000	-0.176
Factors	F1	Difficulty with concentrated thinking	15.2	5.72	16.4	5.13	-1.19	-7.77	0.000	-0.216
	F2	Languor	13.1	5.90	14.0	5.39	-0.94	-5.94	0.000	-0.165
	F3	Reduced motivation	12.9	5.24	13.0	5.02	-0.02	-0.17	0.862	-0.005
	F4	Reduced activity	13.8	5.88	15.4	5.54	-1.57	-9.82	0.000	-0.273
	F5	Drowsiness	19.5	5.34	20.6	4.66	-1.18	-8.36	0.000	-0.233
	F6	Feeling of physical disintegration	14.1	5.65	15.7	5.55	-1.60	-10.27	0.000	-0.286

(Note) ES=effect size.

the other hand, “want to do nothing”, “want recreation” and “become bleary-eyed”, defined F4, F5, and F6 factors, respectively, in both genders, while loadings (0.633–0.735) in males were higher than those (0.263–0.417) in females. All items except “become taciturn” showed high loadings to the same factors in both genders. Six factors were interpreted as follows; difficulty with concentrated thinking (F1), languor (F2), reduced motivation (F3), reduced activity (F4), drowsiness (F5) and feeling of physical disintegration (F6). The correlations between factors based on the oblique Promax rotation method were 0.390–0.657 in males and 0.350–0.641 in females. Each fit index of GFI, AGFI, CFI, and IFI was 0.9 or more. In addition, RMSEA was near 0.0 in both genders.

Table 5 shows the congruence coefficients (CC) between SSF factors interpreted in males and females. The CCs between factors with the same name were 0.778–0.944. Three factors of concentrated thinking difficulty (F1), languor (F2), and feeling of physical disintegration (F6) had high CCs of 0.9 or greater. On the other hand, drowsy (F5) at less than 0.8 was a relatively lower value than the other factors. The CCs between factors with a different name were very low at -0.017–0.243.

Discussion

1. Difference of SSF complaints between males and females

Previous studies reported a gender difference in fatigue symptom complaints for junior high school students (5) and high school students or university students (6, 7).

In the present study, a significant gender difference was found in many items (21/24) and most SSF factors (5/6). The complaints of SSF except difficulty with concentrated thinking were higher in females than males. Ozeki (13) reported more psychological stress complaints from females than males. Lazarus (14) reported that the psychological stress reaction differs by cognitive appraisals regardless of the stressor level. Kobayashi et al. (8) studied a gender difference in SSF based on a cognitive evaluation, reporting that females tended to evaluate higher than males.

From the above, we inferred that the quantitative gender difference of SSF depends on the gender difference in a cognitive evaluation toward the workload or the physical stress tolerance.

Namely, even if the same mental or physical workload is imposed on the body, the degree of consciousness toward it is different between the genders, and a fatigue feeling is consid-

Table 3 Factor pattern matrix for males

			F1	F2	F3	F4	F5	F6	Communality
Variables	3	Difficulty in thinking	0.793	-0.029	-0.025	0.070	0.003	0.019	0.669
	2	Thinking power weakens	0.746	0.024	-0.011	0.053	-0.019	0.041	0.636
	1	Lack concentration	0.718	0.068	-0.084	-0.078	0.152	-0.089	0.523
	4	Lack patience	0.639	-0.033	0.101	-0.009	0.021	0.064	0.522
	12	Feel a depressed mood	0.312	0.068	0.259	0.093	0.090	0.022	0.475
	19	Want recreation	0.024	0.003	-0.035	0.032	0.735	-0.003	0.567
	17	Yawn	0.056	0.032	-0.005	-0.046	0.579	0.029	0.380
	18	Become drowsy	-0.015	0.038	-0.037	0.294	0.544	-0.015	0.538
	20	Want to lie down	0.193	0.002	0.002	0.006	0.367	0.013	0.265
	5	Fatigue of the legs	-0.026	0.852	-0.068	0.011	0.039	-0.025	0.673
	6	Fatigue of the arms	0.033	0.693	0.027	0.025	-0.061	0.069	0.567
	7	Fatigue of the whole body	0.025	0.675	0.140	0.047	0.082	-0.031	0.702
	8	Feel heavy in the body	0.059	0.559	-0.029	0.057	0.031	0.264	0.672
	22	Feel stiff in the shoulders	-0.025	0.012	-0.034	-0.039	0.035	0.847	0.680
	23	Become bleary-eyed	0.002	0.089	-0.003	0.123	-0.102	0.662	0.559
	21	Feel strained in the eyes	0.054	-0.047	0.073	-0.047	0.320	0.410	0.391
	24	Feel strain in the neck	0.070	-0.005	0.128	0.009	0.226	0.322	0.342
	10	Become weary of talking	-0.065	0.011	0.844	-0.122	0.037	-0.013	0.588
	11	Lack of vigor	0.039	-0.052	0.685	0.152	-0.142	0.050	0.550
	9	Become taciturn	0.134	0.165	0.437	0.048	0.133	-0.049	0.524
	15	Difficult to stand	0.004	0.082	-0.046	0.796	-0.048	0.056	0.700
	16	Want to do nothing	0.165	0.043	0.049	0.633	-0.015	-0.008	0.631
	13	Feel lazy	-0.067	0.012	-0.033	0.604	0.237	0.026	0.516
	14	Want to sit down	0.152	0.011	0.205	0.388	0.099	-0.043	0.473
	Contribution		2.342	2.039	1.557	1.727	1.624	1.529	
Factors	F1	Difficulty with concentrated thinking	1.000						
	F2	Languor	0.566	1.000					
	F3	Reduced motivation	0.590	0.514	1.000				
	F4	Reduced activity	0.629	0.657	0.524	1.000			
	F5	Drowsiness	0.569	0.550	0.390	0.528	1.000		
	F6	Feeling of physical disintegration	0.448	0.566	0.405	0.518	0.400	1.000	
			χ^2	Prob> χ^2	GFI	AGFI			
			1582.577	0.000	0.960	0.918			

ered to be higher in females than males. A further detailed examination for this problem will be needed by imposing a similar workload on both genders. Although feeling of physical disintegration (F6) showed the biggest gender difference, its difference per item (means of 4 items) was low at 0.4. This value was less than a category response value (1.0) per item.

It is suggested that even though a gender difference exists, the degree is small, because the effect size of items and factors showed the significant gender difference was very small (item: 0.11–0.40, subscale: 0.17–0.29).

From the above results, it is suggested that fatigue symptom complaints are higher in females than males, but the gender difference is not remarkable, and the gender difference depends on a different cognitive evaluation toward fatigue.

2. Comparison of the factor structure between males and females

The SSF scales selected in this study were composed of six factors (9) (see Table 1). Confirmatory factor analysis with six specified factors was applied to correlation matrixes in both genders. Many items showed a slight gender difference in loadings, but the highest value for the same factors. Therefore,

each factor in both genders was interpreted with the same name as follows; concentrated thinking difficulty, languor, reduced activation, reduced motivation, drowsiness and feeling of physical disintegration.

Since item No. 12 “having a depressed feeling” showed a similar loading to “concentrated thinking difficulty (F1)” and “reduced motivation (F3)” factors, the item-content may relate to both factors. However, the contribution of this item to both factors was suggested to be low because of low loading (0.259–0.370).

The F1 is a factor regarding the state in which one cannot concentrate even if one wants to do so (15) and it differs from F3 which means depreciated motivation. However, relations between both factors in both genders were relatively high. This may also have influenced the above-stated item (“having a depressed feeling”) to show both factors had a common loading.

Kawamoto (16) examined a cross-validity of scales, for reproducibility of a factor structure, based on the similarity among each item-content defining each factor interpreted in different groups. However, a number of factors interpreted in both groups differ and the similarity was not examined based on an objective scale. Hagiuda et al. (17) examined the reproduc-

Table 4 Factor pattern matrix for females

Variable			F1	F2	F3	F4	F5	F6	Communality
Variables	1	Lack concentration	0.775	0.167	-0.103	-0.118	0.097	-0.120	0.582
	2	Thinking power weakens	0.760	-0.060	0.000	0.109	-0.030	0.053	0.643
	4	Lack patience	0.742	0.064	-0.019	0.047	-0.035	0.047	0.629
	3	Difficulty in thinking	0.616	-0.042	0.171	-0.036	-0.012	0.019	0.464
	9	Become taciturn	-0.052	0.050	0.850	-0.095	-0.020	-0.008	0.637
	11	Lack of vigor	0.021	0.075	0.717	-0.001	0.050	-0.044	0.594
	10	Become weary of talking	0.029	-0.007	0.679	0.073	-0.111	0.017	0.491
	12	Feel a depressed mood	0.250	-0.077	0.370	0.050	0.125	0.082	0.416
	5	Fatigue of the legs	0.023	0.717	-0.030	0.078	-0.014	-0.032	0.554
	6	Fatigue of the arms	0.006	0.674	0.016	0.006	0.004	0.063	0.525
	7	Fatigue of the whole body	0.010	0.605	0.189	0.066	0.112	-0.021	0.665
	8	Feel heavy in the body	0.135	0.499	0.054	0.075	-0.040	0.244	0.633
	22	Feel stiff in the shoulders	-0.067	0.075	-0.038	-0.041	0.006	0.796	0.615
	24	Feel strain in the neck	-0.022	0.129	-0.011	0.036	-0.084	0.664	0.505
	21	Feel strained in the eyes	0.103	-0.075	-0.005	-0.019	0.209	0.490	0.364
	23	Become bleary-eyed	0.060	-0.103	0.077	0.040	0.168	0.417	0.290
	15	Difficult to stand	-0.050	0.075	0.010	0.790	-0.058	0.069	0.672
	13	Feel lazy	0.161	-0.017	0.030	0.720	-0.036	-0.050	0.617
	14	Want to sit down	-0.078	0.157	-0.079	0.626	0.124	0.002	0.536
	16	Want to do nothing	0.185	0.036	0.187	0.263	0.222	-0.044	0.467
	18	Become drowsy	-0.009	0.000	0.010	-0.028	0.809	0.017	0.639
	17	Yawn	0.030	0.072	-0.092	-0.033	0.614	0.064	0.418
	20	Want to lie down	0.005	0.120	-0.024	0.304	0.453	-0.043	0.516
	19	Want recreation	0.176	-0.132	0.087	0.035	0.283	0.121	0.223
	Contribution		2.313	1.742	1.982	1.766	1.523	1.613	
Factors	F1	Difficulty with concentrated thinking	1.000						
	F2	Languor	0.482	1.000					
	F3	Reduced motivation	0.536	0.472	1.000				
	F4	Reduced activity	0.564	0.641	0.473	1.000			
	F5	Drowsiness	0.546	0.457	0.335	0.533	1.000		
	F6	Feeling of physical disintegration	0.382	0.495	0.350	0.432	0.365	1.000	
			χ^2	Prob> χ^2	GFI	AGFI			
			1302.744	0.000	0.953	0.904			

Table 5 Coefficient of congruence

			Female					
Factor name			F1	F2	F3	F4	F5	F6
Male	Difficulty with concentrated thinking		0.939	0.087	0.131	0.076	0.128	0.044
	Languor		0.068	0.944	0.140	0.124	0.066	0.090
	Reduced motivation		0.029	0.076	0.882	0.082	-0.017	0.059
	Reduced activity		0.098	0.106	0.145	0.852	0.233	0.020
	Drowsiness		0.172	0.049	0.033	0.163	0.778	0.243
	Feeling of physical disintegration		0.046	0.082	0.017	0.043	0.102	0.926

N.B. Shadowed values indicate same factor names.

ibility of the factor in the anxiety index, judging that the reproducibility of the factor was high, because 93 of 100 items showed high factor loadings to original scales despite differences in the size of the loading. From the results in this study, 6 factors were interpreted with the same name in both genders, and the degree of fit was high.

Although there were some differences in the size of loadings, each item showed high loadings to the same factors. Accordingly, it was suggested that the factor structure for males and females was similar.

3. Similarity of SSF factors between genders

When the CC is 0.7 or greater, it is judged that the relation between factors is high (12). The similarity of factor structures in both genders was considered to be high, because all CCs between factors interpreted with the same name were 0.7 or greater. Toyoshima et al. (18) examined the gender difference and the similarity of the factor structures of SSF for 793 university students, reporting that because seven of eight factors extracted in both genders were interpreted with the same name and they showed high similarity, there was no gender difference in the factor structure.

However, in their study, the CC of some factors interpreted with a different name was high at 0.7 or greater. In general, in the case of a factor structure with higher approximation, the CC between the factors with a different name is very low and that between the factors with the same name is very high.

All factors constituting the factor structure of SSF in both genders derived by the confirmatory factor analysis in the present study were interpreted with the same name and also the relations between factors strongly showed the above-stated general trend. Therefore, the factor structures obtained in this study were similar qualitatively and are not considered to be a gender difference.

On the other hand, three factors of concentrated thinking difficulty (F1), languor (F2), and feeling of physical disintegration (F6) showed an especially high similarity between males and females. These are suggested to be factors influenced little by gender. Drowsiness factor (F4) had a relatively low loading (0.778) as compared with the above 3 factors even in factors interpreted with the same name. The items representing F4 showed relatively high loadings to the other factors in males. Since CC is a measure using factor loadings of all the items, the

CC of the drowsiness factor was suggested to have a lower value than that of the other factors with the same names.

This study examined the gender difference in SSF in adolescents between 15 and 20 years old using a questionnaire method. The SSF was influenced by various factors, such as daily hassles, lifestyle and so on. A complaint differed also by cognitive evaluation to each individual's stressor. In this study, it was assumed that factors affecting the complaints of the SSF were reflected in the SFS-Y score. Under this assumption, the gender difference is suggested to be a basic attribute with an important meaning in the application of the scale. Therefore, the qualitative and quantitative differences were examined.

In summary, gender differences in SSF complaints were found, but they were not remarkable. Factor structure in both genders consisted of the following same factors; "concentrated thinking difficulty", "languor", "reduced motivation", "reduced activity", "drowsiness" and "feeling of physical disintegration". The similarity of factor structure was very high, and a gender difference in SSF hardly exists.

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