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Association of Perceived Stress and Stiff Neck/Shoulder with Health Status: Multiple Regression Models by Gender

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ABSTRACT

It is well known that psychological stress affects health status. Stiff neck and shoulder in a broad sense is one of the major somatic complaints among Japanese. The objective was to determine how much perceived stress and stiff neck/shoulder are associated with health-related quality of life (HRQoL) by gender. Participants (n=512) completed the Japanese version of Perceived Stress Scale, the SF-8 Japanese version and original questions on perceived stiff neck/shoulder. Muscle hardness around the shoulder also was measured with the muscle tension meter. The multiple regression model of the men demonstrated that perceived stress was associated with not only the mental component summary (MCS) (beta: *–0.494*), but also the physical component summary (PCS) (beta = *–0.319*) of the SF-8. Although, in the model of the women, perceived stress was also associated with MCS (beta: *–0.632*) more than in that of the men, stiff neck/shoulder and age group (beta: *–0.231*; *–0.268*, respectively), but not stress, were related to PCS. The subjective neck/shoulder stiffness was hardly correlated with the objective shoulder muscle hardness. This study revealed the associations between perceived stress, stiff neck/shoulder and HRQoL, and their difference by gender. The hypothesis of gender differences was discussed with a focus on kind of stressors, perception of stress, admission of negative symptoms and cause of stiff neck/shoulder.

Key words: *Quality of life, Stress, Stiff neck and shoulder, Somatic complaint*

It is well known that psychological stress affects health status. Perceived stress is an important risk factor for emotional problems such as feeling depressed or anxious[4,10,17,36]. Stress impacts the physical condition as well as mental well-being. Accumulation of chronic stress increases allostatic load, affects the autonomic nervous system, and reduces the immune response[5,24]. People who have perceived stress are more susceptible to the common cold[8,9]. Perceived stress is also known as a risk factor for various diseases such as cardiovascular disease[10], diabetes[33], asthma[40] and rheumatoid arthritis[5,42].

Although stiff shoulder is usually defined as a disorder of the glenohumeral joint[3,14], it has a broader meaning in Japanese. Apart from medical specialists, the general public in Japan is vague about the distinction and border between the neck and shoulder. Not only the glenohumeral joint but the muscles from the joint to the neck as well are generically called the 'shoulder'. In this article, we have defined stiff neck/shoulder as a subjective symptom of neck, shoulder and scapular arch discomfort, tension and/or muscular pain. Chronic non-specific neck pain, which has been defined as a symptom of this kind[30], may be strict and practical for diagnosis. An idea has been proposed that this symptom be clinically treated as fibrositis of the shoulder from a pathological perspective[25]. In community health and preventive medicine, however, stiff neck/shoulder is considered to be a more suitable term when it is a patient-reported symptom, because it is not always accompanied by pains. Measurement of muscle hardness around the shoulder by an instrument was defined as an objective evaluation.

Stiff neck/shoulder in the broad sense is one of the major somatic complaints among the general Japanese population, especially in women[20,30,41]. Although the pathogenesis of stiff neck/shoulder has not been thoroughly verified, several mechanisms have been considered, such as increased

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tension of the sympathetic nerve, degeneration and pains in cervical vertebra, and ischemic change in the shoulder muscles[18,25,30]. A lower level of muscle strength in women possibly causes stiff neck/shoulder. In the case of stress-sensitive women, mental tensions decrease blood circulation around the neck and shoulder muscles such as the trapezius, which may cause the muscle stiffness[15]. A previous case-controlled study conducted on a small number of subjects, all of whom were female nurses demonstrated that neck/shoulder stiffness was associated with work-related stress[41]. Recently, an increasing number of employees who operate computers complain of neck and shoulder pain[12,26,37]. The pain has been associated with physical, psychosocial and individual factors, and reduced health-related quality of life[1]. A high level of stress was also related to neck and shoulder pain among workers[2]. Stiff neck/shoulder including pain and psychological stress are serious problems and may reduce work productivity.

The hypothesis proposed is that subjective symptoms impact on health-related quality of life (HRQoL) and their impacts are different between genders. There may be a crucial difference in psychological assessments between genders[7]. Although gender differences in the associations of depression with various factors such as stressful life events, vulnerability and coping style have been explored in detail[19,28], few studies focusing on gender difference in the association of psychological status such as stress with somatic symptoms such as stiff neck/shoulder have been conducted. The objective was to determine how much perceived stress and stiff neck/shoulder are associated with HRQoL by gender.

METHODS

Data were collected at an event on food and health held in Shizuoka, over 100 km distant from Tokyo, Japan, from October to November, 2004. We recruited subjects at a health-checkup booth in the event, using a signboard and poster. Participants of the event were mainly healthy people interested in healthy practices. The subjects consented to taking part in the survey after hearing an explanation of the aims and contents of examinations by well-trained receptionists at the booth. The inclusive criteria were: males and females more than 15 years old, and healthy people without serious diseases such as cancer, cerebrovascular or cardiovascular disease, and mental disorder. These diseases were identified by the participants' report.

The participants completed three self-administered questionnaires: the Japanese version of Perceived Stress Scale (JPSS) for subjective stress assessment, the 8-Item Short-Form Health Survey (SF-8) Japanese version for health-related quality of life (HRQoL) measurement, and three original questions on perceived stiff neck/shoulder. The JPSS was originally developed by Cohen et al[6] and translated by Iwahashi et al[16]. This scale comprises 14 five-point Likert-type items, and seven of the items were reversal. Each item is scored from 0 to 4, therefore, the range of the total score is 0-56. Higher scores indicate more perceived stress.

The SF-8 was developed by Ware et al[35,38] and translated by Fukuhara et al[11]. This measure is a shortened version of the SF-36[39], and yields two summary scores: physical component summary (PCS) and mental component summary (MCS), indicated as a standard deviation score (the national standard score is 50.). Higher scores mean better health status.

The original questions on perceived stiff neck/shoulder are quoted below.

- "Do you have stiffness in the right shoulder today?"
- "Do you have stiffness in the left shoulder today?"
- "Do you tend to have stiffness in the shoulder in your daily life or work?"

Each question has five responses: 'very stiff', 'stiff', 'a little', 'not very', and 'not at all'.

Muscle hardness around the shoulder was also measured with the muscle tension meter (PEK-1, Imoto Machinery Co., Ltd, Kyoto). This meter is a palm-sized instrument with a needle and display panel. The shoulder muscle hardness is determined by means of pushing the dull needle of the meter directly into the subject's skin without pain or scar[13]. The measurement was made at the midpoint between the spinous process of the 2nd thoracic vertebra and the acromial end of the clavicle[34]. The hardness (g/mm^2) is figured as: force / (distance of needle) ^{2}. Higher values express hard muscle.

Statistical analysis

Means and standard deviations of JPSS, SF-8 (PCS and MCS) and shoulder muscle hardness (right and left) were calculated in total subjects and by gender. The reliability of JPSS was also confirmed with Cronbach's alpha coefficient. Responses to the three questions on perceived stiff neck/shoulder were counted and combined into two categories: positive ('very stiff', 'stiff') and negative ('a little', 'not very', and 'not at all'), to target people with a clear perception of stiff neck/shoulder. These dichotomous variables were used for analyses except correlation. Differences by gender for stiff neck/shoulder were analyzed with Fisher's exact test. Correlations between perceived stress, HRQoL, perceived stiff neck/shoulder (using raw response data), shoulder muscle hardness, and age group were analyzed with

Spearman's coefficients. Differences of perceived stress and HRQoL between positive and negative for stiff neck/shoulder were analyzed with the Mann-Whitney U test in total and by gender. Finally, multiple regression models were developed for HRQoL from stress, stiff neck/shoulder and age group in total and by gender. Gender was included as an independent variable for the model in total. Dependent variables of the multiple regression analyses were PCS and MCS scores of SF-8. To avoid colinearity, we chose "the tendency to stiff neck/shoulder" among the questions as an independent variable. These statistical analyses were conducted using SPSS for Windows, version 11.0[32]. Statistical significance was set at $p < 0.05$.

RESULTS

The number of participants for analysis was 512, comprising 214 men and 298 women. Distribution by age group and gender for the subjects is shown in Table 1. The subjects were distributed over all age groups, although old subjects were more likely to participate in this survey. Mean scores of perceived stress (JPSS) and HRQoL (SF-8), and means of shoulder muscle hardness in total and by gender are shown in Table 2. The mean PCS and MCS scores of SF-8 were fairly close to 50, the national standard, which indicated that the participants were healthy people. The Cronbach's alpha coefficient of JPSS was

Table 1. Distribution by age group and gender for the subjects †

age group	≦ 29	30–39	40–49	50–59	60–69	70 ≦	Total
Total	69	76	61	118	125	63	512
male	28	39	40	48	39	20	214
female	41	37	21	70	86	43	298

† Mean of age was 51.2 (16.4 SD).

Table 2. Scores of perceived stress and health-related quality of life, and data of shoulder muscle hardness, in total and by gender †

	Total	Male	Female	M vs. F ‡
Perceived stress	21.7 (7.6)	21.4 (7.5)	21.9 (7.6)	NS
Physical component summary	47.1 (6.8)	47.7 (6.9)	46.7 (6.7)	*
Mental component summary	48.1 (7.0)	48.3 (6.5)	47.9 (7.3)	NS
Hardness of the right shoulder	63.4 (4.3)	62.5 (4.5)	64.0 (4.0)	***
Hardness of the left shoulder	62.2 (4.5)	61.3 (4.6)	62.9 (4.4)	***

† Means were shown with standard deviations (SD).
‡ Significant differences between male and female were analyzed with Mann-Whitney U Test.
*** $p < 0.001$; * $p < 0.05$; NS: not significant

Table 3. Frequencies (proportion) of responses to the questions on perceived stiff neck/shoulder in total and by gender †

		Total	Male	Female	M vs. F ‡
Right neck/shoulder stiffness	+	219 (43.6%)	83 (39.3%)	136 (46.7%)	NS
	–	283 (56.4%)	128 (60.7%)	155 (53.3%)	
Left neck/shoulder stiffness	+	222 (44.0%)	79 (37.3%)	143 (49.0%)	*
	–	282 (56.0%)	133 (62.7%)	149 (51.0%)	
Tendency to stiff neck/shoulder	+	286 (57.0%)	100 (47.6%)	186 (63.7%)	***
	–	216 (43.0%)	110 (52.4%)	106 (36.3%)	

† Responses were combined into two categories. Stiff neck/shoulder (+) group: 'very stiff' and 'stiff'. Stiff shoulder (–) group: 'a little', 'not very', and 'not at all'.
‡ Significant differences between male and female were analyzed with Fisher's exact test.
*** $p < 0.001$; * $p < 0.05$; NS: not significant

Table 4. Correlations between perceived stress, health-related quality of life, perceived stiff neck/shoulder, and shoulder muscle hardness †

	Stress	PCS	MCS	Stiffness (right)	Stiffness (left)	Tendency	Hardness (right)
Physical component summary	−0.155 ***						
Mental component summary	−0.535 ***	−0.108 *					
Right neck/shoulder stiffness	0.193 ***	−0.145 **	−0.052				
Left neck/shoulder stiffness	0.178 ***	−0.219 ***	−0.086	0.729 ***			
Tendency to stiff neck/shoulder	0.294 ***	−0.229 ***	−0.110 *	0.623 ***	0.642 ***		
Hardness of the right shoulder	0.020	−0.145 **	0.046	0.076	0.056	0.079	
Hardness of the left shoulder	0.023	−0.105 *	0.063	0.092 *	0.127 **	0.114 *	0.519 ***

† Spearman's correlation coefficients were shown.
*** p < 0.001; ** p < 0.01; * p < 0.05

Table 5. Differences of perceived stress and health-related quality of life between positive and negative of stiff neck/shoulder, in total and by gender †

		Right neck/shoulder stiffness			Left neck/shoulder stiffness			Tendency to stiff neck/shoulder		
		−	+		−	+		−	+	
Perceived stress	Total	20.6	23.0	***	20.6	22.9	**	19.6	23.2	***
	male	19.8	23.4	**	20.1	23.4	**	19.3	23.4	***
	female	21.3	22.7	NS	21.1	22.7	NS	19.8	23.1	***
Physical component summary	Total	48.0	46.0	**	48.1	45.9	***	48.6	46.0	***
	male	48.3	47.0	NS	48.2	47.0	NS	48.6	46.8	*
	female	47.8	45.4	**	48.0	45.2	***	48.5	45.6	***
Mental component summary	Total	48.4	47.6	NS	48.6	47.5	NS	48.8	47.5	NS
	male	49.1	47.1	*	49.0	47.0	*	49.2	47.4	*
	female	47.9	47.9	NS	48.2	47.8	NS	48.4	47.6	NS

† Significant differences were analyzed with Mann-Whitney U test.
*** p < 0.001; ** p < 0.01; * p < 0.05; NS: not significant

Table 6. Multiple regression models for health−related quality of life, in total and by gender †

Dependent variable	Total		Male		Female	
	PCS	MCS	PCS	MCS	PCS	MCS
Independent variables						
Perceived stress	−0.178 ***	−0.577 ***	−0.319 ***	−0.494 ***	−0.076	−0.632 ***
Stiff neck/shoulder ‡	−0.164 ***	0.059	−0.065	0.031	−0.231 ***	0.069
Age group	−0.192 ***	0.019	−0.082	0.038	−0.268 ***	0.003
Gender	−0.012	−0.021				
R square	0.081	0.328	0.107	0.248	0.102	0.388

† Standardized regression coefficients (beta) were shown. Gender was included as an independent variable in total.
‡ Binary data of the tendency to stiff neck/shoulder were used. Positive: 1; negative: 0.
*** p < 0.001

0.857. There was no difference between genders for perceived stress. Negative correlation between perceived stress and age group (r = *−0.291*) was found. The PCS of the men was slightly higher than that of the women, but in the MCS, gender difference was not significant. The shoulder muscle of the women was moderately harder than that of the men. Frequencies of responses to the questions on perceived stiff neck/shoulder are shown in Table 3. More females had a tendency to feel stiffness. Table 4 indicates correlations between perceived stress, HRQoL, stiff neck/shoulder, and shoulder muscle hardness in total subjects. The scores of perceived stress were correlated with the SF-8 scores, specifically the MCS. Subjective stiff neck/shoulder from the

questions was hardly correlated with objective data of shoulder muscle hardness by the muscle tension meter. Those who felt stiff neck/shoulder perceived more stress and had worse scores in the PCS. Differences between genders were found in the associations of stiff neck/shoulder with perceived stress and HRQoL (Table 5). The association between stress and stiff neck/shoulder was greater in the men, whereas the association between PCS and stiff neck/shoulder was more significant in the women. The results of multiple regression analysis are shown in Table 6. In the multiple regression model of the men, perceived stress was associated not only with MCS (standardized regression coefficient = beta: *–0.494*) but also with PCS (beta: *–0.319*). Although, in the model of the women, perceived stress was associated with MCS (beta: *–0.632*) more than in that of the men, stiff neck/shoulder and age group (beta: *–0.231*; *–0.268*, respectively), but not stress, were associated with PCS.

DISCUSSION

This study reveals the associations between perceived stress, stiff neck/shoulder and HRQoL by gender in Japanese adults. These findings are summarized in Fig. 1 as a conceptual framework.

1) Perceived stress was closely associated with mental health in both genders. In the men, perceived stress was also associated with physical health.
2) In the women, perceived stiff neck/shoulder was slightly associated with physical health.
3) The relationship between perceived stress and stiff neck/shoulder was found to be stronger in the men than in the women.

These results cannot sufficiently account for the cause-and-effect relationship and reasons for the gender differences. People other than Japanese may be surprised to learn that of the participants more than a half of the sample in this study had a tendency toward stiff neck/shoulder. Most Japanese experience such symptoms including neck problems and upper back pain in the broad sense of stiff neck/shoulder[30,41]. These results support an existing theory that muscles around the shoulder have a lot of autonomic nerve fibers, and increased tension of sympathetic nerve is a major cause of stiff neck/shoulder[18]. This sample included a number of menopausal women who complained of stiff neck/shoulder and psychological stress[29]. However, despite the associations between mental health and stress, stiff neck/shoulder was not conclusively associated with mental health.

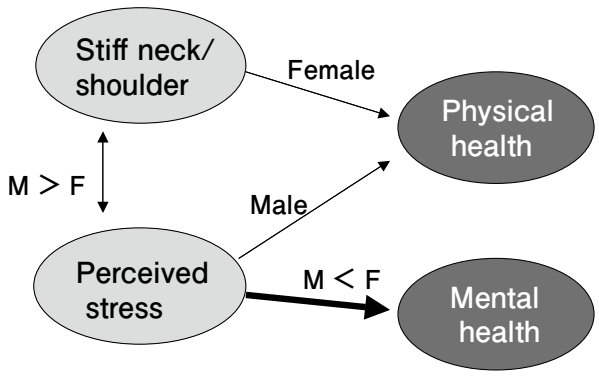

Fig. 1. The associations of subjective symptoms (stiff neck/shoulder and stress) with health-related quality of life: a conceptual framework.

The differences between genders considered are: a) kinds of stressors; b) perception of stress; c) admission of negative symptoms; and d) cause of stiff neck/shoulder. A major stressor in men is job stress. Poor health status also becomes a stressor, because it affects their work performance. Stressors in women are more diverse, including personal relationships and child rearing. Women are more likely to be stressed by little events and admit to their feelings. Therefore, perceived stress in women may have been strongly associated with mental health when compared with the scores of the questionnaire. Stress is considered as a major cause of stiff neck/shoulder in men. In contrast, that in women is assumed to be not only stress but also their body shape. In general, since a considerable number of Japanese women have sloping shoulders and low muscle strength, the weight of their arms and breasts becomes a burden on their shoulders[15]. Moreover, they are possibly more sensitive to pains and discomfort of their neck and shoulders. These characteristics may account partly for the gender differences in the association between stiff neck/shoulder, stress and health status. Since this is a hypothesis claimed by the authors, further research needs to be conducted to clarify the gender differences.

A discrepancy was unexpectedly found between perceived neck/shoulder stiffness and physical shoulder muscle hardness. A subjective symptom is not usually consistent with an objective measurement. For example, subjective HRQoL does not correspond to objective medical examinations[21]. It goes without saying that it is difficult to determine pains and discomfort by mechanical measurement. Moreover, muscle hardness is related to individual physical characteristics. Another study has demonstrated that data on muscle hardness varied between instruments used and was suggested to be associated with subcutaneous fat[34]. Further research needs to be conducted, focusing on how objective hardness of shoulder muscle is determined, and assessing intra- and inter-rater reliability.

This study had several limitations. One of the limitations was that the participants were

healthy people and interested in health issues. They were also biased by living in a certain region. In addition, the subjects who were not selected by random sampling can not be claimed to represent the Japanese population. Since data of socioeconomic factors were not collected, the associations between symptoms may be affected by confounding factors. Although, in this study, simple questions assessed stiff neck/shoulder, more systematic evaluation such as a valid instrument and procedure[22,23,27] should be applied in the next phase. Despite these limitations, stiff neck/shoulder, as well as psychological stress, was partly associated with health status. Further research should be conducted to confirm these findings using larger samples and then be compared with findings from other countries. A previous study on somatic symptoms in depression reported that they are common in many countries, but their frequency varies depending on the definition and measurement of symptoms[31]. Future investigations of the association of HRQoL with stiff neck/shoulder and other somatic complaints such as back pain and headache need to be conducted with strict definitions of them.

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