WORK-RELATED MUSCULOSKELETAL DISORDERS AND ASSOCIATED FACTORS IN TEACHERS OF PHYSICALLY AND INTELLECTUALLY DISABLED PUPILS: A SELF-ADMINISTERED QUESTIONNAIRE STUDY

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Abstract : Teachers in schools for physically and intellectually disabled pupils are assumed to have a risk of developing musculoskeletal disorders including the cervicobrachial and lower back regions. To date, however, studies concerning these issues are extremely limited. The present study aimed at clarifying the magnitude of the musculoskeletal disorders among the teachers, its work-relatedness and associated factors. First, we conducted self-administered questionnaires and medical checkups simultaneously for 126 female nursery school nurses to ascertain the validity of questions and answer options which we developed for epidemiologic research. Questions "have you had any pain or stiffness in your neck, shoulders or arms in the past month?" and "have you had any pain or stiffness in your lower back?", and an answer option "almost all day, everyday" were found to correlate well with the results of clinical examinations and difficulties in daily activities. Secondly, we analyzed self-administered questionnaires of 975 teachers working for physically and intellectually disabled pupils at municipal schools in a city. The questions and answer options which had been validated in the first study were used. In the males 16% and 20% complained "almost all day, everyday" of the cervicobrachial and lower back symptoms, respectively, and in the females 20% and 16% in that order. Adjusted odds ratios of both symptoms increased with an increase in objective scores which were obtained by the homogeneity analysis and were considered to reflect the quantity of nursing care burden on the teachers. In case of the cervicobrachial symptom females against males had a significantly higher odds ratio than unity. These results demonstrated that the musculoskeletal symptoms complained of highly by the teachers were work-related, and that the question and answer options we developed could be useful parameters in epidemiologic research for the symptoms now widely prevailing in various workplaces.

Key words : disabled children, questionnaire study, risk factors, teachers, work-related musculoskeletal disorders

INTRODUCTION

Schools for pupils with disabilities were made part of the compulsory education system in Japan in April 1974. From that time, all pupils who had formerly not been required to attend school because of severe physical or intellectual disability were obliged to attend. The

number of schools for such pupils has gradually increased with teacher numbers increasing accordingly. As of May 2001, there were 818 such schools nationwide, with over 50,000 teachers[1]. In addition, the number of teachers in charge of disabled children in regular elementary and junior high schools is increasing recently, because disabled children who want to attend regular schools are increasing in number and these schools must arrange special education classes for them.

Bending the neck, forward repetitive wrist motions, forceful gripping, frequent handling of heavy loads and prolonged awkward postures are widely recognized risk factors for musculoskeletal disorders including the cervicobrachial and lower back regions. These results have been accumulated through studies chiefly of industrial workers[2-16]. The disorders are also observed, however, in hospital nurses[17, 18], nursery school teachers[19, 20] and caregivers in elderly nursing homes[21, 22]. Among these the risk factors above are observed but continually with a rather shorter duration when compared with those in industrial workers. Work practices among teachers in schools for disabled pupils are similar to those of nurses, nursery school teachers and caregivers. Therefore, the teachers in such schools are assumed to have the same health problems. To date, however, reports on this issue are limited to the studies by Tokunaga[23], Maeda et al.[24], and Taoda et al[25]. To promote health care and further workplace improvements in schools, we need more knowledge about the prevalence of musculoskeletal disorders among the teachers, their work relatedness, and the contribution of individual factors such as age and physical attributes.

The magnitude of risk factors is as low as two to three times[6, 11, 18] with a few exceptions for musculoskeletal disorders so that a comparatively large number of subjects are required to detect the factors. Subjective symptoms such as stiffness, pain, and numbness are considered a better parameter to obtain early signs of the disorders because the symptoms usually precede clinical findings. To ascertain subjective symptoms, interviews and self-administered questionnaires are commonly conducted. A study of a large number of subjects prefers the latter for ease of administration and cost efficiency. This method, however, has a shortcoming. The validity of self-administered answers is relatively low[26] when compared with interviews which can confirm recorded answers, or compared with a medical checkup, which can obtain objective findings. Therefore, to use the results of self-administered answers as an epidemiologic parameter, the validity of the questions and answer options should be evaluated beforehand. However, there have been few reports[27-29] on this point of musculoskeletal disorders.

In the present study, we first conducted self-administered questionnaires and medical checkups simultaneously for over 100 subjects to ascertain the validity of questions and answer options, which the authors developed as an epidemiologic parameter for musculoskeletal disorders. Secondly, a self-administered questionnaire study was carried out for all teachers working for physically and intellectually disabled pupils at municipal schools in Osaka City. The main objective of the present study was to elucidate the current status of musculoskeletal disorders among the teachers and to clarify their work relatedness. Results on these issues would provide clues to develop any measures to prevent disorders among the more than 50,000 teachers nationwide. The next objective was to evaluate the validity of questions and answer options developed by the authors concerning musculoskeletal

symptoms. We considered that the results on this point could provide a useful epidemiologic parameter in an investigation of the symptoms among workers with risk factors of contracting musculoskeletal disorders.

Part 1. Validity of musculoskeletal symptoms obtained by self-administered questionnaires

1. Subjects

We performed medical examinations for work-related musculoskeletal disorders on 435 female nursery school nurses working at municipal day nurseries in Osaka City in August 2000. From those examined, 126 individuals who were examined by the same doctor (N. K.) were selected as study subjects to exclude any bias of different examination techniques among medical doctors.

2. Methods

1) Questionnaires for musculoskeletal symptoms

Prior to the clinical examination, subjects were requested to fill in the questionnaires. To check on subjective symptoms of the cervicobrachial and lower back regions, the questions "have you had any pain or stiffness in your neck, shoulders or arms in the past month?" and "have you had any pain or stiffness in your lower back in the past month?" were asked. Each answer consisted of four options: "almost all day, everyday", "not all day, but everyday", "not everyday, but several times a week" and "almost none". Questions on the treatment status included any treatment in the past half year for symptoms in the neck, shoulders or arms, and in the lower back. The subjects were allowed to choose multiple answer options covering their attendance at a hospital, acupuncture, chiropractor or osteopath, or none. We also asked subjects about the effects of symptoms on daily activities. In respect of the cervicobrachial region, six items (see Table 1) including "difficulty combing" and "difficulty holding a telephone receiver for a long time" were prepared according to the questionnaire by Itani[30]. For the lower back, four questions (see Table 1) including "do you have lower back pain on standing up?" and "do you have any difficulty in walking due to pain, numbness or stiffness in the lower extremities?" were asked in the questionnaire devised by the Committee of Occupational Lower Back Pain, Japan Society for Occupational Health[31]. The subjects were requested to choose an answer from three options such as "always", "sometimes" and "none", which were semi-quantitative responses to the times of the symptoms intruding into daily activities in the past month.

2) Clinical examination[3, 32-34]

All subjects received the same clinical examination. In the sitting position, motion pain and limitation of movement of the neck were observed by anteflexing, retroflexing, lateroflexing and rotating the neck. Also, those signs in the shoulder and elbow joints were observed by abduction and adduction of the shoulder and extension and flexion of the elbow, respectively. The doctors asked the subjects to expand and contract knuckle joints of both hands to detect the presence of snapping fingers. The tendon reflexes of the biceps and triceps brachii muscles were checked. Tactile sense in the proper regions innervated by the medial and ulnar nerves (palms of the second and fifth finger tips, respectively) was

Table 1. Clinical findings, activities of daily living and treatment status by frequency of subjective symptoms in cervicobrachial and lower back regions among 126 female nursery school nurses

		Almost none	Not everyday, but several times a week	Not all day, but everyday	Almost all day, everyday
Pain or stiffness in the neck, shoulders or arms in the past month		20	41	33	32
Number of subregions with tenderness [1]	None	95.0	63.4	39.4	9.3
	1	5.0	7.3	6.1	6.2
	2-3	0.0	24.4	30.3	31.3
	≥4	0.0	4.9	21.2*	53.1**
Daily activities ("Always" in the past month)					
Difficulty holding a telephone receiver for a long time		0.0	7.3	9.1	37.5
Difficulty squeezing water out of dust cloth		0.0	2.4	9.1	25.0
Difficulty combing		0.0	2.4	0.0	18.8
Easily let something fall from hands		0.0	0.0	0.0	12.5
Awake during night due to numbness of hands or arms		0.0	4.9	0.0	9.4
Difficulty dressing or undressing		0.0	0.0	0.0	6.3
The total number of "always" in the above 6 items	0	100.0	87.8	84.8	40.6
	1	0.0] 0.0	9.8] 11.2	12.1] 15.1	40.6] 59.4**
	≥2	0.0	2.4	3.0	18.8
Treatment status in the past half year	Hospital, clinic or acupuncture	0.0	17.1	39.4	34.4
Pain or stiffness in the lower back		30	54	17	25
Number of subregions with tenderness	None	96.7	57.4	29.4	8.0
	Local tenderness [2]	3.3	25.9	47.1	32.0
	Spreading tenderness [3]	0.0	16.7	23.5	60.0**
Daily activities ("Always" in the past month)					
Have lower back pain on standing up		0.0	3.7	0.0	44.0
Have lower back pain on turning over in bed		0.0	5.6	17.6	36.0
Have lower back pain on washing face		0.0	5.6	5.9	28.0
Difficulty walking due to pain, numbness or stiffness		0.0	0.0	0.0	12.0
The total number of "always" in the above 4 items	0	100.0	88.9	82.4	44.0
	1	0.0] 0.0	11.1] 11.1	17.6] 17.6	8.0] 56.0**
	≥2	0.0	0.0	0.0	48.0
Treatment status in the past half year	Hospital, clinic or acupuncture	3.3	20.4	58.8+	16.0

1) total number of the parts with tenderness among 10 subregions in the cervicobrachial region.
2) and 3) tenderness was observed in either or both, respectively, the paravertebral muscle and/or the iliolumbar ligament. *and ** show significant differences in percentages in the group concerned compared with those of the groups complaining of the symptom less frequently at the level of 0.05. + shows a statistically higher value than those in the other three groups.

examined using a brush, and atrophy of the thenar, hypothenar and interosseous muscles was also examined. Tests for carpal tunnel syndrome such as the Phalen test and Perfect O sign were added when necessary. While asking the subjects whether they felt tenderness, doctors sequentially palpated the muscles of the finger and forearms, lateral and medial epicondyles of the humerus, brachial muscles, ligaments attached to the shoulder joints, muscles of the pectoralis major, anterior scalene, neck, shoulder region of the trapezius, scapula levator and rhomboideus. In a supine position, the Laséue, Achilles tendon reflex, and patellar tendon reflex tests were checked and tenderness of the lumbar paravertebral muscle and iliolumbar ligament was examined. In the standing position, motion pain and limitation of movement in the lumbar region were observed by bending the upper part of the body back and forth. The series of examinations was performed on average in about 15 minutes with the completed questionnaire masked. Diagnostic imaging including conventional radiography was not carried out.

The extent of tenderness in the cervicobrachial region found in the examination was evaluated by the total number of the parts with tenderness among 10 subregions: (1) from the

fingers to the proximal upper arm (right and left, ventral and dorsal); (2) the shoulder joint and its surroundings (right and left); (3) the cervical region (ventral and dorsal); and (4) the upper back (right and left of the backbone). The extent of tenderness in the lower back region was classified into three: "no tenderness"; "local tenderness (observed in either lumbar paravertebral muscle or iliolumbar ligament)"; and "spreading tenderness (observed in both)".

3) Statistical analysis

Differences in the rates between two groups were evaluated by χ^2 test, and a null hypothesis was rejected when P value was below 5%.

3. Results

All self-administered questionnaires returned by the 126 subjects were filled in adequately, and there was no missing data.

As shown in Table 1, 20 subjects answered that they had had pain or stiffness in the neck, shoulders or arms (cervicobrachial symptom, hereafter) "almost none" in the past month. Among these, 95.0% showed no tenderness in the cervicobrachial region by clinical examination. The greater the frequency of the symptom complained of in the past month, the lesser the percentage of those showing no tenderness. In the "almost all day, everyday" group, only 9.3% of 32 subjects had no tenderness in the region. Contrarily, this group showed the highest value in the proportion of those having tenderness in four or more subregions. The value of 53.1% was statistically higher than those of the other three groups, and the corresponding value in the "not all day, but everyday" group was significantly higher than those of the remaining two groups. More than half (59.4%) of the subjects in the "almost all day, everyday" group "always" had had difficulty in one or more daily activities in the past month, being statistically higher than the corresponding values in the other three groups. The percentage of subjects who had a history of treatment in the past half year in the "almost all day, everyday" and "not all day but everyday" groups were similar, but higher than those of the other groups.

In the past month, 25 subjects had had pain or stiffness in the lower back (lower back symptom, hereafter) "almost all day, everyday". Among these, 60% showed tenderness in both the lumbar paravertebral muscle and iliolumbar ligament. This figure was significantly higher than those of the other three groups. More than half (56.0%) of the "almost all day, everyday" group "always" had one or more difficulties in daily activities, in contrast less than 20% did in the other three groups. Regarding the history of treatment in the past half year, the "not all day, but everyday" group showed the highest percentage, which was significantly higher than those of the other groups.

Part 2. Musculoskeletal symptoms and associated factors among teachers at schools for pupils with disabilities

We conducted a questionnaire study for all teachers working with physically and intellectually disabled pupils at public schools in Osaka, Japan.

1. Subjects

Subjects were 1663 staff working at special education classes for physically or

intellectually disabled pupils at regular elementary and junior high schools, and 10 schools for pupils with disabilities (4 schools for physically disabled pupils, 3 for intellectually disabled pupils, 1 for invalid pupils, 1 for the blind and 1 for the deaf).

2. Methods

1) Questionnaires

The questionnaire consisted of three parts. The first part was to collect demographic data including the name of school, gender, age, height and body weight of subjects. The second part asked about cervicobrachial and lower back symptoms with the same wording of questions and answer options used in the study in Part 1, days taken away from work due to the symptoms in the past year, the severity, duration and appearance status of the symptoms. The third part inquired about nursing-care needed by pupils of whom the subjects were in charge. The questions consisted of nine items, which were developed by workplace inspections and interviews with teachers at several representative schools by the authors, and from the report of Taoda et al.[25] The subjects were requested to respond "Yes" or "No" to each of the items.

Answers to each question were chosen from already prepared options, except age, body weight, height and number of years working. Questionnaires were unregistered to help elicit a favorable response rate and distributed by the Secretariat of the Board of Education of Osaka City to all school staff through principals. The questionnaire was kept for two weeks by the subjects and returned through principals and the Secretariat of the Board of Education.

2) Statistical analysis

Differences in the averages between two groups were evaluated by t test, and the χ^2 test was used to evaluate differences in the rates. Null hypothesis was rejected when a P value was below 5%, but in the case of multiple comparisons, judgment was made from the adjusted P value multiplied by the number of combinations of tests challenged according to the method of Bonferroni[35]. The factors associated with cervicobrachial and lower back symptoms were evaluated by multiple logistic regression analysis. Independent variables included individual factors such as gender, age and BMI (Body mass index: obtained by weight in Kg divided by the square of height in m) as well as occupational factors such as the kinds of schools and the quality and quantity of workload. Ages were classified into 10-year intervals, and BMI was categorized into <18.5 (underweight), 18.5–25 (normal) and 25 (obese). The homogeneity analysis[36] was applied to the "Yes/No" answering patterns for the nine questions about nursing care needed with regard to the conditions of pupils of whom the subjects were in charge, and calculated individual object scores, which were summarized on a two-dimensional plane, were provided as a parameter for the quantity and quality of workload of each subject. Goodness of fit for the regression models and trend on the odds ratio were tested by the Hosmer and Lemeshow test[37] and the Cochran-Mantel Haenszel test[38], respectively. SPSS 11.0.1J for Windows was used for homogeneity analysis, and the other statistical analyses were performed on SAS release 6.12 for Windows.

3. Results

Table 2. Demographic data of subjects who responded to the questionnaire by school and gender

		No.	Age		Years of work	
			Mean	SD	Mean	SD
Total	M	453	43.2	9.8	15.1	10.3
	F	661	42.7	9.7	16.7	10.4
S classes	M	172	44.8	9.4	16.7	10.8
	F	316	46.0	8.5	19.4	10.8
I schools	M	128	43.5	10.7	14.7	10.5
	F	156	40.2	9.4	14.8	8.9
P schools	M	93	39.8	9.5	12.1	8.9
	F	110	37.5	9.9	11.7	8.5
Schools for pupils with a poor constitution	M	13	39.4	8.6	14.6	8.8
	F	10	41.2	12.1	13.7	12.8
Schools for the blind	M	25	45.6	8.2	17.2	10.3
	F	27	43.4	9.1	18.1	9.4
Schools for the deaf	M	22	43.3	8.7	14.8	9.7
	F	42	41.4	10.6	16.5	10.4

S classes: special education classes for physically or intellectually disabled pupils in regular elementary or junior high schools, I schools: schools for intellectually disabled pupils, P schools: schools for physically disabled pupils, M: male, F: female.

1) Subjects for analysis

Questionnaires were returned from 1,411 (84.8%) of the 1663 subjects. Excluded subjects were 19 who did not answer the questions on gender or age and 278 subjects who were engaged in management or office work and not in teaching classes. Table 2 shows the demographic data of the remaining 1,114 teachers by school and gender. In total, the mean age was about 43 in both males and females and they had been working for about 15 years. Over 40% (488/1114) worked at special education classes for physically or intellectually disabled pupils at regular elementary or junior high schools (S classes, hereafter). There were 10 pupils at most in a single S class, with one to three teachers. A total of 284 teachers worked at schools for intellectually disabled pupils (I schools, hereafter). The pupils had hardly any physical problems. Two to five teachers in a team took charge of around 20 pupils in a class. A total of 203 teachers worked at schools for physically disabled pupils (P schools, hereafter). The mean ages of these teachers were younger than those of the other schools in both genders. Pupils had physical problems and needed intensive and various help in daily life. Two or three teachers in a team had a class of several pupils. The ages of pupils ranged from six to 18 in P and I schools. Twenty-three teachers worked at a school for pupils with a poor constitution, 52 for the blind and 64 for the deaf. These three numbers were too small to analyze, particularly when the subjects were classified by gender. For the following study, therefore, a total of 975 teachers working at P or I schools or S classes were included only.

2) Nursing care required by the pupils and workload among the teachers

Figure 1 shows the percentage of teachers in charge of pupils who needed nursing care by gender and schools. Almost 100% of both male and female teachers in P schools had pupils "who needed holding for moving or getting in and out of a wheelchair", "who needed

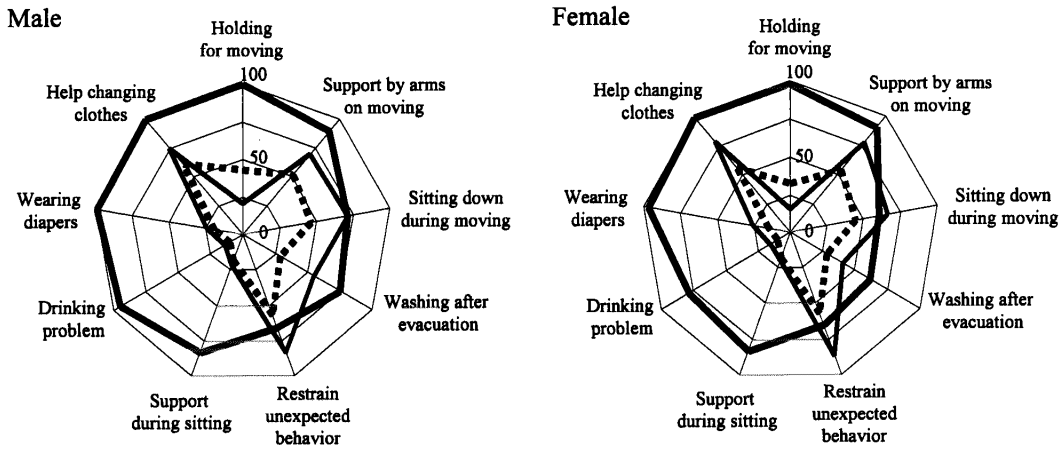

Fig. 1. Radar charts showing the percentages of teachers who took charge of pupils by gender, school and nine kinds of nursing care points required. ▬▬: P schools, ——: I schools and - - -: S classes (see the footnote of Table 2)

help changing clothes" and "who wore diapers". In addition, more than 75% of the teachers were in charge of pupils "who needed help drinking or swallowing food or discharging sputum", "who needed to be supported by arms or led by hands on moving" and "who needed the support of hands or arms during sitting". These nursing care points and those "who needed washing after evacuation" showed the highest values in P schools. On the other hand, the percentages of teachers in charge of pupils "who behaved unexpectedly" and "who often sat down during moving" were the highest in I schools. The teachers in S classes had the fewest pupils who needed various types of nursing care except "needed holding for moving or getting in and out of a wheelchair".

Individual patterns of answers to the nine nursing care points were integrated into two-dimensional information based on the homogeneity analysis (Fig. 2). The cumulative contribution ratio of the first and the second factors was 60.7%, which was satisfactory. In the positive direction of the x axis, with "Yes" answers indicating the presence of pupils who needed respective nursing care were placed, and in the negative direction, the "No" answers indicating the absence of such pupils were arranged. In the positive direction of the y axis, with the "Yes" answers indicating the presence of pupils "who needed help drinking or swallowing food or discharging sputum", "who wore diapers", "who needed holding for moving or getting in and out of a wheelchair" and "who needed the support of hands or arms during sitting" were placed, and in the negative direction of the y axis, the "Yes" answers indicating the presence of pupils "who often sat down while moving" and "who behaved unexpectedly" were arranged. These arrangements showed that the y axis reflected the physical and intellectual conditions of pupils.

3) Complaint rates of cervicobrachial symptoms and associated factors

Table 3 shows the complaint rates of cervicobrachial symptoms and their characteristics

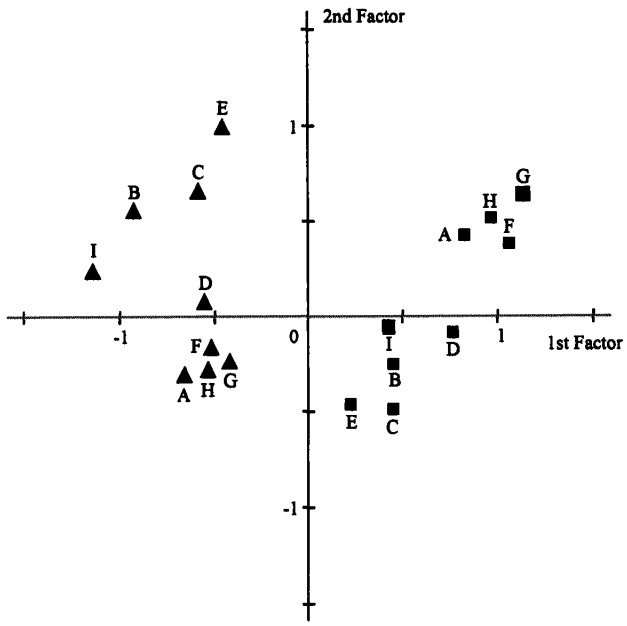

Fig. 2. Configuration of nursing-care items based on homogeneity analysis. A~I show the children who needed various type of nursing care. A: Holding for moving or getting in and out of a wheelchair, B: Support by arms or led by hands on moving, C: Sitting down during moving, D: Washing after evacuation, E: Restraining unexpected behavior, F: Support of hands or arms during sitting, G: Help drinking or swallowing food or discharging sputum, H: Wearing diapers, I: Help changing clothes. Squares and triangles indicate the presence and absence, respectively, of children who needed the respective nursing care.

in terms of gender and schools. Among the 393 male teachers in total, 16.3% complained of cervicobrachial symptoms "almost all day, everyday" in the past month. When those answering "not all day, but everyday" were added, 29.3% complained of the symptom "everyday". More than half of the male teachers had an experience of attending a "hospital or clinic" in the past year. Those who took "paid holidays" and "sick leave" due to the symptom reached 15.5% and 1.0% of the subjects, respectively. Among the 243 mole teachers who complained of cervicobrachial symptoms more than several times a week in the past month, 7.8% felt it was difficult to continue their work without taking paid holidays. The symptom appeared "gradually without awareness" in 63.8% of the subjects, but "suddenly" in a low 9.5%. More than one-third of subjects complained of the symptom lasting for "more than half a year" and another third said it was "difficult to answer because of repetitive remission and recurrence". Compared with these results in the males, the female teachers complained of cervicobrachial symptoms more frequently, did not need rest but felt "the symptom strongly" more times during work, but attended a hospital or clinic less frequently. The percentages of females taking "paid holidays" and "sick leave" were slightly lower than those of the males.

In terms of schools, the rates of males who complained of cervicobrachial symptoms "not everyday, but several times a week" and took "paid holidays" because of the symptoms were significantly higher in those who worked at P schools than in S classes. In addition, the rate of females who took "paid holidays" was significantly higher in I schools than in S classes.

Table 3. Cervicobrachial symptoms, treatment experience, and current status of the symptoms among teachers by gender and school. All figures with a decimal point show the percentages of the corresponding number of the subjects in each column

	Total		Male				Female			
	Male	Female	P schools	I schools	S classes	χ^2 test	P schools	I schools	S classes	χ^2 test
Number of subjects	393	582	93	128	172		110	156	316	
Cervicobrachial symptom in the past month										
Almost all day, everyday	16.3	20.4	15.1	12.5	19.8	ns	20.0	25.6	18.0	ns
Not all day, but everyday	13.0 <<	23.7	12.9	11.7	14.0	ns	27.3	25.0	21.8	ns
Not everyday, but several times a week	32.6	34.9	40.9	35.2	26.2	P > S	37.3	29.5	36.7	ns
Almost none	38.2 >>	21.0	31.2	40.6	40.1	ns	15.5	19.9	23.4	ns
Treatment experience in the past year										
Hospital, Clinic	56.0 >	49.1	48.4	53.9	61.6	ns	41.8	47.4	52.5	ns
Acupuncture	23.7	21.1	24.7	21.9	24.4	ns	18.2	22.4	21.5	ns
Holidays taken due to the cervicobrachial symptom										
Paid holidays	15.5	12.5	22.6	18.8	9.3	P > S	16.4	17.9	8.5	I > S
Sick leave	1.0	0.3	0.0	1.6	1.2	ns	0.9	0.0	0.3	ns
Number of subjects [1]	243	460	64	76	103	ns	93	125	242	ns
Current status of the symptom										
Difficult to continue work without taking paid holidays	7.8	6.3	10.9	6.6	6.8	ns	9.7	7.2	4.5	ns
Need occasional rest during worktime	11.9	9.8	14.1	13.2	9.7	ns	10.8	8.8	9.9	ns
Don't need rest but feel the symptom strongly	32.9 <<	43.7	35.9	30.3	33.0	ns	41.9	44.8	43.8	ns
Mild symptoms	32.5	32.6	31.3	27.6	36.9	ns	30.1	32.0	33.9	ns
Almost ignorable	6.6 >	3.3	6.3	9.2	4.9	ns	3.2	2.4	3.7	ns
No answer	8.2	4.3	1.6	13.2	8.7	ns	4.3	4.8	4.1	ns
Appearance status of the symptom										
Appeared suddenly during working	9.5	6.5	14.1	9.2	6.8	ns	7.5	8.0	5.4	ns
Appeared suddenly during non-working time	7.4 >	3.5	6.3	10.5	5.8	ns	3.2	4.8	2.9	ns
Appeared not suddenly but in a short time	13.6	12.2	14.1	9.2	16.5	ns	15.1	10.4	12.0	ns
Gradually appeared without awareness	63.8 <	73.5	64.1	65.8	62.1	ns	69.9	72.0	75.6	ns
No answer	5.8	4.3	1.6	5.3	8.7	ns	4.3	4.8	4.1	ns
Duration of the symptom										
About 1 week	1.6	1.1	1.6	0.0	2.9	ns	1.1	1.6	0.8	ns
About 1 month	2.9	2.0	0.0	5.3	2.9	ns	1.1	1.6	2.5	ns
2-3 months	8.6	7.4	10.9	5.3	9.7	ns	6.5	4.0	9.5	ns
About half a year	3.7 >	1.1	0.0	5.3	4.9	ns	1.1	1.6	0.8	ns
More than a half year	38.3	42.6	42.2	35.5	37.9	ns	38.7	48.0	41.3	ns
Repeated remission and recurrence	36.6	41.5	43.8	35.5	33.0	ns	47.3	38.4	40.9	ns
No answer	8.2	4.3	1.6	13.2	8.7	ns	4.3	4.8	4.1	ns

1) the number of the subjects who complained of the symptom more than several times a week. P schools, I schools and S classes: see the footnote to Table 2. >, >> or <, << indicate that the value of the leftside is significantly higher or lower than that of the right side at the levels of 0.05 and 0.01, respectively, by the χ^2 test. ns means that no significant difference was found between any combination among the three groups by school.

No significant differences were found in the other inventories in both genders.

Table 4 shows the results of the logistic regression analysis under three different models, in which the condition of the cervicobrachial symptom in the past month was set to be a dependent variable. Only the answer "almost all day, everyday" was regarded as presence of the symptom, and the other answers were regarded as none. In each model, the fitness for the regression model was accepted (P>0.1). In Model I, in which only individual factors were included, female against male as well as the thirties age group and older generations against the twenties age group were shown to be the factors that significantly increased the complaint rate of cervicobrachial symptoms. In Model II, added school factors were not significant, but obesity (BMI≥25) was found to be a significant risk in addition to age. Model III added the workload factors represented by the 1st and 2nd objective scores obtained by the homogeneity analysis. In this model, obesity was not a significant factor. Age remained a significant factor as shown in the other models, with the odds ratio increasing with age. Regarding the 1st score, being the Q1 group (score value: <25%ile) used as a referent, the odds ratios of Q3 (≥50%ile and<75%ile) and Q4 (≥75%ile) groups both showed 2.6, significantly higher than 1, and the odds ratio increased with the object scores. Contrarily, the second factor did not show any significant association with the symptom.

Table 4. Individual and occupational factors related to the cervicobrachial symptom by logistic regression analysis under three different models. Figures show odd ratios with 95% confidence intervals after adjusting for all other factors in each model

Factor		Model I		Model II		Model III	
Gender	: Female/Male	1.4	1.0−1.1	1.5	1.0−2.1	1.5	1.0−2.1
BMI	: Underweight/Normal	0.5	0.1−1.2	0.5	0.1−1.2	0.5	0.1−1.3
	Obese/Normal	1.5	0.9−2.3	1.6	1.0−2.4	1.6	0.9−2.4
Age	: 30s/20s	1.8	0.9−3.7	1.8	0.9−3.9	1.7	0.9−3.6
	40s/20s	2.3	1.2−4.5	2.4	1.3−4.9	2.0	1.1−4.2 P_1=.01
	50s/20s	2.5	1.3−5.1	2.8	1.4−5.8	2.7	1.4−5.5
School	: P schools/I schools			0.9	0.6−1.5	0.7	0.4−1.4
	S classes/I schools			0.8	0.5−1.1	0.9	0.6−1.5
1st factor	: Q2/Q1					1.2	0.7−2.2
	Q3/Q1					2.6	1.5−4.7 P_2=.01
	Q4/Q1					2.6	1.4−4.8
2nd factor	: Q2/Q1					1.2	0.7−1.9
	Q3/Q1					1.0	0.6−1.8
	Q4/Q1					0.8	0.4−1.5

Underweight: BMI<18.5, Obese: BMI≥25, Q1: Score value <25%ile, Q2: Score value ≥ 25%ile and <50%ile, Q3: Score value ≥50%ile and 75%ile, Q4: Score value ≥75%ile. P_1 and P_2 show the results of trend test for age and 1st factor, respectively. P schools, I schools and S classes: see the footnote to Table 2.

4) Complaint rates of lower back symptoms and their associated factors

Table 5 shows the complaint rates of lower back symptoms and their characteristics in terms of gender and schools. Among the 393 male teachers, 19.6% complained of the symptom "almost all day, everyday" in the past month, and nearly one-third had an experience of attending a "hospital or clinic" in the past year. "Paid holidays" and "sick leave" because of the symptom were taken by 30.8% and 1.5% of the males, respectively. In the 290 males who complained of the symptom more than several times a week in the past month, the lower back symptom appearing "gradually without awareness" was four times higher than that appearing "suddenly during working". The symptom showed a "repetitive remission and recurrence" in 44.5% and lasted for "more than half a year" in 38.3%. Compared with these results in the males, female teachers showed significantly lower percentages than those who attended a hospital or clinic, took "paid holidays" and felt it was "difficult to continue work without taking paid holidays" due to the lower back symptom. No significant difference was found in other inventories.

In terms of schools, the rate of teachers who described their symptoms as "almost none" was significantly lower at P schools than S classes in the males, and than S classes and I schools in the females. "Paid holidays" taken because of the symptom occurred more often at P schools than S classes in both genders. The symptom appeared "suddenly during working" with a significantly higher frequency at P schools compared with S classes only in the males. The male teachers of S classes experienced repeated remission and recurrence of the symptom less frequently than those at I schools.

Table 6 shows the results of the logistic regression analysis, in which the condition of lower back symptoms in the past month was set to be a dependent variable, and the same factors as in the case of the cervicobrachial symptom were considered independent variables. Only the "almost all day, everyday" answer was regarded as presence of the symptom, and

Table 5. Lower back symptoms, treatment experience, and current status of the symptoms among teachers by gender and school. All figures with a decimal point show the percentages to the corresponding number of the subjects in each column

	Total		Male				Female			
	Male	Female	P schools	I schools	S classes	χ^2 test	P schools	I schools	S classes	χ^2 test
Number of subjects	393	582	93	128	172		110	156	316	
Lower back symptom in the past month										
Almost all day, everyday	19.6	15.8	21.5	14.1	22.7	ns	25.5	10.9	14.9	P >> I, P > S
Not all day, but everyday	19.3	22.2	28.0	17.2	16.3	ns	22.7	23.7	21.2	ns
Not everyday, but several times a week	34.9	40.7	34.4	40.6	30.8	ns	41.8	41.7	39.9	ns
Almost none	26.2	21.3	16.1	28.1	30.2	P < S	10.0	23.7	24.1	P << I, S
Treatment experience in the past year										
Hospital, Clinic	30.3 >	23.2	37.6	27.3	28.5	ns	23.6	20.5	24.4	ns
Acupuncture	15.5	19.8	17.2	15.6	14.5	ns	22.7	21.8	17.7	ns
Holidays taken due to the symptom										
Paid holidays	30.8 >>	19.4	43.0	29.7	25.0	P >> S	30.0	17.9	16.5	P >> S
Sick leave	1.5	1.2	1.1	1.6	1.7	ns	0.9	1.3	1.3	ns
Number of subjects [1]	290	458	78	92	120	ns	99	119	240	ns
Current status of the symptom										
Difficult to continue work without taking paid holidays	11.4 >	6.8	15.4	8.7	10.8	ns	11.1	6.7	5.0	ns
Need occasional rest during worktime	16.9	15.9	20.5	17.4	14.2	ns	17.2	16.8	15.0	ns
Don't need rest but feel the symptom strongly	31.4	38.2	33.3	30.4	30.8	ns	40.4	34.5	39.2	ns
Mild symptoms	34.1	35.6	25.6	34.8	39.2	ns	30.3	38.7	36.3	ns
Almost ignorable	3.4	2.6	2.6	7.6	0.8	I > S	0.0	2.5	3.8	ns
No answer	2.8	0.9	2.6	1.1	4.2	ns	1.0	0.8	0.8	ns
Appearance status of the symptom										
Appeared suddenly during working	15.5	14.0	21.8	18.5	9.2	P > S	11.1	14.3	15.0	ns
Appeared suddenly during non-working time	5.5	6.6	1.3	7.6	6.7	ns	5.1	9.2	5.8	ns
Appeared not suddenly but in a short time	14.1	13.1	20.5	8.7	14.2	ns	21.2	9.2	11.7	P > I
Gradually appeared without awareness	61.7	64.8	52.6	64.1	65.8	ns	61.6	64.7	66.3	ns
No answer	3.1	1.5	3.8	1.1	4.2	ns	1.0	2.5	1.3	ns
Duration of the symptom										
About 1 week	3.4	2.8	3.8	2.2	4.2	ns	5.1	1.7	2.5	ns
About 1 month	3.1	3.9	1.3	0.0	6.7	I < S	2.0	4.2	4.6	ns
2-3 months	4.8	7.2	3.8	3.3	6.7	ns	9.1	3.4	8.3	ns
About a half year	2.8	1.5	2.6	2.2	3.3	ns	1.0	0.8	2.1	ns
More than half a year	38.3	34.3	38.5	38.0	38.3	ns	34.3	36.1	33.3	ns
Repeated remission and recurrence	44.5	48.5	46.2	53.3	36.7	I > S	48.5	52.1	46.7	ns
No answer	3.1	1.7	3.8	1.1	4.2	ns	0.0	1.7	2.5	ns

1) the number of the subjects who complained of the symptom more than several times a week. P schools, I schools and S classes: see the footnote to Table 2. >, >> or <, << indicate that the value of the left side is significantly higher or lower than that of the right side at the levels of 0.05 and 0.01, respectively, by the χ^2 test. ns means that no significant difference was found between any combination among the three groups by school.

the others were regarded as none. In each model, fitness for the regression model was accepted (P>0.1). Neither gender nor BMI was a significant factor in any of the models, while age was always a significant factor. The odds ratio for subjects in their fifties was highest (around 3), and there was a tendency to increase with age. The object scores of the two factors were divided as in the cases of the cervicobrachial symptom and incorporated as an index for workload in Model III. In this model, the odds ratio was higher in the groups with larger scores of the first score (P=0.058 for trend test). On the contrary, the second factor did not show any significant association. After considering these two factors, the odds ratios of the symptom in P schools and S classes were significantly higher than 1, when I schools were referent.

DISCUSSION

It has been widely accepted that continued and repeated loads on a specific region in the upper extremities develop work-related diseases where damaged areas are rather limited such as lateral and medial epicondylitis[5, 39], cubital and carpal tunnel syndromes[6, 40-42], peritendinitis or tenosynovitis or De Quervain's disease[2, 43], and rotator cuff syndrome[44]. Aside from these diseases, the existence of conditions presenting chronic pain or stiffness over a wider range

Table 6. Individual and occupational factors related to the lower back symptom by logistic regression analysis under three different models. Figures show odd ratios with 95% confidence intervals after adjusting for all other factors in each model

Factor		Model I		Model II		Model III		
Gender	: Female/Male	0.8	0.6−1.1	0.8	0.6−1.1	0.8	0.6−1.1	
BMI	: Underweight/Normal	1.7	0.8−3.6	1.7	0.8−3.6	1.9	0.8−4.0	
	Obese/Normal	1.3	0.8−2.0	1.2	0.8−1.9	1.2	0.8−2.0	
Age	: 30s/20s	2.4	1.2−5.3	2.6	1.3−5.8	2.5	1.2−5.2	┐
	40s/20s	2.3	1.2−4.8	2.6	1.3−5.5	2.2	1.1−4.8	P_1=.05
	50s/20s	2.8	1.4−6.0	3.3	1.6−7.2	3.1	1.5−7.0	┘
School	: P schools/I schools			2.4	1.5−3.9	2.0	1.0−3.9	
	S classes/I schools			1.4	0.9−2.2	1.7	1.1−2.8	
1st factor	: Q2/Q1					1.6	0.9−3.0	┐
	Q3/Q1					2.5	1.3−4.6	P_2=.058
	Q4/Q1					2.4	1.2−4.8	┘
2nd factor	: Q2/Q1					0.9	0.5−1.5	
	Q3/Q1					1.0	0.5−1.7	
	Q4/Q1					0.8	0.4−1.4	

Underweight: BMI<18.5, Obese: BMI≥25, Q1: Score value <25%ile, Q2: Score value ≥ 25%ile and 50%ile, Q3: Score value ≥50%ile and <75%ile, Q4: Score value ≥75%ile. P_1 and P_2 show the results of trend test for age and 1st factor, respectively. P schools, I schools and S classes: see the footnote to Table 2.

from the fingers to the shoulder and neck has recently been recognized, and attracted much attention. This feature is referred to as nonspecific upper-extremity musculoskeletal disorder[32, 45, 46], and is considered the dominant portion of disorders previously referred to as repetitive strain injuries[47, 48], cumulative trauma disorders[3], and occupational cervicobrachial disorders[49,50]. Where damaged areas tend to be restricted as a result of working practices, it is appropriate to design questions that ask about symptoms separately in the neck, shoulder, arms, elbows, and wrist joints and in the right and left regions. However, school teachers of disabled pupils perform a variety of short duration actions[23, 24, 51] such as holding a pupil in class, supporting sitting or standing positions, supporting walking or restraining unexpected behaviors of a pupil. These actions were also applicable to nursery school nurses[52], who were the subjects of the present study, to examine the validity of the self-administered questionnaire. The effects of such work practices exerted on all the upper extremities are not limited to a specific region. So, nonspecific upper-extremity musculoskeletal disorders must account for the majority of diseased conditions among the nursery school nurses. Accordingly, a question which we developed for the entire upperextremities; "have you experienced any pain or stiffness in your neck, shoulders or arms in the past month?" would be appropriate. The alternative would have been to prepare questions for each subregion of the upper extremities and then to evaluate the combinations that were generated. This alternative, however, would have resulted in more questions, which naturally increase the numbers of questions not answered, reducing the number of valid responses.

There was only one question relating to lower back symptoms in the present study: "have you experienced any pain or stiffness in your lower back in the past month?". No question was included to screen the presence of lumbar disc herniation or facet syndrome as represented by a radiating pain to the lower extremities. This was primarily because the majority of lower back symptoms detected in workers of various jobs was of the muscular or fascial nature[53], and partly because the question provided in this study could identify

persons with disorders such as lumbar disc herniation as long as it was accompanied by lower back symptoms.

Four answer options exclusive of one another were prepared to ascertain cervicobrachial and lower back symptoms. Muscle tenderness evident by our clinical examination was recognized among only 5% of the subjects who chose the answer option of "almost none" in both of the symptoms. The more frequently subjects complained of symptoms, the wider the regions where tenderness was observed. Further, the rates of those feeling difficulty in daily activities were significantly higher in the group most frequently complaining of symptoms than in the other three groups.

Thus, the question and answer options adopted in the present study reflected well clinical conditions of nonspecific upper-extremity musculoskeletal disorders and the extent to which musculoskeletal symptoms intervened in daily activities. The descriptions used were plain and the number of questions was limited. We considered that these questions and answer options could be applicable in a self-administered questionnaire study on musculoskeletal disorders including the cervicobrachial and lower back regions.

Our present self-administered questionnaire survey of about a thousand teachers working for disabled pupils clarified that 19.6% of male teachers complained of lower back symptoms "almost all day, everyday" in the previous month. Also the study revealed that 30.3% of the males attended a hospital or clinic in the past year, 30.8% took "paid holidays" and 1.5% "sick leave" in the past year because of the symptoms. The corresponding rates for females were 15.8%, 23.2%, 19.4%, and 1.2%, respectively. These figures were consistent with those reported by Taoda et al.[25], who surveyed teachers of physically and intellectually disabled pupils. Furthermore, these were comparable with results obtained from Japanese workers in occupations prone to lower back problems: male sanitation workers[53], construction workers[54], and forest workers[55]; for women: nurses[17], nursery school nurses[23], and school lunch cooks[56,57]. The lower back symptom among the present subjects appeared "gradually without awareness" four to five times greater than "suddenly during work time". The numbers of those whose symptoms took a chronic course of "repetitive remission and recurrence" or persisted "for more than a half year" were high, nearly 80% of the subjects in total. Such courses of the symptom were one of the features[58] observed in static muscle work occupations where awkward posture, such as bending forward and twisting, was undergone frequently rather than a dynamic muscle work occupation where primarily heavy loads were handled.

More females complained of cervicobrachial symptoms "almost all day, everyday" in the past month (20.4%) than males (16.3%). The rates of those who took "paid holidays" or "sick leave" because of cervicobrachial symptoms were rather low in both males and females compared with those taken due to lower back symptoms. Contrarily, experiences of treatment in the past year were high. The cervicobrachial symptom appeared "gradually without awareness" and persisted for "more than a half year" or was "repetitive remission and recurrence" in the majority of the subjects, as was the case with lower back symptoms.

In the present study, we used the two factors integrated by the homogeneity analysis as an index of the workload on teachers working with disabled pupils. The positive direction of the first factor axis was plotted with answers showing the presence of pupils who needed

nursing care, while the negative direction of the same axis showed the absence of such pupils. We considered that the first factor indicated the quantity of nursing care burden on the teachers, and that the higher the points scored, the greater the burden. On the second factor axis, the presence of pupils "who needed help drinking or swallowing food or discharging sputum" and "who wore diapers" were plotted in a positive direction, while pupils "who often sat down while moving" and "who behaved unexpectedly" were plotted in a negative direction. From this, we considered that the second factor suggested the quality of a nursing care burden, and that the higher the points scored, the more physical nursing care that was needed.

An investigation using logistic regression analysis showed that of the two factors we have used as indices of the burden of nursing care, the first factor increased the risk significantly for developing the cervicobrachial symptom, even after considering individual factors, i.e. gender, age, and BMI, and the different types of schools that teachers are attending. Further, the higher the points of the first factor, namely the more nursing care required, the significantly higher the odds ratio became. Maeda et al.[24] assigned school teachers into groups of slight, moderate, and heavy nursing care burden groups, based on the physical conditions of the pupils in the classes. They observed that the complaint rates of pains in the neck, shoulders, and arms increased gradually according to this order of groupings. Although the criteria for this classification were not clearly stated, their findings agreed with our result. Nursing care represented by the first factor includes maintaining the sitting and standing posture of pupils, holding them for moving[24, 51], and holding the upper extremities to restrain against unexpected behaviors. These correspond to static muscle loads, forceful wrist extension/flexion or grasping with an arm extended, and sustained flexion/extension of the neck.

As for lower back symptoms, the first factor was confirmed as an independent risk factor showing a dose-response relationship. The teachers of disabled pupils were required to use repetitive anteflexing posture for many aspects of their working practices[23, 24, 51, 59]. Our previous study[51] showed that the trunk inclination angle of teachers in class was an average 24.1 degrees (SD 4.3), which was well over the considered 20 degrees point where the risk of lower back symptom begins increasing[60,61]. This was because their point of working was always at a low height since their pupils were usually in a dorsal position on a floormat, or on an ancillary skid due to their illness. Additionally, weight loads were exerted on the lumbar area while holding pupils to move or when lifting pupils. These working practices might cause the significant association between the first factor and the complaint rate of the lower back symptom.

The second factor, which we considered the index for the quality of nursing care burden on the teachers, showed no significant relationship with either the cervicobrachial or lower back symptoms. In our study, the subjects were only requested to respond to whether or not they took charge of pupils who needed the nine different nursing care points. The result of the lower back symptom study showed that the type of school remained a significant risk factor even after the first and second factors were taken into account. This suggested that workloads other than those represented by the two factors could associate with the musculoskeletal symptoms. Further investigation should be conducted considering the body

weight, physical constitution and the nature of paralysis of the pupil concerned, with or without application of ancillary tools, and the numbers of teaching staff and so on.

As for individual factors, age was a risk factor for both the cervicobrachial and lower back symptoms. In addition, every regression model in this study confirmed that being female was a significant risk factor for cervicobrachial symptoms. Similar results were found in other jobs[5, 62]. Gender difference[63, 64] in muscle fiber composition in the trapezius muscle could be one of the reasons. The present study, however, showed a higher risk of the lower back symptom in males, though not significantly. Further, in another job[56] cervicobrachial symptoms were also found more frequently in females, while the complaint rates of lower back symptoms were higher in males. From these, there is a possibility that the difference in the prevalence of the musculoskeletal symptom between males and females is attributable to workloads reflected by differences in the roles of working naturally borne between males and females in the same workplace. BMI was not a significant risk factor in the regression model incorporating all factors. However, if a standard body weight ($18.5 \leq BMI < 25$) was referenced for the cervicobrachial symptom, a lower risk was noticed with lower weight ($BMI < 18.5$) and a higher risk with obesity ($BMI \geq 25$), while a risk of the lower back symptom tended to be high in both lower weight and obese subjects. These results are of interest because there is a possibility of lowering the risk of developing musculoskeletal symptoms by intervening in the body weight of subjects. Further study is necessary on this point, however.

CONCLUSIONS

The present self-administered questionnaire study clarified that complaint rates of the cervicobrachial and lower back symptoms were clearly high in teachers in charge of physically and intellectually disabled pupils. These symptoms were considered to be work-related causing the teachers to take "paid holidays" and "sick leave" frequently. Also the present study showed that the question and answer options we developed are useful parameters in epidemiologic research for musculoskeletal symptoms now widely prevailing in various workplaces.

REFERENCES

1) **Ministry of Education, Culture Sports, Science** and **Technology** : Report on Fisical 2001 School Basic Survey. Zaimu-insatukyoku, Tokyo, pp.15,45, 2001.

2) **Armstrong, T. J., Fine, L. J., Goldstein, A. A., Lifshitz, Y. R.** and **Silverstein, B.**: Ergonomics considerations in hand and wrist tendonitis. J. Hand Surg. **12A**: 830-837, 1987.

3) **Vern Putz-Anderson: Cumulative trauma disorders** : A manual for musculoskeletal diseases of the upper limbs. National Institute for Occupational Safety and Health. Cincinnati, Ohio, USA, New York, 1988.

4) **Ohlsson. K., Attewell, R.** and **Skerfving, S.**: Self-reported symptoms in the neck and upper limbs of female assembly workers: impact of length of employment, and selection. Scand. J. Work Environ. Health **15**: 75-80, 1989.

5) **Viikari-Juntura, E., Kurppa, K., Kuosma, E., Huuskonen, M., Kuorinka, I., Ketola, R., et al.**: Prevalence of epicondylitis and elbow pain in the meat-processing. Scand. J. Work Environ. Health **17**: 38-45, 1991.

6) **Hagberg, M., Morgenstern, H.** and **Kelsh, M.**: Impact of occupations and job tasks on the prevalence of

carpal tunnel syndrome. Scand. J. Work Environ. Health **18**: 337–345, 1992.

7) **Moore, J. S.** and **Garg, A.**: Upper extremity disorders in a pork processing plant: relationships between job rib factors and morbidity. Am. Ind. Hyg. Assoc. J. **55**: 703–715, 1994.
8) **Ohlsson, K., Attewell, R. G., Palsson, B., Karlsson, B., Balogh, I., Johnsson, B., Ahlm, A.** and **Skerfving, S.**: Repetitive industrial work and neck and upper limb disorders in females. Am. J. Ind. Med. **27**: 731–747, 1995.
9) **Bergqvist, U., Wolgast, E., Nilsson, B.** and **Voss, M.**: Musculoskeletal disorders among visual display terminal workers: individual, ergonomic, and work organizational factors. Ergonomics **38**: 763–776, 1995.
10) **Ranney, D., Wells, R.** and **Moore, A.**: Upper limb musculoskeletal disorders in highly repetitive industries. Precise anatomical physical findings. Ergonomics **38**: 1408–1423, 1995.
11) **Kurumatani, N., Dejima, M., Ohkado, K., Yoshioka, N., Sakamoto, R., Zheng, Y.** and **Yonemasu, K.**: Occupational and personal factors associated with low-back pain in female workers carrying loads frequently. Advances in Occupational Ergonomics and Safety **1**: 321–326, 1996.
12) **Hughes, R. E., Silverstein, B. A.** and **Evanoff, B. A.**: Risk factors for work-related musculoskeletal disorders in an aluminum smelter. Am. J. Ind. Med. **32**: 66–75, 1997.
13) **Sobti, A., Cooper, C., Inskip, H., Searle, S.** and **Coggon, D.**: Occupational physical activity and long-term risk of musculoskeletal symptoms: a national survey of post office pensioners. Am. J. Ind. Med. **32**: 76–83, 1997.
14) **Burdorf, A., van Riel, M.** and **Brand, T.**: Physical load as risk factor for musculoskeletal complaints among tank terminal workers. Am. Ind. Hyg. Assoc. J. **58**: 489–497, 1997.
15) **Fredriksson, K., Alfredsson, L., Koster, M,. Thorjornsson, C.B., Toomiingas, A., Torgen, M.** and **Asa Kilbom**: Risk factors for neck and upper limb disorders: results from 24 years of follow up. Occup. Environ. Med. **56**: 59–66, 1999.
16) **Ariës G. A. M., Mechelen, W., Bongers, P. M., Bouter, L. M.** and **Wal, G.**: Physical risk factors for neck pain. Scand. J. Work Environ. Health **26**: 7–19, 2000.
17) **Koda, S., Hisashige, A., Ogawa, T., Kurumatani, N. Dejima, M., Miyakita, T., Kodera, R., Hamada, H., Nakagiri, S.** and **Aoyama, H.**: An epidemiologic study on low back pain and occupational risk factors among clinical nurses. Jpn. J. Ind. Health **33**: 410–422, 1991.
18) **Lagerrström, M., Wenemark, M., Hagberg, R., Hjelm, E. W.** and **Moses Study Group**: Occupational and individual factors related to musculoskeletal symptoms in five body regions among Swedish nursing personnel. Int. Arch. Occup. Environ. Health **68**: 27–35, 1995.
19) **Kurumatani, N., Iki, M.** and **Katayama, K.**: A study on occupational cervicobrachial disorder (OCD) of nursery school teachers based on subjective symptoms related to OCD. Jpn. J. Ind. Health **26**: 389–396, 1984.
20) **Ono, Y., Imaeda, T., Shimaoka, M., Hiruta, S., Hattori, Y., Ando, S., Hori, F.,** and **Tatsumi, A.**: Associations of length of employment and working conditions with neck, shoulder and arm pain among nursery school teachers. Ind. Health **40**: 149–158, 2001.
21) **Amari, N.**: Subjective pain and tenderness in low back among care workers in relation to work load and daily life. J. Occup. Health **41**: 166–173, 1999.
22) **Fujimura, T., Yasuda, N.** and **Ohara, H.** : Work-related factors of low back pain among nursing aides in nursing homes for the elderly. J. Occup. Health **37** 89–98 1995.
23) **Tokunaga, R.**: Current status of health problems and preventive measures among workers for disabled children. Digest of Science of Labour **32(7)**: 39–44, 1977.
24) **Maeda, K., Takahasi, A.** and **Tanaka, S.**: Health problems among workers engaged in education of handicapped children - Staff daily care and trend of physical complaints - . Jpn. J. Ind. Health **28**: 17–27, 1986.

25) **Taoda, K., Wayanabe, S., Yamasita, H., Kitahara, T.** and **Nisiyama, K.**: Health and low back pain in Japanese school teachers for the disabled children. J. Science of Labour **73**: 1-22, 1997.

26) **Kelsey, J. L., Thompson, W. D.** and **Evans, A. S.**: Methods in Observational Epidemiology. Oxford University Press, New York, pp.309-336, 1986.

27) **Toomingas, A., Nemeth, G., Alfredsson, L.** and **the Stockholm MUSIC I Study Group**: Self-administered examination versus conventional medical examination of the musculoskeletal system in the neck, shoulders, and upper limb. J. Clin. Epidemiol. **48**: 1473-1483, 1995.

28) **Baron, S., Hales, T. and Hurrell, I.**: Evaluation of symptom surveys for occupational musculoskeletal disorders. Am. J. Ind. Med. **29**: 609-617, 1996.

29) **Franzblau, A., Salerno, D. F., Armstrong, T. J.** and **Werner, R. A.**: Test-retest reliability of an upper-extremity discomfort questionnaire in an industrial population. Scand. J. Work Environ. Health **23**: 299-307, 1997.

30) **Itani, T.** : Keikenwan syougai no kenkoukanri (Health care management of occupational cervicobrachial disorders). Digest of Science of Labour **31(7)** : 45-56, 1977.

31) **Roudousyou Roudoueiseika** : Youtsuu yobou taisaku manyuaru. Tyuouroudou saigaibousi kyoukai, Tokyo, P242-243, 1998.

32) **Sluiter, J. K., Rest, K. M.** and **Frings-Dresen. M. H. W.**: Criteria document for evaluating the work-relatedness of upper-extremity musculoskeletal disorders. Scand. J. Work Environ. Health **27**: 1-102, 2001.

33) **Plancher, K. D., Peterson, R. K.** and **Steichen, J. B.**: Compressive neuropathies and tendinopathies in the athletic elbow and wrist. Clinics in Sports Medicine **15(2)**: 331-371, 1996.

34) **Nakano, N.** : Youtuu no rinsyou. Nankoudou, Tokyo, pp.4-18, 1985.

35) **Dawson-Saunders, B.** and **Trapp R. G.**: Basic and Clinical: Biostatistics. Appleton and Lange, London, pp.133-134, 1994.

36) **SPSS**: SPSS Categories 11.0. SPSS Inc., Chicago, pp.59-64, 2001.

37) **Hosmer,D.W.** and **Lemeshow S.**: Applied logistic regression. John Wiley & Sons, New York, pp.140-145, 1989.

38) **Armitage A.** and **Berry G.**: Statistical Methods in Medical Research. Blackwell Scientific Publication, London, pp.420-422, 1994.

39) **Ono, Y., Nakamura, R., Shimaoka, M., Hiruta, S., Hattori, Y., Ichihara, G., et al.**: Epicondylitis among cooks in nursery schools. Occup. Environ. Med **55**: 172-179, 1998.

40) **Kurumatani, N., Dejima, M., Enomoto,Y.** and **Moriyama, T.**: Carpal tunnel syndrome symptoms and occupational factor. JJTOM **40**: 28-38, 1992.

41) **Dawson, D. M.**: Entrapment neuropathies of the upper extremities. New Engl. J. Med. **329**: 2013-8, 1993.

42) **Viikari-Juntura, E.** and **Silverstein, B.**: Role of physical load factors in carpal tunnel syndrome. Scand. J. Work Environ. Health **25**: 168-185, 1999.

43) **Cotton, F. J., Morrison, G. M.** and **Bradford, C. H.**: DeQuervain's disease: radial styloid tendovaginitis. N. Engl. J. Med. **219**: 120-123, 1938.

44) **Herberts, P., Kadefors, R., Hogfors, C.** and **Sigholm, G.**: Shoulder pain and heavy manual labor. Clinical Orthopaedics **191**: 166-178, 1984.

45) **Methorn, M. J.**: Cumulative trauma disorders and repetitive strain injuries. Clinical Orthopaedics and Related Research **361**: 107-126, 1998.

46) **Harrington, J. M., Carter, J. T., Birrell K.** and **Gompertz, D.**: Surveillance case definitions for work related upper limb pain syndromes. Occup. Environ. Med. **55**: 264-271, 1998.

47) **Miller, M. H.** and **Topliss, D. J.**: Chronic upper limb pain syndrome (repetitive stain injury) in the

Australian workforce: a systematic cross sectional rheumatological study of 229 patients. J. Rheumatol. **15**: 1705-1712, 1988.

48) **Yassi, A.**: Repetitive strain injuries. Lancet, **349**: 943-947, 1997.

49) **Nakaseko, M., Tokunaga, R.** and **Hosokawa, M.**: History of occupational cervicobrachial disorders in Japan. J. Human Engol. **11**: 7-16, 1982.

50) **Ono, Y.**: Occupational cervicobrachial disorder(OCD), Jpn. J. Ind. Health Raview **13**: 1-16, 2000.

51) **Kurumatani, N., Yamamoto, N., Ogata, N., Morita, N.** and **Matsuda R.**: Analysis of working postures using a newly developed inclinometer: a study on trunk inclination angle among teachers for physically handicapped students. J. Ergonomics Occupational Safety and Health **3**: 42-47, 2001.

52) **Kumagai, S., Tabuchi, T., Taninaka, H., Miyajima, K., Matsunaga, I., Kosaka, H., Andoh, H.** and **Seo, A.**: Load on the low back of teachers in nursery schools. Int. Arch. Occup. Ennviron. Health 68: 52-57, 1995.

53) **Yosizawa, S.**: Low back pain and countermeasures among sanitation workers. Digest of Science of Labour **30(4)**: 25-29, 1975.

54) **Yoshida, T., Goto, M., Nagira, T., Ono, A., Fijita, I., Goda, S.** and **Bando, M.** : Studies on low back pain among workers in small scale construction companies- Report 1 Analysis of clinical and radiological findings-. Jap. J. Ind. Health **13** : 37-45, 1981.

55) **Moriyama, T., Kurumatani, N., Sugimoto, K., et al.**: Effects of vibrating tools on forestry workers and validity of medical examination to detect vibration disease. -A comprehensive review of medical examination programs for vibration disease over 10 years and some future issues in Nara prefecture-. J. Nara Med. Assoc. **42**: 261-292, 1991.

56) **Kurumatani, N., Iki, M., Arai, T., Moriyama, T., et al.**: Questionnaire survey of occupational cervicobrachial disorder and low back pain among the cooks providing meals for schoolchildren. JJTOM **35**: 366-373, 1987.

57) **Ono, Y., Shimaoka, M., Hiruta, S.** and **Takeuchi, Y.**: Low back pain among cooks in nursery schools. Ind. Health **35(2)**: 194-201, 1997.

58) **Nagira, T.** : Studies on the low back pain among electric construction workers. Jap. J. Ind. Health **16** : 201-211, 1974.

59) **Okuno, M., Uketa, S., Nakaseko, M.** and **Tokunaga, R.**: Work and workload of nursing personnel in a nursery school and two institutions for handicapped children. Ind. Health **35(2)**: 202-211, 1997.

60) **Keyserling, W. M.**: Postural analysis of the trunk and shoulders in simulated real time. Ergonomics **29**: 569-583, 1986.

61) **Punnett L., et al.**: Back disorders and nonneutral trunk postures of automobile assembly workers. Scand. J. Work Environ. Health **17**: 337-346, 1991.

62) **Hagberg, M.** and **Wegman, D. H.**: Prevalence rats and odds ratios of shoulder-neck diseases in different occuoational grouos. Br. J. Ind. Med. **44**: 602-610, 1987.

63) **Lindman, R., Erikson, Q.** and **Thornell, L. E.**: Fiber type composition of the human female trapezius muscle. Am. J. Anat. **190**: 385-392, 1991.

64) **Lindman, R., Hagberg, M., Ängqvist, K. A., Soderlund, K., Hultman, E.** and **Thornell, L. E.**: Chenges in muscle morphology in chronic trapezius myalgia. Scand. J. Work Environ. Health **17**: 347-355, 1991.