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Associations between Prevalence of Self-reported Musculoskeletal Symptoms of the Spine and Biopsychosocial Factors among Office Workers

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Abstract: Associations between Prevalence of Self-reported Musculoskeletal Symptoms of the Spine and Biopsychosocial Factors among Office Workers: Prawit JANWANTANAKUL, *et al.* Department of Physical Therapy, Faculty of Allied Health Sciences, Chulalongkorn University, Thailand—Objectives: To investigate the relationships between the self-reported prevalence of musculoskeletal symptoms in the neck, upper back and low back and certain individual, work-related physical and psychosocial factors. **Methods:** We conducted a cross-sectional survey using a descriptive questionnaire, which was distributed to 2000 office workers in 54 workplaces, in Bangkok, registered at the Social Security Office of Thailand. **Results:** Returns were 1,428 (71%) questionnaires, and after screening for exclusion criteria, 1,185 office workers were found to be eligible for the study. For the head/neck region, frequently working in an uncomfortable posture increased the risk of experiencing head/neck symptoms (adjusted OR=1.81, 95% CI=1.35–2.44). For the upper back region, frequent trunk bending during work increased the risk of experiencing upper back symptoms (adjusted OR=1.80, 95% CI=1.32–2.44) whereas working in a job that required little interaction with others decreased the risk of experiencing upper back symptoms (adjusted OR=0.42, 95% CI=0.25–0.68). For the low back region, working for >8 h a day showed an elevated risk for low back symptoms (adjusted OR=1.66, 95% CI=1.25–2.22). **Conclusions:** Some biopsychosocial factors were associated with the prevalence of musculoskeletal symptoms in the spine among office workers. Further research should focus on these factors in order to develop specific strategies to reduce the occurrence of such symptoms in the office environment.
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Key words: Low back pain, Musculoskeletal disorders, Neck pain, Occupational injuries, Office work, Upper back pain

Increasing evidence suggests that musculoskeletal symptoms are common among office workers[1, 2]. Our recent survey of self-reported musculoskeletal symptoms in all body regions in a general population of office workers showed a high proportion of them experienced musculoskeletal symptoms in the spine during the previous 12 months with a prevalence of 42% in the head/neck, 28% in the upper back and 34% in the low back[3]. Similarly, Van den Heuvel *et al.*[4] found 38% of office workers reported neck pain in the previous year. Yu and Wong[5] reported that 31% of bank employees complained about back pain annually.

Musculoskeletal symptoms in workers are assumed to be of multi-factorial origin, indicating that individual, physical and psychosocial factors can contribute to their development and persistence[6–8]. Increased computer usage has been linked to a high prevalence of musculoskeletal symptoms in the neck, upper extremity and back[9–11]. Previous research has indicated that sustained sitting posture during computer use in combination with poor workstation ergonomics was significantly attributable to the development of musculoskeletal symptoms[12–14]. Ariëns *et al.*[15] showed a significant positive correlation between the percentage of the working time in a sitting position and neck pain in office workers. Office workers are frequently exposed to manual handling tasks which are identified as risk

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factors for developing musculoskeletal symptoms[1, 16]. They also encounter various psychosocial problems which may contribute to an increased occurrence of musculoskeletal symptoms including the lack of influence on the timing of a rest pause[17], low influence at work[9], working in a very crowded place or having stressful work[6].

There are some limitations in the literature regarding the study of musculoskeletal symptoms in office workers. Several previous studies have reported the associations between biopsychosocial risk factors and musculoskeletal symptoms among office workers whose jobs were predominantly involved with computer work[2, 5, 9, 13, 17]. However, no earlier study has investigated musculoskeletal symptoms in the upper back among office workers nor attempted to identify cases with musculoskeletal symptoms attributed to work from other causes[1, 2, 6, 11, 13]. The present study was designed to add information and increase understanding of musculoskeletal symptoms among office workers beyond that of previously published studies. In particular, the present study did not specifically select office workers who mainly worked with computers but included all employees who worked in an office environment. In addition, the whole spine was surveyed and those who attributed their musculoskeletal symptoms to work were identified as cases in this study. The aim of this study was to examine the relationships between the self-reported prevalence of musculoskeletal symptoms in the neck, upper back and low back and certain individual, work-related physical and psychosocial factors in a general population of office workers.

Materials and Methods

Subjects and procedure

A cross-sectional survey was conducted during the period from January to June 2006. A convenient sample of 2,000 office workers was selected from 54 conveniently selected workplaces, in Bangkok, registered at the Social Security Office of Thailand. The enterprises participating in this study were medium- to large-scale financial, banking, or insurance enterprises (with number of employees >50), according to the Office of Small and Medium Enterprise Promotion of Thailand. A self-administered questionnaire, together with an invitation letter and information about the study, was distributed to each office worker by hand. The researcher made an appointment a few days later to come back and collect the completed questionnaire. The study was approved by Chulalongkorn University Human Ethics Committee.

Questionnaire

The questionnaire was adapted from the standardized Nordic questionnaire[18] and Dutch musculoskeletal questionnaire[19]. The questionnaire gathered data on individual, work-related physical and psychosocial data as well as musculoskeletal symptoms in the spinal region (head/neck, upper back and low back) during the previous 12 months.

Individual factors included gender, age, height, body weight, hand and leg dominance, chronic diseases, educational level, marital status, number of family members, average monthly income, leisure activities, frequency of weekly exercise sessions, self-rated perception of health status, quality of sleep, smoking habit and alcohol/coffee/tea drinking habits. Information about the average number of sleeping hours a night, the hours a week doing housework and the hours a day commuting from office to home were also requested.

Work-related physical factors included the average number of working hours a day, working days a week and overtime working hours a week as well as years of working experience. Respondents were asked whether the job involved a supervision role, the frequency of performing various physical activities during the working day (such as bending, twisting, climbing stairs, sitting, standing, lifting, working with computers, working in uncomfortable posture) and frequency of rest breaks during work. The questionnaire also asked respondents to self-rate physical tiredness at the end of working day, the ergonomics of their workstations (including desk, chair as well as positions of monitor, keyboard and mouse) and work environment conditions (including temperature, light intensity, noise level, size of office space, air circulation).

Psychosocial factors included questions concerning the mental demands and responsibility required, work repetitiveness, work-related decision latitude, frequency of work-related problems, lack of personnel in the workplace, level of interaction with others, relationships with colleagues, level of supervisor and family support and psychological status in the past 4 wk (including the frequency of feeling stress, anxiety, fear of job loss, job dissatisfaction, work pressure, conflicts with family members, health concerns).

Musculoskeletal symptoms were measured by the standardized Nordic questionnaire[18]. Respondents who reported symptoms were asked to specify what they thought were the causes of symptoms (e.g. due to work, sport, a hobby, housework or other causes). In this study, workers were identified as cases if they reported musculoskeletal symptoms in the head/neck, upper back and low back in the previous 12 mo and attributed the symptoms to work.

Statistical analyses

Chi-square analysis was carried out first to determine significant differences in the prevalence of self-reported musculoskeletal symptoms in each body part (i.e. head/neck, upper back and low back) with various individual,

Table 1. Demographic information of responding office workers (n=1,185)

Characteristics	n	%	Mean	SD
Gender				
-Male	378	32		
-Female	807	68		
Age (yr)			35.2	8.4
Body mass index (kg/m^2)			21.9	3.6
Year of work experience (yr)			9.4	7.8
Education				
-High school	60	5.1		
-College	146	12.3		
-Bachelor's degree	777	65.6		
-Higher than Bachelor's degree	198	16.7		
-Not specified	4	0.3		

work-related physical and psychosocial characteristics. Chi-square analysis was performed using 2 × 2 contingency tables. The odds ratios (OR) and their 95% confidence intervals (95% CI) were calculated.

Separated multivariable logistic regression models were used to assess the associations between the prevalence in each spinal region and biopsychosocial factors. Backward selection procedures were used in the statistical modeling. Any factors with a p value <0.05 in the Chi-square analysis were eligible for addition to the modeling procedures. In the final modeling, the statistically significant level of each determining factor was adjusted using the Bonferroni correction procedure. According to the procedure, a p value of 0.05 is divided by the number of factors added to the modeling procedure, and the new statistically significant level is then set as a p value less than this obtained value. Adjusted ORs and 95% CI were presented for the final models. All statistical analyses were performed using a statistical software package.

Results

A total of 1,428 office workers responded to the questionnaire, a response rate of 71%. Two hundred and forty three office workers were excluded because they did not meet the inclusion criteria of having at least 1 yr of experience in the current position. Therefore, 1,185 were used in the data analysis of this study. Table 1 presents the demographic characteristics of the office workers participating in the study.

Head/neck region

When multivariable logistic regression was used and the Bonferroni correction procedure was applied (the significance level was set at p<0.001), the frequency of working in an uncomfortable posture strongly correlated with complaints of musculoskeletal symptoms in the head/neck (p<0.001). In the questionnaire, the frequency of long periods in an uncomfortable posture during work was rated by the subject according to four categories (1=never, 2=occasionally, 3=often, 4=very often). In data analysis, the first two categories (never - occasionally) were combined as well as the last two categories (often - very often). Workers who reported frequently working in an uncomfortable posture were at greater risk of experiencing neck symptoms compared to those who never or occasionally worked in an uncomfortable posture (adjusted OR=1.81, 95% CI=1.35–2.44) (Table 2).

Upper back region

When multivariable logistic regression was used and the Bonferroni correction procedure was applied (the significance level was set at p<0.001), the results showed that the frequency of trunk bending during work and the level of interaction with others during work strongly correlated with complaints of musculoskeletal symptoms in the upper back (p<0.001). The frequency of trunk bending during work was rated by the subject in the same way as the frequency of long periods in an uncomfortable posture during work. For the level of interaction with others during work, the subject was asked whether they agreed with the sentence 'job requires little interaction with others' with a scale of two classes (1=agree, 2=disagree) given. Subjects who reported themselves as frequently bending their trunk during work were at greater risk of experiencing upper back symptoms compared to those who never or occasionally bent their trunk (adjusted OR=1.80, 95% CI=1.32–2.44). While workers who reported that their job required little interaction with others were less likely to experience upper back symptoms compared to those who reported the opposite (adjusted OR=0.42, 95% CI=0.25–0.68) (Table 3).

Table 2. Prevalence and adjusted odds ratio (OR_{adj}) with 95% confidence intervals (95%CI) of head/neck symptoms with respect to factors in the final modeling (n=1,185)

Factors	N	Prevalence n (%)	OR_{adj}	95%CI	*p*
Gender					
Male	377	126 (33)	0.67	0.51–0.88	0.004
Female	808	384 (48)	1.00		
Living alone					
Yes	95	30 (32)	0.56	0.35–0.91	0.018
No	1,090	480 (44)	1.00		
Self-rated perception of health status					
Poor	940	432 (46)	1.42	1.04–1.95	0.030
Good	245	78 (32)	1.00		
Average number of working hours a day					
>8 h a day	301	171	1.63	1.22–2.16	0.001
≤8 h a day	884	339	1.00		
Self-rated perception of tiredness at the end of working day					
Tired	650	327 (50)	1.43	1.11–1.85	0.006
Not tired	535	183 (34)	1.00		
Frequency of long periods in an uncomfortable posture during the working day					
Often–Very often	299	181 (61)	1.81	1.35–2.44	<0.001*
Never–Occasionally	886	329 (37)	1.00		
Frequency of doing repetitive activities during the working day					
Often–Very often	869	413 (48)	1.66	1.24–2.21	0.001
Never–Occasionally	316	97 (31)	1.00		
Self-rated perception of the ergonomics of the desk					
Poor	358	189 (53)	1.47	1.12–1.94	0.005
Good	827	321 (39)	1.00		
Job requires high concentration					
Agree	914	421 (46)	1.53	1.13–2.07	0.006
Disagree	271	89 (33)	1.00		

*The level of statistical significance after the Bonferroni correction procedure was set at <0.001.

Low back region

When multivariable logistic regression was used and the Bonferroni correction procedure was applied (the significance level was set at $p<0.002$), the results revealed that the average work hours a day strongly correlated with complaints of musculoskeletal symptoms in the low back ($p=0.001$). Average work hours a day was scaled into two classes (1=≤8 h a day, 2=>8 h a day). Working for >8 h a day showed an elevated risk for low back symptoms among office workers (adjusted OR=1.66, 95% CI=1.25–2.22) (Table 4).

Discussion

When the relationships between spinal symptoms and each individual, work-related physical and psychosocial factor were analyzed, the common factors found to be significantly associated with spinal symptoms were the self-rated perception of health status, the average number of working hours a day and the frequency of working in an uncomfortable posture during the working day. Apart from common factors, different biopsychosocial factors were significantly related to musculoskeletal symptoms in different spinal parts. However, when all biopsychosocial factors were analyzed together with the Bonferroni correction procedure, the results indicated that the frequency of long periods in an uncomfortable posture and trunk bending during work, level of interaction with others and duration of working day remained independently associated with the self-reported prevalence of spinal symptoms among office workers.

In Thailand, research on musculoskeletal symptoms in office workers has been scant. To date, only one study has examined the prevalence of musculoskeletal symptoms in the neck and upper extremity among workers who worked mainly with visual display units in a bank and it found that 60% reported such symptoms[20].

Table 3. Prevalence and adjusted odds ratio (OR_{adj}) with 95% confidence intervals (95%CI) of upper back symptoms with respect to factors in the final modeling (n=1,185)

Factors	N	Prevalence n (%)	OR_{adj}	95%CI	*p*
Gender					
Male	377	84 (22)	0.71	0.53–0.97	0.029
Female	808	263 (33)	1.00		
Age					
<30 yr	346	125 (36)	1.00		
30–39 yr	495	137 (28)	0.67	0.49–0.92	0.012
40–49 yr	264	71 (27)	0.67	0.46–0.97	0.036
>49 yr	80	14 (18)	0.41	0.22–0.77	0.005
Self-rated perception of health status					
Poor	940	299 (32)	1.81	1.25–2.61	0.002
Good	245	48 (20)	1.00		
Average number of working hours a day					
>8 h a day	301	118 (39)	1.43	1.06–1.92	0.019
≤8 h a day	884	229 (26)	1.00		
Frequency of trunk bending during the working day					
Often–Very often	267	107 (40)	1.80	1.32–2.44	<0.001*
Never–Occasionally	918	240 (26)	1.00		
Frequency of long periods in an uncomfortable posture during the working day					
Often–Very often	299	126 (42)	1.66	1.23–2.23	0.001
Never–Occasionally	886	221 (25)	1.00		
You have control over work					
Yes	831	269 (32)	1.58	1.16–2.15	0.004
No	354	78 (22)	1.00		
Job requires little interaction with others					
Agree	134	23 (17)	0.42	0.25–0.68	<0.001*
Disagree	1,051	324 (31)	1.00		
Frequently have problems at work					
Agree	324	115 (35)	1.46	1.09–1.97	0.012
Disagree	861	232 (27)	1.00		
Frequently have conflicts with family members					
Agree	94	40 (43)	1.62	1.02–2.55	0.039
Disagree	1,091	307 (28)	1.00		

*The level of statistical significance after the Bonferroni correction procedure was set at <0.001.

There were a few previous studies investigating musculoskeletal symptoms in other occupations, such as physical therapists[21], para-rubber planters[22] and construction workers[23]. These studies also reported a high prevalence of musculoskeletal symptoms among the targeted workers. Saicheua[24] investigated Thai workers who were diagnosed by an authoritative medical committee with work-related lumbar disc herniation and showed that the most common risk factor was lifting. This finding is in line with other studies demonstrating that the work-related physical factor is one of the primary risk factors for developing musculoskeletal symptoms among Thai workers.

Head/neck region

We found that the prevalence of head/neck symptoms were significantly correlated to gender, subjects who were living alone, self-rated perception of tiredness at the end of the working day, frequency of doing repetitive activities during the working day, self-rated perception of the ergonomics of the desk and jobs requiring high concentration. However, after the Bonferroni correction procedure, only the frequency of long periods in an uncomfortable posture during work remained independently associated with the self-reported prevalence of head/neck symptoms.

In the present study, the risk of experiencing head/neck symptoms was almost twofold for those who reported a

Table 4. Prevalence and adjusted odds ratio (OR_{adj}) with 95% confidence intervals (95%CI) of low back symptoms with respect to factors in the final modeling (n=1,185)

Factors	N	Prevalence n (%)	OR_{adj}	95%CI	*p*
Involved in leisure activities					
Yes	731	282 (39)	1.39	1.07–1.80	0.014
No	454	147 (32)	1.00		
Self-rated perception of health status					
Poor	940	365 (39)	1.49	1.07–2.06	0.017
Good	245	64 (26)	1.00		
Average number of working hours a day					
>8 h a day	301	153 (51)	1.66	1.25–2.22	0.001*
≤8 h a day	884	276 (31)	1.00		
Average number of over-time working hours a week					
>5 h a week	393	181 (46)	1.45	1.11–1.89	0.007
≤5 h a week	792	248 (31)	1.00		
Self-rated perception of tiredness at the end of working day					
Tired	650	275 (42)	1.34	1.03–1.75	0.032
Not tired	535	154 (29)	1.00		
Frequency of trunk bending during the working day					
Often–Very often	267	126 (47)	1.46	1.09–1.96	0.010
Never–Occasionally	918	303 (33)	1.00		
Frequency of long periods in an uncomfortable posture during the working day					
Often–Very often	299	148 (49)	1.48	1.11–1.98	0.008
Never–Occasionally	886	281 (32)	1.00		
Frequency of doing repetitive activities during the working day					
Often–Very often	869	344 (40)	1.53	1.13–2.06	0.005
Never–Occasionally	316	85 (27)	1.00		
Frequently feeling tired in the morning					
Agree	467	200	1.33	1.03–1.73	0.030
Disagree	718	229	1.00		

*The level of statistical significance after the Bonferroni correction procedure was set at <0.002.

high frequency of working in an uncomfortable posture in comparison with those who never or occasionally worked in an uncomfortable posture. Our finding is supported by Ortiz-Hernández *et al.*[10] who found that the adoption of uncomfortable postures elevated the risk of experiencing neck symptoms among newspaper office workers. Also, Cagnie *et al.*[25] found a significant association between neck pain and office workers often holding the neck in a forward bent posture for a prolonged period of time.

Perceived muscular tension has been found to be associated with muscle loading[26]. Thus, a plausible explanation for the strong association between frequency of working in an uncomfortable posture and neck symptoms relates to static loading of neck and shoulder muscles. Office work usually involves computer use and document work which continuously requires static contraction of neck and shoulder muscles[10]. Sustained muscle activity has been previously identified as a risk factor for developing musculoskeletal symptoms[1, 16]. Continuous low-intensity contraction of the neck and shoulder muscles has been shown to induce Ca^{2+} accumulation and homeostatic disturbances in the active muscles due to poor blood circulation and an impaired metabolic waste removal mechanism[27]. These pathological changes in the active muscles lead to musculoskeletal discomfort[8]. Various factors may predispose office workers to constrained postures or awkward positions more frequently or for a long period of time, including poor ergonomics of workstation design, working habits or job requirements. As a result, accumulation of muscle overwork leads to the development of musculoskeletal disorders[28]. Previous studies demonstrated that sitting at work for more than 95% of the work time was significantly associated with neck pain and workers with poor neck muscle strength and endurance had an increased risk of experiencing neck symptoms[15, 29].

Upper back region

The prevalence of upper back symptoms was significantly associated with gender, age, frequency of trunk bending during the working day, work-related decision latitude, level of interaction with others, frequency of having problems at work and frequency of having conflicts with family members. However, after the Bonferroni correction procedure, only the frequency of trunk bending during work and level of interaction with others remained independently associated with the self-reported prevalence of upper back symptoms.

To our knowledge, this is the first study investigating the association between the prevalence of upper back symptoms and biopsychosocial factors among office workers. The results indicated that repetitive trunk bending during work increased the risk of experiencing upper back symptoms by almost twofold. Previous studies showed a strong effect of repetitive trunk twisting or bending during work and experiencing neck symptoms[6, 30].

From a mechanical point of view, the thoracic spine has limited mobility due to its attachment to the ribcage[31]. However, thoracic vertebral movement is necessary during trunk bending[32]. It is hypothesized that repetitive trunk bending may lead to injury to the structure of the thoracic spine, especially in combination with forceful exertions.

Regarding the role of psychosocial exposures at work on the development of musculoskeletal symptoms, our study found that jobs requiring little interaction with others decreased the risk of experiencing upper back symptoms. An individual working in a job that does require a high level of interaction with others is likely to encounter several psychosocial exposures, particularly conflict, time pressure and less job control, compared to a job that needs little or no interaction with others. Thus, workers whose jobs require a high level of interaction with others may experience more stress than those whose jobs require little or no interaction with others. The role of stress in the development of musculoskeletal disorders has been widely recognized[8, 33].

Low back region

The prevalence of low back symptoms was significantly related to whether the subjects participated in leisure activities, the average number of overtime working hours a week, self-rated perception of tiredness at the end of the working day, frequency of trunk bending during the working day, frequency of doing repetitive activities during the working day and frequency of feeling tired in the morning. However, after the Bonferroni correction procedure, only the duration of the working day remained independently associated with the self-reported prevalence of low back symptoms.

A long working day (average >8 h a day) increased the risk of experiencing low back symptoms by almost twofold in comparison with a shorter working day (average ≤8 h a day). To our knowledge, no previous study has reported on the relationship between the duration of the working day and the prevalence of low back symptoms in office workers. Van den Heuvel *et al*.[4] reported an elevated risk of experiencing neck-shoulder symptoms in office workers who worked for more than 8.5 h a day. Wergeland *et al*.[34] showed that by shortening the duration of the working day to ≤6 h a day significantly reduced the risk of experiencing neck-shoulder symptoms.

Since computer use and document work require a sitting posture, the strong association between a long working day and low back symptoms may relate to the prolonged sitting posture. Several previous studies reported a positive relationship between the duration in a sitting posture and self-reported neck, upper limb and back pain[10, 11, 30]. Prolonged sitting posture causes changes to intervertebral discs, ligaments, joint capsules and muscles. Sitting causes lumbar flexion and decreases the lumbar lordotic curve[35] which, in turn, leads to the compression of the anterior annulus and the nucleus pulposus of intervertebral discs and stretching of the posterior annulus of intervertebral discs, joint capsules and posterior ligaments[36]. Lack of movement during sitting also leads to the reduction of fluid exchange in the intervertebral discs and poor blood supply to muscles[37]. Evidence suggests that sustained lumbar flexion reduces the ability of the spine to resist forces acting upon it[38]. In addition, prolonged sitting also induces the shortening of some muscles, such as the hamstring, as well as weakening other muscles, such as abdominal muscles, which result in altered biomechanical loading of the spine during movement[39]. The adverse effect of prolonged sitting on the lumbar spine as mentioned above may predispose the lumbar spine to injury during forceful loading[37].

Interestingly, in this study the self-reported prevalence of spinal symptoms was found to correlate mostly with work-related physical factors. Although it is currently accepted that a large index number within the psychosocial dimensions contributes to the development and persistence of musculoskeletal symptoms[17], only one psychosocial factor, i.e. level of interaction with others, was found to be associated with the prevalence of spinal symptoms in the present study. From the findings, it appears that work-related physical factors have a predominant effect upon the development of musculoskeletal symptoms among Thai office workers compared to psychosocial and individual factors. Most previous studies demonstrating the link between psychosocial factors and musculoskeletal symptoms were conducted in Western countries[6, 9, 17]. In some Asian countries like Thailand, due to limited resources, it is

unlikely that companies will provide workstations that suit each individual ergonomically; therefore, the workplace environment condition is likely to be less than ideal. Therefore, work-related physical factors may become an important contributor to musculoskeletal symptoms. Additionally, work and social culture among Asians are different from those of Westerners. As a result, the role of psychosocial factors on the development of musculoskeletal symptoms in Asians may be not comparable to that of Westerners. The findings of the current study may indicate a different contributing model of biopsychosocial factors on the development of musculoskeletal symptoms, at least in the spine, among Asian office workers compared to their Western counterparts. This issue warrants further investigation.

There are a number of methodological limitations of the present study that are noteworthy. First, the current study only collected self-reported data for which there is the risk of an overestimation of the exposures[4]. For example, subjects experiencing neck symptoms may consider themselves to have worked in uncomfortable postures more frequently than those without symptoms and the reason could be merely that subjects had symptoms while doing some activities or remaining in some postures. Thus, when asked about the frequency of working in an uncomfortable posture, subjects experiencing neck symptoms may have tended to overestimate the frequency compared to those without symptoms. Also, symptomatic workers may be more aware of the factors that they think influence their symptoms than healthy workers. Thus, they may overestimate the amount of exposure to these factors. However, Toomingas *et al.*[40] found no supporting evidence for bias from rating behavior when subjects rated both exposure and outcome at the same time. Second, this study may be susceptible to the "healthy worker effect", i.e. office workers suffering from musculoskeletal injury due to work may move on to other jobs and may not be included in the present study. Third, the cross-sectional study design only allows the association between exposure and outcome to be examined. It is difficult to establish the causal relation between exposure and outcome. Therefore, further prospective study design is required to validate the findings of this study.

In conclusion, a high frequency of working in an uncomfortable posture increased the risk of experiencing head/neck symptoms. High repetitive trunk bending during work increased the risk of experiencing upper back symptoms and working in a job that required little interaction with others decreased the risk of experiencing upper back symptoms. Working for >8 h a day elevated the risk of low back symptoms. The results of this study indicate that the prevention of spinal symptoms among office workers should at least focus on the modification of work-related physical factors, including the frequency of long periods in an uncomfortable posture and trunk bending during the working day and the duration of the working day. One effective preventative measure may be ergonomic intervention.

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