



Original Article

Risk factors associated with musculoskeletal symptoms in Korean dental practitioners

KIHUN CHO, PT, PhD¹⁾, HWI-YOUNG CHO, PT, PhD²⁾, GYEONG-SOON HAN, DDS, PhD^{3)*}

¹⁾ Department of Rehabilitative and Assistive Technology, Korea National Rehabilitation Research Institute, Korea National Rehabilitation Center, Republic of Korea

²⁾ Department of Physical Therapy, College of Health Science, Gachon University, Republic of Korea

³⁾ Department of Dental Hygiene, College of Health Science, Gachon University: 191 Hambangmoe-ro, Yeonsu-gu, Incheon 406-799, Republic of Korea

Abstract. [Purpose] The purpose of this study was to investigate the association between psychosocial stress, occupational stress, and musculoskeletal symptoms in Korean dental practitioners. [Subjects and Methods] Self-reported questionnaires were distributed to 401 dental practitioners in Korea. To assess the risk factors related to musculoskeletal disorders, the Nordic Musculoskeletal Questionnaire, the Korean Occupational Stress Scale, and Psychosocial Well-Being Index Short Form were used. General and work-related characteristics of the subjects consisted of seven items, including age, career, height, weight, working days/week, working hours/day, and physical strain levels. [Results] In this study, 86.8% of the practitioners experienced musculoskeletal symptoms (shoulders, 72.8%; neck, 69.3%; waist, 68.3%; wrist, 58.4%; back, 44.1%; ankle, 38.7%; knee, 36.9%; hip, 20.4%; and elbows, 9.2%). Moreover, psychosocial and occupational stress can affect the occurrence of musculoskeletal disorders. In particular, we found that psychosocial stress has significant influence on the occurrence of musculoskeletal disorders. [Conclusion] To increase the quality of life and provide high-quality medical service for dental practitioners, risk factors for musculoskeletal disorders must be managed. Accordingly, dental practitioners must maintain good posture, get an appropriate amount of rest, and perform regular stretching exercise to reduce psychological stress and improve the work environment.

Key words: Dental practitioners, Musculoskeletal disorder, Psychosocial stress

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INTRODUCTION

A musculoskeletal disorder (MSDs) is defined as a chronic health problem of the musculoskeletal system that causes pain and paresthesia through damage to the nerves and blood vessels in various joints, such as the neck, shoulder, back, elbow, wrist, finger, hip, knee, and ankle¹⁾. MSDs is influenced by various factors, including physical characteristics (height and weight), and occupational and sociopsychological characteristics (overuse of a body region, uncomfortable posture, high work intensity, insufficient breaks, inappropriate work environment)²⁾. In particular, repetitive work activities cause overuse of specific muscles, which has become a major cause of MSDs¹⁾.

Prevention and management require investigation both of the incidence of MSD by job category, as well as of the basic causes³⁾. Work-related MSDs are caused by various and complex factors⁴⁾, which must be considered in order to identify the major causes, and to examine the associations among the factors causing the MSDs. Imaging, blood, and electrophysiological tests have been used for objective diagnosis. However, in most cases, subjective symptoms of MSDs appear before a diagnosis based on objective tests is made, and must be taken into consideration in the diagnosis⁵⁾.

Many studies have analyzed the factors causing MSDs, based on subjective symptoms, such as pain or functional disorder.

*Corresponding author. Gyeong-Soon Han (E-mail: gshan@gachon.ac.kr)

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ders⁶⁻⁹). Dental practitioners reportedly have a higher likelihood of MSDs, because they work in a static posture using their hands and wrists, while their backs, shoulders, and legs are bent. In fact, 64–96% of dental practitioners reportedly experience MSD pain^{3, 4, 10}). In dental hygienists, 60–69.5% reported that MSD pain occurred primarily in the hand and wrist regions, whereas in dentists, 36.3–60.1% and 19.8–85% reported that MSD pain occurred in the back and neck regions, respectively⁴). Female dentists also reportedly experienced greater pain in the shoulder, hand, and neck, compared with males⁸). However, previous studies on dental practitioners primarily evaluated the development of MSDs, the frequency of pain, and subjective symptoms, based on posture and occupational environment.

The purpose of this study was (1) to investigate the symptom severity of MSDs in Korean dental practitioners; (2) to analyze the association with various factors, such as individual characteristics, work-related factors, and psychosocial and occupational stress; and (3) to investigate the major factors influencing MSDs.

SUBJECTS AND METHODS

This study was designed as a cross-sectional research study, and 410 dental practitioners from dental clinics located in the areas of Incheon and Seoul province were participated from June to July 2014. We used the G * Power 3.1.7 software to calculate the sample size. At least 372 subjects were required for analysis. To allow for dropout, we selected 410 participants. A total of 410 dental practitioners participated in this survey. Of these, unclear answers or incomplete questionnaires ($n = 9$) were excluded, and 401 questionnaires were included in the final analysis. Of the 401 practitioners sampled, 88 were dentists, and 313 were dental hygienists.

Dental practitioners aged 20–35 years, with a minimum of two years in practice and a minimum 40 hours of clinical work per week, were included in this study. Those with any disease that may influence the musculoskeletal system, such as uncontrolled diabetes, were excluded. Prior to data collection, we explained the objectives and requirements of our study to all participants. We obtained informed consent and made it clear that participation was voluntary. Approval for this study was obtained from the Research Ethics Committee at Gachon University.

Each of the subjects completed a self-administered, anonymous data-gathering sheet. General and work-related characteristics of the subjects consisted of seven items, including age, career, height, weight, working days/week, working hours/day, and physical strain levels. Self-reported questionnaires distributed to the participants included the Nordic Musculoskeletal Questionnaire (NMQ)⁶, Korean Occupational Stress Scale (KOSS)¹¹, and Psychosocial Well-Being Index Short Form¹².

We assessed MSDs by means of the NMQ⁶. The NMQ is an internationally accepted instrument to standardize evaluation of MSDs, and consists of questions about nine anatomical regions. Subjects were asked to report whether they had experienced pain or discomfort in any of these 9 regions during the previous 12 months or 7 days and whether normal activities were restricted because of these symptoms. Items to determine the intensity of the pain were also added. Grade 1 indicated somewhat uncomfortable pain, which was not experienced during work; Grade 2 indicated pain during work, which resolved with rest; Grade 3 indicated pain during work, with intermittent pain after work; and Grade 4 indicated severe pain during work, with continuing pain after work.

The KOSS-43 is composed of 8 subregions and 43 questions 1–3, physical environment; 4–11, task requirement; 12–16, task autonomy; 17–20, relation conflict; 21–26, task instability; 27–33, organizational system; 34–39, inappropriate compensation; 40–43, workplace culture¹¹). Higher stress was scored from 1–4, with 1 being highest, and lower stress was scored from 4–1, with 1 being lowest. Cronbach's α coefficient for occupational stress showed high internal consistency at 0.817. Calculated scores were divided into two groups, a lower and upper 50% groups, for both men and women.

In addition, the PWI-SF was used for evaluation of psychosocial stress¹²). Cronbach's α coefficient for occupational stress showed high internal consistency at 0.880. The psychosocial stress score ranged from 0 to a maximum of 54 points; the higher the score, the greater the level of stress. Based on the total score, three groups were identified: ≥ 27 points indicated severe stress; 9–26 points indicated potential stress; and ≤ 8 points indicated positive well-being.

Statistical analyses were conducted using IBM SPSS Statistics Version 21 (IBM Corp., Armonk, NY, USA). Frequency analysis was performed to determine the MSD symptom severity of the nine body regions. Independent t-tests and one-way analysis of variance (ANOVA) were performed to investigate the differences in pain among body regions according to general and work-related characteristics. Multivariate binary logistic regression analysis was used to elucidate the explanatory factor associated with musculoskeletal symptoms. Statistical significance was accepted for values of $p < 0.05$. Data are presented as mean \pm standard deviation (SD) values.

RESULTS

The prevalence and severity of musculoskeletal complaints are shown in Table 1. In this study, 86.8% of practitioners experienced MSDs. Symptoms involved the shoulders, neck, waist, wrist, back, ankle, knee, hip, and elbows in 72.8%, 69.3%, 68.3%, 58.4%, 44.1%, 38.7%, 36.9%, 20.4%, and 9.2% of dental practitioners, respectively. The severity of MSD symptoms was reported as Grade 1 by 32.0% of dental practitioners, Grade 2 by 30.0% of dental practitioners, Grade 3 by 21.8% of dental practitioners, and Grade 4 by 2.5% of dental practitioners.

The number of involved pain regions according to general and work-related characteristics is shown in Table 2. Among

Table 1. Prevalence and severity of musculoskeletal complaints of the subjects (n=401)

Part of body	Present*	Level of symptoms			
		Grade I	Grade II	Grade III	Grade IV
Neck	278 (69.3%)	98 (24.4%)	109 (27.2%)	65 (16.2%)	6 (1.5%)
Shoulder	292 (72.8%)	92 (23.0%)	118 (29.3%)	76 (19.0%)	6 (1.5%)
Elbow	37 (9.2%)	25 (6.0%)	4 (1.0%)	6 (1.4%)	2 (0.4%)
Wrist	234 (58.4%)	104 (25.9%)	88 (22.0%)	36 (9.0%)	6 (1.5%)
Back	177 (44.1%)	96 (24.0%)	55 (13.7%)	24 (6.0%)	2 (0.5%)
Waist	274 (68.3%)	88 (22.0%)	120 (29.9%)	58 (14.5%)	8 (2.0%)
Hip	82 (20.4%)	64 (16.0%)	11 (2.7%)	5 (1.2%)	2 (0.5%)
Knee	148 (36.9%)	79 (19.7%)	38 (9.5%)	28 (0.7%)	3 (0.7%)
Ankle	155 (38.7%)	85 (21.2%)	46 (11.5%)	21 (5.2%)	3 (0.7%)
Total	348 (86.8%)	129 (32.0%)	122 (30.5%)	87 (21.8%)	10 (2.5%)

*Duplicate response

Table 2. Number of pain regions according to general and job-related characteristics

Variables	N	M±SD
Age (years)		
≤25	185	4.36±2.53
26–30	122	4.22±2.72
>30	94	3.79±2.56
Career (years)		
≤3	180	4.24±2.51
4–6	80	4.16±2.80
7–9	59	4.49±2.57
>9	82	3.84±2.56
Height (cm)		
<160	98	4.50±2.46
160–165	173	3.96±2.74
>165	130	4.24±2.50
Weight (kg)		
<50	107	4.33±2.51
50–55	193	4.23±2.73
>55	101	3.93±2.45
Working days/week		
≤5	250	4.10±2.57
>5	151	4.32±2.66
Working hours/day		
≤8	167	3.91±2.69
>8	234	4.38±2.53
Physical strain*		
Never	15	2.80±2.11 ^a
Little	164	4.00±2.67 ^{ab}
Moderate	169	3.93±2.48 ^{ab}
Severe	53	5.94±2.24 ^b
Average value	401	4.18±2.06

* < 0.05.

^{ab}The same characters was not significant by Bonferroni's multiple comparisons at $\alpha=0.05$

Table 3. Number of pain regions according to psychosocial stress (PWI-SF)

Variables	N	M±SD
Psychosocial stress*		
Positive well-being	6	2.20±2.86 ^a
Potential stress	364	4.23±2.50 ^{ab}
Severe stress	31	6.96±1.39 ^b

* < 0.05

^{ab}The same characters was not significant by Bonferroni's multiple comparisons at $\alpha = 0.05$ **Table 4.** Number of pain regions according to occupational stress

Variables	N	M±SD
Physical environment		
Lower 50%	298	4.32±2.58
Upper 50%	103	3.78±2.79
Task requirement		
Lower 50%	230	3.98±2.66
Upper 50%	171	4.45±2.50
Task autonomy*		
Lower 50%	303	3.99±2.55
Upper 50%	98	4.79±2.67
Relation conflict		
Lower 50%	227	4.37±2.53
Upper 50%	174	3.98±2.68
Task instability		
Lower 50%	336	4.18±2.57
Upper 50%	65	4.22±2.76
Organizational system*		
Lower 50%	322	3.94±2.59
Upper 50%	79	5.16±2.42
Inappropriate compensation*		
Lower 50%	382	4.12±2.61
Upper 50%	19	5.53±2.06
Workplace culture*		
Lower 50%	262	4.00±2.58
Upper 50%	139	4.53±2.61
Total*		
Lower 50%	312	3.95±2.61
Upper 50%	89	5.03±2.40

* < 0.05

the nine anatomical regions, MSD symptoms occurred in 4.18 regions. In addition, the number of involved pain regions showed significant differences according to physical strain level. The severe group, which experienced a physical burden (5.94), showed a significantly higher score than the never group (2.80), which experienced no physical burden ($p < 0.001$).

The number of involved pain regions according to the PWI-SF is shown in Table 3, with significant differences depending on the level of psychosocial stress: severe stress group, 6.96 regions; potential stress group, 4.23; and positive well-being group, 2.20 ($p < 0.001$).

The number of painful body regions according to occupational stress is shown in Table 4. In the totals for occupational stress, the upper 50% group experienced pain in 5.03 regions, and the lower 50% group experienced pain in 3.95 regions ($p = 0.001$). In the sub-items (task autonomy, organizational system, inappropriate compensation, and workplace culture), the upper 50% group experienced pain in 4.79, 5.16, 5.53, and 4.53 regions, and the lower 50% group experienced pain in 3.99, 3.94, 4.12, and 4.00 regions, respectively ($p = 0.001$).

Table 5. Occupational stress sub-items related to musculoskeletal symptoms

Variables		OR (95% CI)
Physical environment	(lower 50%=1, upper 50%=0)	1.67 (1.15–2.88)
Task requirement	(lower 50%=1, upper 50%=0)	1.26 (0.98–1.61)
Task autonomy*	(lower 50%=1, upper 50%=0)	1.13 (0.85–1.50)
Relation conflict*	(lower 50%=1, upper 50%=0)	1.16 (0.84–1.60)
Task instability	(lower 50%=1, upper 50%=0)	0.71 (0.55–0.91)
Organizational system*	(lower 50%=1, upper 50%=0)	1.66 (1.17–2.36)
Inappropriate compensation	(lower 50%=1, upper 50%=0)	1.82 (0.82–4.03)
Workplace culture	(lower 50%=1, upper 50%=0)	1.06 (0.81–1.37)

* < 0.05. P-values obtained from the multivariate binary logistic regression.

Wald χ^2 test, model $\chi^2=32.36$, $df=8$, pseudo R-square=12.2% (Nagelkerke)

OR: odds ratio; CI: confidence interval

Table 6. Characteristics of subjects related to the musculoskeletal symptoms

Variables		OR (95% CI)
Age (years)	($\leq 25=1$, $\geq 26=0$)	1.26 (0.48–3.27)
Career (years)	($\leq 6=1$, $\geq 7=0$)	0.78 (0.27–2.25)
Height (cm)*	(<160=1, $\geq 160=0$)	0.58 (0.34–0.97)
Weight (kg)	(<50=1, $\geq 50=0$)	0.78 (0.44–1.39)
Working hours	($\leq 8=1$, $\geq 9=0$)	0.69 (0.40–1.10)
Physical strain	(\leq Grade 1=1, \geq Grade 2=0)	0.99 (0.59–1.69)
Psychosocial stress*	(<19 points=1, ≥ 19 points=0)	2.36 (1.38–4.04)
Occupational stress*	(lower 50%=1, upper 50%=0)	1.75 (1.40–2.93)

* < 0.05. P-values obtained from the multivariate binary logistic regression.

Wald χ^2 test, model $\chi^2=24.04$, $df=8$, pseudo R-square =11.7% (Nagelkerke)

OR: odds ratio; CI: confidence interval

Occupational stress subitems related to the MSDs are shown in Table 5. Among the occupational stress subitems, physical environment, organizational system, and relation conflict were associated with MSDs. In addition, the upper 50% group had 1.26 times, 1.16 times, and 1.66 times higher risk of MSDs compared with the lower 50% group in the categories of physical environment, relation conflict, and organizational system, respectively ($p < 0.01$).

Characteristics of the subjects related to MSDs are shown in Table 6. The pain level of the height ≥ 160 cm group was 42% lower than that of the height < 160 cm group ($p < 0.05$). The possibility of MSD occurrence was 2.36 times higher in the psychosocial stress ≥ 19 points group than in the < 19 points group ($p < 0.01$). In addition, for occupational stress, the possibility of MSD occurrence was 1.75 times higher in the upper 50% group than in the lower 50% group ($p < 0.05$).

DISCUSSION

Dental practitioners are highly likely to develop MSDs due to the occupational characteristics of repetitive activity^{13, 14}. According to our results, 86.8% of Korean dental practitioners experienced MSDs. This prevalence is higher than those in America (76.0%)⁷ and India (78.0%)¹⁵, similar to those in Lithuania (86.5%)¹⁶ and Australia (87.2%)¹⁷, and lower than that in Poland (92%)¹⁸. In addition, MSDs in dental practitioners were found in the neck, hand/wrist, shoulders, and back.

Similarly, in this study, MSD symptoms were found in the shoulders (72.8%), neck (69.3%), waist (68.3%) and wrist (58.4%). Although there were differences in the ranking compared with previous studies, the regions where the symptoms occurred were similar. This is presumably due to investigation of the same occupational environment in the countries studied. In addition, in this study, pain Grades 1 and 2 were reported by 62.5% of dental practitioners; notably, 21.8% experienced pain during work and intermittent pain after work (Grade 3). These results indicate that pain affects the work performance of practitioners.

A raised-arm work position is a significant factor causing muscle fatigue in the neck and shoulders¹⁹. Thus, it is important for dental practitioners to correct their posture to avoid adding persistent pressure on a specific body region. Hardage et al. suggested that good posture included fixing the feet on the ground, keeping the knees and shoulders parallel to the ground, straightening the head and back, and keeping the elbows close to the trunk. Thus, a training program could be used to make good posture a habit, and an MSD prevention program should be included in the regular university coursework. Because re-

petitive work activity with a fixed posture causes overuse of specific muscles, proper break time is needed during work hours.

In this study, among the nine anatomical regions, 4.18 showed occurrence of MSD symptoms, indicating the importance to dental practitioners. In particular, in terms of physical strain, under the category of general and job-related characteristics, the severe group, which experienced a physical burden (5.94), showed a significantly higher score than the never group (2.80), which experienced no physical burden ($p < 0.001$). In other words, physical burden due to work can lead to MSD symptoms. Thus, stretching exercises or rest during work hours is necessary.

An interesting finding shown by multivariate, binary logistic regression was the association between height and pain. In this study, height was a risk factor affecting pain regions; the ≥ 160 cm group had a 42% lower pain level than the < 160 cm group. This is apparently because the < 160 cm group excessively raise their arms when working beside a dental unit chair. These practitioners should use a stool and take breaks during work.

There is growing interest concerning the association between the prevalence of MSD and stress in medical personnel. In particular, increased occupational stress has been shown to be a causative factor of MSD-related pain^(20, 21). In nurses, increased occupational stress and physical and psychological instability were found to be causes of MSDs⁽²²⁾. In radiology technicians, occupational stress, fatigue, and psychosocial stress were associated with the incidence of MSD⁽⁴⁾. In addition, muscle tension, delayed recovery of the musculoskeletal system, and a reduced pain-tolerance threshold in muscle caused by occupational stress, reportedly leads to MSDs⁽²³⁾.

Another study demonstrated that heavy workloads, lack of autonomy in work, ambiguity and simplicity of work, and poor social support are causes of occupational stress⁽²¹⁾. Similar to previous reports, this study showed that occupational stress was a risk factor for increased MSD in dental practitioners. The higher occupational stress group (in terms of task autonomy, organizational system, inappropriate compensation, and workplace culture) showed a significantly higher pain level compared with the lower stress group. In addition, multivariate binary logistic regression showed that the upper 50% group had 1.26 times, 1.16 times, and 1.66 times higher risk of MSDs, compared with the lower 50% group in the categories of physical environment, relation conflict, and organizational system, respectively ($p < 0.01$).

Simple and repetitive work, high perceived work load, and time pressure are likely to lead to occupational stress. In particular, repetitive tasks and excessive workload in dental practitioners are highly likely to cause occupational stress. In addition, the pressure of an appointment reservations system and the acquisition of new techniques can be a cause of psychosocial stress. Thus, this study examined the psychological stress levels of dental practitioners and classified them into three groups to compare the number of pain regions. There were significant differences in pain regions between the severe stress (6.96 regions), potential stress (4.23), and positive well-being groups (2.20) ($p < 0.001$).

Interestingly, the level of psychosocial stress in these subjects was concentrated in the potential stress group. In multivariate binary logistic regression, the possibility of MSD occurrence was 2.36 times higher in the psychosocial stress ≥ 19 points group than in the < 19 points group ($p < 0.01$). In addition, regarding occupational stress, the possibility of MSD occurrence was 1.75 times higher in the upper 50% group than in the lower 50% group ($p < 0.05$). Thus, we showed that two stress factors (psychosocial and occupational stress) can affect the occurrence of MSDs in dental practitioners; in particular, psychosocial stress had greater influence on the occurrence of MSD. According to a report on absence due to illness in the labor market by the Office for National Statistics of the UK, the leading illness that led to absence from work in 2013 was MSD, followed by minor illnesses or stress, depression, and anxiety⁽²⁴⁾. In other words, MSDs must be taken into account in normal work operations, and stress and psychosocial factors must also be managed. Janssens et al. reported that a greater level of control over psychosocial risk factors is important in reducing the risk of MSD in middle-aged workers⁽²⁵⁾.

In conclusion, to increase the quality of life and provide high-quality medical service for dental practitioners, risk factors for MSDs must be managed. Therefore, practitioners must make a habit of maintaining good posture, getting an appropriate amount of rest, and performing regular stretching exercise to reduce psychological stress and improve the work environment. This study had a limitation. Although the sample size was calculated using G * Power software, the sample may not have been sufficient for generalization of the results of the study. Thus, the sample size may have influenced the results for certain variables.

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