

Relationship of Musculoskeletal Disorder Pain to Patterns of Clinical Care in California Dental Hygienists

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Abstract

Purpose: To relate self-reported levels of musculoskeletal disorder (MSD) pain and patterns of clinical care among members of the California Dental Hygienists' Association (CDHA), using a web-based survey.

Methods: The 24-item survey consisted of questions on patterns of clinical care, health habits, experience with MSD pain and demographic information. Recruitment information, including survey link and consent form, was emailed to the CDHA for distribution to its members. Descriptive analysis and cross tabulations were conducted using the online software program Qualtrics™. A Chi-square test determined statistical significant differences between the responses of the no/mild pain and moderate/severe pain groups.

Results: The response rate was 19% (500/2,700). Ninety-six percent of all respondents reported some level of MSD pain, causing nearly 25% of the respondents to miss work. Respondents, who reported moderate/severe pain, treated more patients per day ($p=0.007$) and on average treated greater numbers of moderate to heavy calculus patients ($p=0.017$) than those respondents reporting no/mild pain. Forty percent of the respondents in the moderate/severe group treated more than 8 patients per day. A higher percentage of respondents ($p=0.000$) in the moderate/severe pain group than in the no/mild group reported using proper posture less than 50% of treatment time. Using proper posture more than 50% of treatment time was more frequent in respondents who had practiced more than ($p=0.012$), compared with less than, 5 years.

Conclusion: Workload and ergonomics are related to MSD pain. Educational programs need to emphasize the importance of these factors in the development and reduction of MSD pain.

Keywords: dental hygienists, back pain/etiology, musculoskeletal disease/etiology, occupational disease/etiology, risk factors, dental scaling/adverse effect, hand/pathology, prevalence, pain/epidemiology

This study supports the NDHRA priority area, **Occupational Health and Safety:** Investigate the impact of exposure to environmental stressors on the health of the dental hygienist (aerosols, chemicals, latex, nitrous oxide, handpiece/instrument noise).

INTRODUCTION

Work-related musculoskeletal disorders (MSD) are common in practicing dental hygienists, as well as dental hygiene students.¹⁻⁸ Most MSD adversely affects the upper and lower back, neck, shoulder, arm, hand and wrist, causing pain.⁹⁻¹¹ Even at optimal seating positions more than 50% of the body's muscles are contracted allowing very little movement in the vertebrae.¹⁰ This muscle contraction can lead to micro traumas to the bones, joints, muscles, ligaments, nerves and blood vessels.^{10,12} Studies have shown that MSD pain in the back and neck was related to exposure to static postures and vibration in the workplace.^{4,9,12-16}

The physical burden of clinical dental work is shown to be strongly associated with MSD pain.³ MSD is not due to a single incident, but rather develops over time through repetitive, forceful or awkward movements and positions in the workplace.^{2,12} The symptoms of MSD may present as burning, tingling, numbness, swelling, limited motion or pain in the back, neck, shoulder, arm, hand, and wrist.²

One-third of the time that dental hygienists miss work was found to be due to pain caused by MSD.² It has been suggested that MSD pain in dental hygienists may be a major cause of sick leave, decreased productivity during work and the possibility of disability or early retirement from the profession.^{4,5,11}

While MSD is known to be associated with work-related pain in dental hygienists, more research is needed to identify patterns of clinical care that may be the major contributing factors in MSD pain. The purpose of this quantitative study was to investigate the relationship between self-reported levels of MSD pain and patterns of clinical care among dental hygienists who are members of the California Dental Hygienists' Association (CDHA).

METHODS AND MATERIALS

This cross-sectional study was approved by the University of California San Francisco (UCSF) Institutional Review Board. The study population was ac-

tive voting members of the CDHA, for whom CDHA had email addresses.

The survey was developed based on review of the current literature. The survey was critically pre-tested for feasibility and acceptability by 5 licensed dental hygienists, excluded from the survey. Following the review, the survey was modified accordingly.

The 10-minute survey consisted of 24 items in the following domains: patterns of clinical care (12 multiple-choice questions), health habits (2 multiple-choice questions), experience with MSD pain (6 multiple-choice and 1 Likert-like-scale statements) and demographic information (3 multiple-choice questions).

The study was implemented using the UCSF online survey software program, Qualtrics™. The recruitment letter explaining the study and providing the survey link, as well as the informed consent form, was sent to the CDHA for distribution to its members. Two weeks later, CDHA sent 1 follow-up email message to all its members with a disclaimer stating that if they had already completed the survey to disregard the notice. Participants' response to the survey implied informed consent.

Qualtrics™ software calculated the frequencies of responses for each survey item. An overall pain score was calculated by adding each respondent's self-reported pain on a scale of 0 to 4 for each of the following 8 areas: neck, shoulder, upper back, lower back, hips, arms, wrist and thumb. This score was derived from having the respondents rate their pain from 0 to 4 with 0=no pain, 1=mild ache not noticeable without stopping to think about it, 2=definite ache that makes you consciously uncomfortable, 3=ache that causes you to pause or discontinue treatment of a patient, and 4=numbness and/or tingling. The sum of the ratings of each area represented the overall pain score, with a potential range of 0 to 32. Based on the pain score, respondents were divided into 2 groups: no/mild pain (0 to 8) and moderate/severe pain (9 to 32). The Chi-squared test was conducted to compare the responses of the 2 groups. A p-value <0.05 was used to determine statistical significant differences between the 2 pain groups.

RESULTS

Of the approximate 2,700 active voting members of the CDHA, 500 members responded, resulting in a response rate of 19%. Because 12 surveys were completely blank, results are based on 488 respondents. Nearly half the respondents were born between 1950 and 1969 (49 to 64 years of age) (Table I). Respondents were mostly female and Caucasian (non-Hispanic). The majority of respondents were

Table I: Characteristics of Study Sample (n=488)

	n	Percent of Respondents
Years of birth		
1940 to 1949	60	13
1950 to 1959	125	27
1960 to 1969	106	22
1970 to 1979	60	12
1980 to 1989	107	23
1990 to 1999	13	3
Gender		
Female	468	97
Male	14	3
Race/Ethnicity		
African American	6	1
Asian or Pacific Islander	46	10
Caucasian (Non-Hispanic)	370	77
Hispanic or Latino	38	8
Other	22	5
Currently practicing clinical dental hygiene		
Yes	415	86
No	67	14
Years practiced		
0 to 2	78	16
3 to 5	58	12
6 to 9	44	9
10 or more years	303	63
Days per week practiced		
1 to 2	93	19
3 to 4	316	65
5 to 7	79	16
Hours per day practiced		
1 to 3	5	1
4 to 6	27	5
7 to 8	411	85
>8	43	9
Patients treated per day		
<8	317	66
>8	164	34
Minutes per appointment		
15 to 30	15	3
31 to 45	46	9
46 to 60	420	86
>60	6	1

Table II: Respondents' Patterns of Practice: Comparison of the No/Mild and Moderate/Severe Pain Groups of Respondents

Patterns of Practice	No/Mild Pain		Moderate/Severe Pain		p-value
	n	Percent of Respondents	n	Percent of Respondents	
Years of birth					
1940 to 1949	40	14	20	11	0.240
1950 to 1959	85	29	40	22	
1960 to 1969	58	20	48	27	
1970 to 1979	40	14	20	11	
1980 to 1989	62	21	46	26	
1990 to 1999	7	2	6	3	
Years practiced					
0 to 2	49	16	32	17	0.530
3 to 5	36	12	24	13	
6 to 9	26	9	17	9	
>10	192	63	112	61	
Days practiced					
1 to 2	66	22	27	15	0.095
3 to 4	186	61	130	70	
5 to 7	51	17	28	15	
Hours per day practiced					
1 to 3	2	1	3	1	0.440
4 to 6	16	5	11	6	
7 to 8	260	86	151	82	
>8	23	8	20	11	
Patients treated per day					
<8	213	71	111	60	*0.007
>8	88	29	74	40	
Minutes per appointment					
15 to 30	6	2	9	5	0.140
31 to 45	30	10	16	9	
46 to 60	264	87	156	84	
>60	2	1	4	2	
Average amount of deposits					
<light-moderate	225	75	118	64	*0.017
>moderate	77	25	66	36	

Sample sizes varied

*Significant differences between the two groups ($p < 0.05$)

currently employed as clinical dental hygienists, and most have worked for 10 or more years. Most respondents indicated that they practiced 3 to 4 days per week, 7 to 8 hours per day and treated 8 or fewer patients per day, with 46 to 60 minute appointment times (Table I).

Ninety-six percent of the respondents reported

suffering some level of pain. A quarter of the respondents reported having taken time off work due to MSD pain, and 53% of them reported taking 1 to 2 days off work per month.

The pain scores of the respondents ranged from 0 to 29 out of a possible 32 with the mean of 7, median of 7 and a mode of 3. Based on the pain score,

292 to 303 respondents were in the no/mild pain group, and 180 to 185, in the moderate/severe pain group. The numbers per item varied due to not all respondents answering all questions.

The majority of respondents, reporting moderate/severe pain, exhibited similar patterns of clinical practice as the total group: practiced for 10 or more years, 3 to 4 days per week, and 7 to 8 hours per day; treated 8 or less patients per day for 46 to 60 minutes; and mainly patients with light-moderate to moderate amounts of calculus (Table II). Forty percent of the respondents, reporting moderate to severe pain, treated more than 8 patients per day. Furthermore, the percentage of respondents in the moderate/severe pain group who treated more than 8 patients per day was significantly higher ($p=0.007$) than the percentage in the no/mild pain group. Also, the frequency of respondents with moderate/severe pain, who treated patients with greater than or equal to moderate amount of calculus, was significantly greater ($p=0.017$) than those with no/mild pain (Table II). Age, determined by decade of birth, was not related to moderate/severe pain.

The neck was the most common location of moderate/severe pain in respondents in the moderate/severe pain group (Table III). Moderate to severe pain in the shoulder, upper back and lower back was also reported by nearly one-third of these respondents (Table III).

Most respondents in both the no/mild and moderate/severe pain groups used the ultrasonic instrument for less than 50% of the appointment and wore magnification lenses or loupes for more than 4 hours per day (Table IV). A higher percentage of those reporting no/mild pain indicated they exercised more than 3 days per week, whereas the percentages of those with moderate/severe pain, who exercised less than and more than 3 days per week, were fairly comparable (Table IV). Using proper posture during clinical care greater than 50% of the treatment time was reported by the majority of those with no/mild pain, but only by half the moderate/severe pain group (Table IV). The difference between these 2 groups was significantly different ($p=0.000$).

A significantly greater percentage of respondents ($p=0.012$) who have practiced more than 5 years reported using proper posture during clinical care greater than 50% of the treatment time, as compared with those who have practiced 5 or less years (Table V).

Over half of the respondents reported that they had sought treatment for their MSD pain. Over 25% reported being referred to a chiropractor. Additional

Table III: Body Region of MSD Pain in the Moderate/Severe Pain Group of Respondents

Location	Moderate/Severe Pain Respondents	
	n	Percent
Neck	162	41
Shoulder	169	35
Upper Back	145	30
Lower Back	143	30
Hips	84	18
Arms	94	20
Wrist	101	22
Thumb	117	25

recommended treatment options were taking time off work, referral for an MRI, CT scan or X-rays, or referral to a specialist. Half of the respondents indicated other types of treatments, and specified the recommendations which they had received. Twenty-five percent specified physical therapy. Nearly half of the respondents received recommendation for a combination of two or more of the treatment options.

DISCUSSION

This study examined the relationship of self-reported MSD pain and factors associated with patterns of clinical care among active, voting members of the CDHA. MSD pain was found to be a major problem in practicing clinical dental hygienists, as almost all the respondents reported having some level of pain. Other studies also have demonstrated this occupational risk.¹⁻⁸ Nearly a quarter of the respondents reported taking days off work because of MSD pain. This finding supports other studies that state MSD pain is a major cause of dental hygienists' taking time off work.^{8,17}

The results indicated that workload was related to MSD pain: respondents, who reported moderate/severe pain, treated significantly more patients per day than those respondents reporting no/mild pain, and 40% treated more than 8 patients per day. This relationship is consistent with studies in the literature: dental hygienists working increased hours had more wrist pain, compared to those practicing less hours,¹² and dental hygienists had more shoulder pain when working more than 4 days per week and had greater wrist/hand pain when their duration of work increased.¹³ Another major predictor of pain in this study was the average amount of calculus deposits on the respondents' patients: heavier deposits related to more pain. These finding may indicate that applying greater force when trying to remove

Table IV: Use of Ultrasonic Instruments, Loupes, Proper Posture and Exercise by Respondents: No/Mild and Moderate/Severe Pain Groups

	No/Mild		Moderate/Severe Pain		p-value
	n	Percent	n	Percent	
Ultrasonic instrument use					
≤50% of appointment	257	85	148	80	0.122
>50% of appointment	44	15	37	20	
Loupes use					
≤4 hours	109	36	62	34	0.573
>4 hours	192	64	122	66	
Proper posture use					
<50% of appointment	90	30	96	52	*0.000
>50% of appointment	211	70	89	48	
Exercise					
<3 days/ week	118	39	85	46	0.143
>3 days/week	183	61	100	54	

*Significant differences between the 2 groups (p<0.05)

heavy deposits of calculus may lead to more pain. Accordingly, a correlation between the number of heavy calculus patients and symptoms of carpal tunnel syndrome has been reported.¹³

The use of ultrasonic scalers versus hand scaling on patients with heavy deposits was not addressed in this study. However, it is interesting to note that 36% of the moderate/severe pain group reported their average amount of deposits being moderate, while the percentage using ultrasonic scalers >50% of the appointment was only 20% of these respondents. This may indicate that not all in the moderate/severe pain groups may be maximizing the use of ultrasonics on patients with heavy deposits. Using ultrasonics on patients with heavy deposits may prevent or minimize MSD.

The predominant locations of MSD pain in the moderate/severe group of respondents were similar to those in dental hygiene students, reported by Hayes et al.⁴ These researchers reported that in 3 classes of students the prevalence for MSD pain, defined as persistent greater than 2 days and comparable to moderate/severe pain, was, as follows: neck (44 to 46.3%, lower back (39 to 46%), shoulders (29.3 to 32%) and upper back (22 to 34.1%). These percentages for specific body regions were similar to ours for practicing dental hygienists. Morse and colleagues compared dental hygiene students, dental hygiene students with prior experience as dental assistants and experienced dental hygienists in terms of prevalence of MSD in the neck and shoulder.¹⁸ In those 3 populations neck symptoms were reported as 37%, 43% and 72%, respectively. Shoulder symptoms were 11%, 20%

Table V: Use of Proper Posture Related to Number of Years Practicing as a Dental Hygienist

	Correct posture used >50% of treatment		
	n	Percent	p-value
Practiced <5 years	75	25	*0.012
Practiced >5 years	227	75	

*Significant differences between the 2 groups (p<0.05)

and 35%, respectively. In the current study, the percentage for shoulder pain was comparable to the data for practicing dental hygienists, but lower for neck pain (41%).

Morse and colleagues also studied risk factors in the same 3 populations.¹⁸ They demonstrated statistically significant stepwise progressions for these risk factors: often or very often working with a bent or twisted neck, static posture (holding same position, unsupported), precise hand motions, and hand/arm repetition. These risk factors support the findings that a higher percentage of respondents with more pain reported that they used proper posture less than 50% of the time. Poor posture during clinical procedures often occurs when the dental hygienist tries to avoid indirect vision, causing forward trunk flexion and shoulder elevation.¹³ Poor working position is thought to be the main risk factor for MSD pain according to the results of Marklin and Cherney.¹⁹ In addition, the current study found

that respondents, practicing more than 5 years, used proper posture more than 50% of the time. It seems that the more experienced dental hygienists have learned the importance of proper posture through experience. The lack of proper posture from respondents who have been practicing for less than 5 years indicates a need to have more or improved ergonomic instruction and evaluation during dental hygiene educational programs.

The number of respondents reporting pain in the neck and shoulders is not surprising since repetitive scaling has been linked to upper body pain.^{4,9,12-16} This link is supported by the results of another study that showed a correlation between MSD pain in dental hygiene students and performing tasks such as hand scaling and ultrasonic scaling.²⁰ This correlation indicates the importance of finding ways to change patterns of clinical practice in order to reduce the amount of repetitive motion that is leading to MSD pain. Dental hygienists working in orthodontic practices have been reported to have less MSD pain than those working in a general dental or periodontal offices, a result that the authors suggested was due to dental hygienists in orthodontic practices generally performing a wider range of duties and less repetitive scaling tasks throughout the day.¹² Their data would suggest that repetitive scaling accounts for most of MSD in dental hygienists.

The use of loupes has the potential to minimize MSD pain. Previous studies of dental hygiene students have demonstrated that wearing magnification lenses or loupes improved head and neck positions and decreased neck, shoulder and back pain.^{21,22} However, in this study the percentages of respondents wearing loupes for less than or for more than 4 hours did not differ between the no/mild pain and moderate/severe pain groups. The differing results may be due to the fact that the study population was not students, but practicing dental hygienists with a higher workload, less supervision on posture and less breaks while treating the patient. On the other hand, it has also been reported that licensed dental hygienists, using loupes as an adjunct to proper posture, maintained the health of their musculoskeletal system.²²

Simply wearing loupes for a specified number of hours may not have been the critical issue to distinguish no/mild pain from moderate/severe pain. When these data are related to percentage of time using proper posture, 66% of the moderate/severe pain group uses loupes, but only 48% reported that they used proper posture. Thus, some respondents are not using proper posture while wearing loupes, and more experienced ones may have acquired proper posture habits without the benefit of loupes. Wearing loupes does not guarantee proper posture. Research projects need to be conducted to

compare the types of loupes on the market in terms of factors, such as operator positioning. To study the interrelationship of loupes, proper posture and pain, one would need to photograph loupe-wearing participant to observe and record whether loupe-wearing does maintain proper posture. Loupes were not the central theme of this study, therefore the subject was not further explored.

These results show that exercise may not be a factor relating to MSD pain. The literature regarding the effectiveness of exercise in reducing MSD pain is mixed. Some studies, such as the current study, have found that there are minimal benefits of exercise on MSD pain,^{23,24} while other studies suggest exercising reduces the amount of MSD pain.^{25,26} This study did not inquire whether exercises were specifically addressing MSD. Additional studies need to be conducted to determine what specific types of exercise, if any, are best able to reduce pain from MSD, as certain exercises may even worsen the muscle imbalances of dental hygienists. Exercise and personal fitness programs should also be evaluated to determine whether they help prevent and minimize MSD pain.

The low response rate limits the ability to generalize these results to all CDHA members or to clinical dental hygienists in general. The fact that the survey was only distributed to CDHA members, for whom CDHA had email addresses, also would have caused the results not to be generalizable to all CDHA members. Also, the initial distribution of the survey to the CDHA membership contained a faulty survey link, which may have deterred dental hygienists from responding to the correct link when it was sent a few hours later. The lack of responses may also be due to a potential lack of interest on the topic from dental hygienists without pain, which may have exaggerated the percentage of respondents with MSD pain. Additionally, it is possible that dental hygienists who have retired due to MSD pain may no longer be members of CDHA, therefore minimizing the percentage of respondents with moderate and severe pain. Another limitation is that the term "proper posture" was not defined for the respondents and was self-reported. This subjective assessment could be influenced by many factors including the use of loupes.

CONCLUSION

The findings in this study indicate that workload and ergonomics are related to MSD pain. Educational programs need to emphasize the importance of these factors in the development and reduction of MSD pain among dental hygienists. Extensive ergonomics instruction and evaluation during dental hygiene educational programs may be able to prevent the

development of MSD pain in newly educated dental hygienists. Development of continuing education classes that allow experienced hygienists to access new information and techniques may minimize ergonomic risk factors associated with MSD. Recommendations to take frequent breaks from the repetitive motion of scaling and decrease workload during the workday may minimize muscle fatigue and thus pain. MSD is a multi-factorial disorder that requires further investigation into the many possible solutions.

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REFERENCES

1. Chismark A, Asher G, Stein M, Tavoc T, Curran A. Use of complementary and alternative medicine for work-related pain correlates with career satisfaction among dental hygienists. *J Dent Hyg.* 2011;85(4):273-284.
2. Hamman C, Werner R, Rhode N, Rodgers P, Sullivan K. Upper extremity musculoskeletal disorder in dental hygiene: Diagnosis and options for management. American Dental Association [Internet]. 2004 [cited 2013 July 20]. Available from: http://www.ada.org/sections/professionalresources/pdfs/ergonomics_ce_musculoskeletal.pdf
3. Hayes M, Cockrell D, Smith DR. A systematic review of musculoskeletal disorders among dental professionals. *Int J Dent Hyg.* 2009;7(3):159-165.
4. Hayes M, Smith D, Taylor J. Musculoskeletal disorders in a 3 year longitudinal cohort of dental hygiene students. *J Dent Hyg.* 2014;88(1):36-41.
5. Hayes M, Smith D, Cockrell D. Prevalence and correlates of musculoskeletal disorders among Australian dental hygiene students. *Int J Dent Hyg.* 2009;7(3):176-181.
6. Anton D, Rosecrance J, Merlino L, Cook T. Prevalence of musculoskeletal symptoms and carpal tunnel syndrome among dental hygienists. *Am J Ind Med.* 2002;42(3):248-257.
7. Puriene A, Janulyte V, Musteikyte M, Bendinskaite R. General health of dentists. literature review. *Stomatologija.* 2007;9(1):10-20.
8. Hayes MJ, Smith DR, Cockrell D. An international review of musculoskeletal disorders in the dental hygiene profession. *Int Dent J.* 2010;60(5):343-352.
9. Punnett L, Wegman D. Work-related musculoskeletal disorders: The epidemiologic evidence and the debate. *J Electromyogr Kines.* 2004;14:13-23.
10. Valachi B, Valachi K. Preventing musculoskeletal disorders in clinical dentistry: Strategies to address the mechanisms leading to musculoskeletal disorders. *J Am Dent Assoc.* 2003;134(12):1604-1612.
11. Khan S, Chew K. Effect of working characteristics and taught ergonomics on the prevalence of musculoskeletal disorders amongst dental students. *BMC Musculoskelet Disord.* 2013;14:118-125.
12. Hayes MJ, Taylor JA, Smith DR. Predictors of work-related musculoskeletal disorders among dental hygienists. *Int J Dent Hyg.* 2012;10(4):265-269.
13. Liss GM, Jesin E, Kusiak RA, White P. Musculoskeletal problems among Ontario dental hygienists. *Am J Ind Med.* 1995;28(4):521-540.
14. Åkesson I, Johnsson B, Rylander L, Moritz U, Skerfving S. Musculoskeletal disorders among female dental personnel—clinical examination and a 5-year follow-up study of symptoms. *Int Arch Occup Environ Health.* 1999;72(6):395-403.
15. Ylipaa V, Arnetz BB, Preber H. Predictors of good general health, well-being, and musculoskeletal disorders in Swedish dental hygienists. *Acta Odontol Scand.* 1999;57(5):277-282.
16. Pargali N, Jowkar N. Prevalence of musculoskeletal pain among dentists in Shiraz, southern Iran. *Int J Occup Med Environ Health.* 2010;1(2):69-74.
17. Osborn JB, Newell KJ, Rudney JD, Stoltenberg JL. Musculoskeletal pain among Minnesota dental hygienists. *J Dent Hyg.* 1990;64(3):132-138.
18. Morse T, Bruneau H, Michalak-Turcotte C, et al. Musculoskeletal disorders of the neck and shoulder in dental hygienists and dental hygiene students. *J Dent Hyg.* 2007;81(1):1-16.

19. Marklin R W, Cherney K. Working postures of dentist and dental hygienists. *J Can Dent Assoc.* 2005;33:133-136.
20. Morse T, Michalak-Turcotte C, Atwood-Sanders M, et al. A pilot study of hand and arm musculoskeletal disorders in dental hygiene. *J Dent Hyg.* 2003;77(3):173-179.
21. Branson B, Bray K, Gadbury-Amyot C, et al. Effect of magnification lenses on student operator posture. *J Dent Educ.* 2004;68(3):384-389.
22. Sunell S, Rucker L. Ergonomic risk factors associated with clinical dental hygiene practice. *Probe.* 2003;37(4):159-66.
23. Nurminen E, Malmivaara A, Ilmarinen J, et al. Effectiveness of worksite exercise program with respect to perceived work ability and sick leaves among women with physical work. *Scand J Work Environ Health.* 2002;28(2):85-93.
24. Gram B, Holtermann A, Bultmann U, et al. Does an exercise intervention improving aerobic capacity among construction workers also improve musculoskeletal pain, work ability, productivity, perceived physical exertion, and sick leave? *J Occup Environ Med.* 2012;54(12):1520-1526.
25. Hildebrandt VH, Bongers PM, Dul J, et al. The relationship between leisure time, physical activities and musculoskeletal symptoms and disability in worker populations. *Int Arch Occup Environ Health.* 2000;73:507-18.
26. Horton SJ, Wade KJ. Exercise intervention for a musculoskeletal disorder in an oral health student: A case report. *N Z Dent J.* 2013;109(1):12.