

# Prevalence of Musculoskeletal Disorders Symptoms among Czech Dental Students. Part 1: a Questionnaire Survey

Martin Kapitán<sup>1,\*</sup>, Nela Pilbauerová<sup>1</sup>, Lenka Vavříčková<sup>1</sup>, Zdeňka Šustová<sup>1</sup>, Stanislav Machač<sup>2,3</sup>

## ABSTRACT

Musculoskeletal disorders (MSDs) frequently occur among dentists and dental students. The first aim of this study was to gather and analyze information about the prevalence of symptoms of MSDs. The second aim was to determine a correlation between subjectively described complaints and the results of an objective examination of the spine using the Spinal Mouse® device; that part is described in the second section of this article. Dental students of the first, third and fifth years at Charles University, Faculty of Medicine in Hradec Králové were included. The participants filled out a questionnaire regarding the prevalence of symptoms of MSDs and the potential risk factors. From a total of 182 students that participated in this study, 71 reported musculoskeletal pain (prevalence 39%). The musculoskeletal pain was more frequent among women. During the studies its prevalence increased. The most frequent areas of pain were neck, lower back and upper back. The results indicate that musculoskeletal pain often begins and continues to develop throughout the dentistry studies.

## KEYWORDS

dentistry students; musculoskeletal disorders; questionnaire survey

## AUTHOR AFFILIATIONS

<sup>1</sup> Department of Dentistry, Charles University, Faculty of Medicine in Hradec Králové, and University Hospital Hradec Králové, Hradec Králové, Czech Republic

<sup>2</sup> Institute of Sports Medicine, Prague, Czech Republic

<sup>3</sup> Department of Rehabilitation and Sports Medicine, Charles University, 2nd Faculty of Medicine, and Motol University Hospital, Prague, Czech Republic

\* Corresponding author: Department of Dentistry, University Hospital Hradec Králové, Sokolská 581, 500 05, Hradec Králové, Czech Republic; kapitánm@lfhk.cuni.cz

Received: 5 August 2018

Accepted: 29 November 2018

Published online: 22 January 2019

Acta Medica (Hradec Králové) 2018; 61(4): 131–136

<https://doi.org/10.14712/18059694.2018.131>

© 2018 The Authors. This is an open-access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

## INTRODUCTION

Musculoskeletal disorders (MSDs) are diseases of the musculoskeletal apparatus affecting muscles, tendons, joints, nerves and supporting structures. The dominant symptoms are: frequently occurring pain, a failure of coordinated stabilization (as a function of the neuromuscular system), a restricted range of motion, and is often accompanied by a decrease of muscular strength of certain muscle groups. Apart from pain, other subjective signs are stiffness of muscles and joints, tingling and feeling of warmth or cold. If work is assumed to initiate or develop these symptoms, then they are referred to as work-related musculoskeletal disorders (WRMSDs) (1).

The prevalence of MSDs among dentists was between 62% and 91% (2–10). The most frequent areas of pain are neck, shoulders, lower back, hands and wrists (3, 5, 7, 8, 10–16). In the dental profession there are many risk factors which combine and can contribute to initiation and development of MSDs. These risk factors include mainly a long-term static position, forced unnatural posture during work, doing tasks with small instruments using a large force, small working field with limited access, intensive lighting, noise and psychosocial stress (5, 12, 13, 17–19). Another factor which is considered negative is a lack of adequate physical activities (20).

MSDs begin from dental school studies with an prevalence among students between 44% and 93% (2, 21–27). Students of the final two years suffer from musculoskeletal pain more often than the students of the first two years (28).

The aim of this study was to gather and analyze information about the prevalence of symptoms of MSDs and the role of potential risk factors among dental students. The second aim was to determine a correlation between subjectively described complaints and the results of an objective examination of the spine using the Spinal Mouse® device; this is described in the second part of this article. The results could contribute to understand the early development of MSDs among dental students and to find out possible risk factors detectable during the objective examination.

## MATERIAL AND METHODS

Students of the current first, third and fifth years of the study program Dentistry at Charles University, Faculty of Medicine in Hradec Králové, in academic years 2014/2015 and 2015/2016 were included in this study. The collection of data for this study started in October 2014 and was finished in May 2016. The participation was voluntary. All the participants signed an informed consent. The students were examined at the beginning of their studies (the beginning of the first year), before the start of the clinical part of their studies (the beginning of the summer term of the third year) and at the end of their studies (the end of the fifth year). The only inclusion criterion was that the student was currently studying in the included year of studies as described above. No exclusion criteria were applied. There were no students

repeating the particular year, who would have participated twice in the study.

This study was approved by the Ethics committee of University Hospital Hradec Králové (Ref. no. 201410 S04P) and by the dean of the Charles University, Faculty of Medicine in Hradec Králové.

A questionnaire survey was performed among the participants to gather the required information about the respondents and their complaints. The questionnaire was created by the authors and was based on other similar studies (5, 6, 8–10, 13, 29). The questionnaire consisted of the questions of the following areas:

- Personal information of the respondents (i.e. gender, age, weight and height).
- General health status, medication and allergies.
- Factors possibly influencing the development of MSDs (i.e. dominant hand, musculoskeletal diseases in the family history, in the personal medical history and the sport activity).
- Currently experienced musculoskeletal pain and its consequences.
- Respondents' opinions on dentistry studies (e.g. whether the participant consider the dentistry studies as psychically demanding; if the level of ergonomic education is sufficient; and whether they had known before they were making the decision about their further profession, that 2 out of 3 dentists suffered from musculoskeletal disorders).

The questionnaire was distributed to all possible participants, i.e. to all students currently studying in the included years of studies. A total of 192 questionnaires were distributed.

The collected data were statistically analyzed in the NCSS 10 Statistical Software (2015; NCSS, LLC. Kaysville, Utah, USA, [ncss.com/software/ncss](http://ncss.com/software/ncss)) using methods of descriptive statistics, two-sample t-test, nonparametric Mann-Whitney test, Kolmogorov-Smirnov test, nonparametric Kruskal-Wallis analysis of variance with post hoc Dunn's test with Bonferroni modification and Pearson's  $\chi^2$  test of independence in contingency tables or Fisher's exact test. The level of statistical significance was set to  $\alpha = 0.05$ .

## RESULTS

A total of 182 students participated in this study; there was a response rate of 94.8%. The student's information is summarized in Table 1. As the data were not distributed normally, the median values along with the first and the third quartiles are presented. Table 2 presents the anamnestic data of the respondents' and their influence on the prevalence of musculoskeletal pain. Pain of the musculoskeletal apparatus was declared by 39% of the respondents ( $n = 71$ ). The differences of a prevalence of musculoskeletal pain between men and women and between the years of studies are summarized Table 3. The age, height, weight and BMI didn't present any statistically significant influence on the prevalence of musculoskeletal pain.

**Tab. 1** Information about the respondents' gender, age, height, weight and BMI in individual years and in total.

	No.	Men	Women	Age [years]	Height [cm]	Weight [kg]	BMI
		% (n)	% (n)	median (Q1; Q3)	median (Q1; Q3)	median (Q1; Q3)	median (Q1; Q3)
1st year	65	26.2 (17)	73.9 (48)	20 (19; 20)*	170 (165; 176)	62 (56; 68)	21.3 (19.8; 22.7)
3rd year	61	31.2 (19)	68.9 (42)	22 (21; 22)*	173 (168; 178)	63 (57; 71,5)	21.6 (20.1; 23.5)
5th year	56	41.1 (23)	58.9 (33)	24 (24; 25)*	173 (167; 179)	65.5 (60; 80)	22.4 (20.3; 24.4)
Total	182	32.4 (59)	67.6 (123)	22 (20; 24)	173 (166; 178)	63 (57; 71)	21.6 (20.1; 23.5)

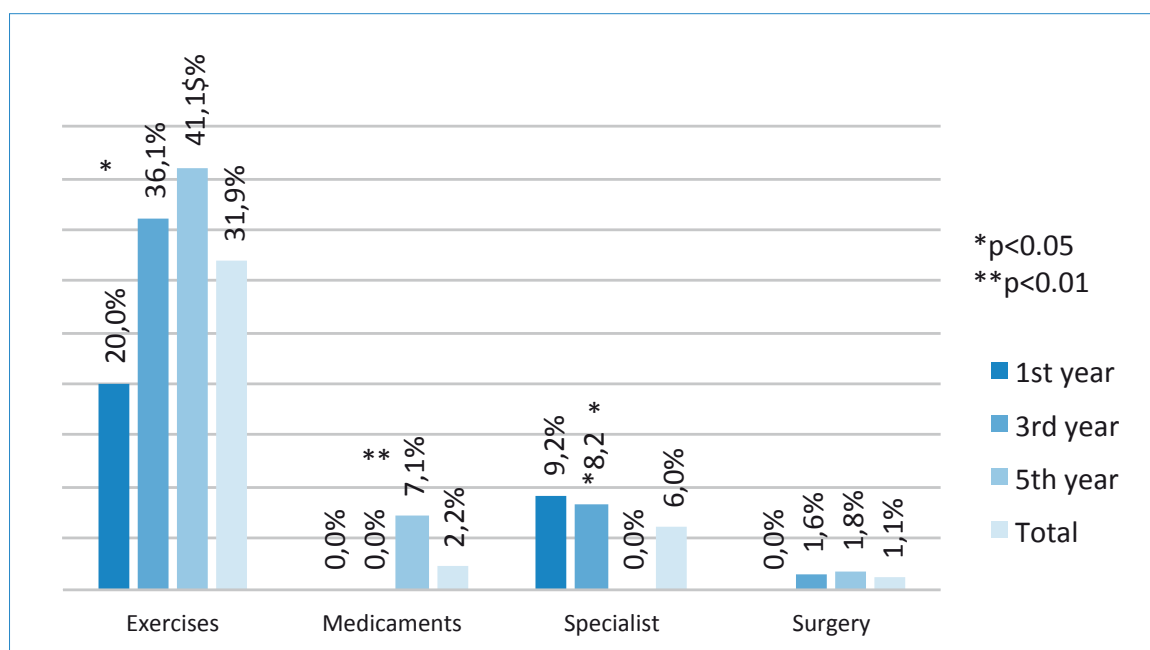
\*p &lt; 0.001

**Tab. 2** Anamnestic data of the respondents and their influence on musculoskeletal pain.

		Respondents	Musculoskeletal pain	
		% (n)	% (n)	
General disease	yes	13.2 (24)	58.3 (14)	p < 0.05
	no	86.8 (158)	36.1 (57)	
Regular medicaments intake	yes	28.0 (51)	58.8 (30)	p < 0.001
	no	72.0 (131)	31.3 (41)	
Smoking	yes	3.9 (7)	28.6 (2)	NS
	no	96.2 (175)	39.4 (69)	
Dominant hand	right	89.6 (163)	38.0 (62)	NS
	left	10.4 (19)	47.7 (9)	
Occurrence of the musculoskeletal system disease among blood relatives	yes	45.6 (83)	49.4 (41)	p < 0.01
	no	54.4 (99)	30.3 (30)	
Congenital disease of the musculoskeletal system	yes	5.0 (9)	88.9 (8)	p < 0.01
	no	95.0 (173)	36.4 (63)	
Severe disease or injury of the musculoskeletal system	yes	15.4 (28)	53.6 (15)	NS
	no	84.4 (154)	36.4 (56)	
Top-level sport now or in the past	yes	26.4 (48)	43.8 (21)	NS
	no	73.6 (134)	37.3 (50)	
Regular physical activity at least once a week	yes	81.3 (148)	38.5 (57)	NS
	no	18.7 (34)	41.2 (14)	

**Tab. 3** An influence of gender and year of studies on the musculoskeletal pain.

		Musculoskeletal pain	
		% (n)	
Gender	male	28.8 (17)	p = 0.05
	female	43.9 (54)	
Year of studies	first	23.2 (19)	NS
	third	44.3 (27)	
	fifth	44.6 (25)	



**Chart 1** Ways of solving the musculoskeletal pain.

Chart 1 shows the ways in which the respondents solved their musculoskeletal pain. In 10.4% of respondents ( $n = 19$ ) the musculoskeletal pain had an influence on their lifestyle. A total of 56.6% of the respondents ( $n = 103$ ) did not know that approximately 2 out of 3 dentists suffer from MSDs, when they were making the decision about their future profession.

From the third and fifth year students 21.4% of them ( $n = 25$ ) opined, that dentistry studies contributed to the initiation or development of their problems. More female students (28.0%;  $n = 21$ ) than male students (9.5%;  $n = 4$ ) ( $p < 0.05$ ) stated this assumption. Dentistry studies were considered as psychologically demanding by 88.0% ( $n = 117$ ) of the third and fifth years. The students of the third year considered dentistry studies as psychologically demanding more often (96.7%,  $n = 59$ ) than the students of the fifth year (78.6%,  $n = 44$ ). This difference was statistically significant ( $p < 0.01$ ). Statistically significantly more female students (93.3%,  $n = 70$ ) than male students (78.6%,  $n = 33$ ) considered

dentistry studies as psychologically demanding ( $p < 0.05$ ). The extent of ergonomic education was assessed as sufficient by 81.2% ( $n = 50$ ) of the third and fifth year students; more often by the third year students (90.2%,  $n = 55$ ) than the fifth year students (71.4%,  $n = 40$ ). This difference was statistically significant ( $p < 0.05$ ).

Table 4 shows the declared intensity of pain in different body regions. For further statistical analysis the answers no + mild and moderate + severe were connected. Female students declared headaches and neck pain more often than male students ( $p < 0.05$ ). Older students declared lower back pain more often than younger students ( $p < 0.05$ ). No other statistically significant relationship between the anamnestic data and pain in different body regions was found.

The general health status was assessed as very good by 50.0% of respondents ( $n = 91$ ); as good by 43.4% of respondents ( $n = 79$ ); and as satisfactory by 6.6% of respondents ( $n = 12$ ). No respondent assessed the general health status as bad or very bad.

**Tab. 4** Declared intensity of pain in different body regions.

	Intensity of pain			
	No % (n)	Mild % (n)	Moderate % (n)	Severe % (n)
Headache	63.7 (116)	23.1 (42)	12.1 (22)	1.1 (2)
Neck pain	53.8 (98)	29.1 (53)	15.4 (28)	1.6 (3)
Upper back pain	73.6 (134)	23.6 (43)	2.7 (5)	0 (0)
Low back pain	54.4 (99)	35.2 (64)	8.2 (15)	2.2 (4)
Shoulders pain	80.2 (146)	15.4 (28)	3.3 (6)	1.1 (2)
Elbows pain	97.3 (177)	2.7 (5)	0 (0)	0 (0)
Wrists/hands pain	78.6 (143)	17.0 (31)	2.2 (4)	2.2 (4)
Hips pain	88.5 (161)	8.8 (16)	2.2 (4)	0.5 (1)
Knees pain	79.1 (144)	14.8 (27)	5.5 (10)	0.5 (1)
Ankles/feet pain	86.8 (158)	11.0 (20)	2.2 (4)	0 (0)

## DISCUSSION

A questionnaire survey was chosen as a study design to accomplish the first aim of this study. A questionnaire survey is often used in similar studies, because it is a cheap and relatively fast method with a sufficient value of gathered information, however, it is not possible to verify its truthfulness and accuracy. The questionnaire for this study was created by a combination of questionnaires from other studies (5, 6, 9, 10, 13, 29) and from a pilot study performed by the authors among the dentists (8). It covered information about relevant personal information, possible risk factors, currently experienced musculoskeletal pain and opinions of the respondents related to musculoskeletal pain, ergonomics and dental education.

The participants of this study were students in three important moments of their studies: Students at the beginning of the first year represented the initial default status. These students were not subjected to any influences related to dentistry studies/profession yet, thus, no control study was involved in this evaluation. Students in the middle of the third year represented the turning point between the preclinical and clinical phase of their studies. The students at the end of the fifth year represented the situation at the end of their studies. The study was performed in two subsequent academic years to gather a sufficient number of participants. About 1/3 of them were men and 2/3 were women. This corresponds with the gender distribution among dentists in the Czech Republic (30) and also in the study of Diaz-Caballero et al. (22).

The prevalence of musculoskeletal pain among dental students in this study was lower than in other studies (2, 21–27). In accordance to other studies the prevalence of musculoskeletal pain was higher in women than men (2, 6, 21, 23, 25, 28, 31), nevertheless, the difference was on the limit of statistical significance. A difference was found between the years of studies, however it was not statistically significant. An increase of musculoskeletal pain prevalence was seen between the first and the third year. In the following years, the prevalence didn't change more significantly. Thus, it can be assumed that dentistry studies could contribute to the initiation and development of musculoskeletal pain, particularly in the preclinical part. An important factor may also be a lifestyle with a lack of adequate physical activity. It is likely, that a long-term influence of the forced position on the prevalence of musculoskeletal pain manifests mainly after the end of the studies, i.e. after the beginning of daily dental work.

The most frequent areas of pain were neck, lower back and upper back. This finding is in accordance with other studies (3, 5, 7, 10–16, 22, 25). Also, headaches were rather frequent; however, this is not classified as MSDs. An important factor for headache is the psychological stress, which was felt by the majority of the students. The third year students and female students considered dentistry studies as psychically demanding more often than fifth year students and male students. The reason may be that during their studies the students gradually become accustomed to deal with a lot of various demands. The female students, for their generally higher conscientiousness, approach the task solving with higher responsibility and mental engagement and they deal with overloading and sectional failures worse than male students (17).

The presence of general disease and permanent medication had a negative influence on the prevalence of musculoskeletal pain. These factors were not analyzed in detail within the scope of this study. The musculoskeletal pain was more frequent in students with a prevalence of musculoskeletal disease in their blood relatives and in students with a congenital disease of the musculoskeletal system. Other followed factors didn't present any influence on the prevalence of musculoskeletal pain. Hodačová et al. (6) found an influence of the severe disease or injury of the locomotive apparatus on the musculoskeletal pain among dental practitioners. In the study of De Carvalho et al. (21) regularly doing exercises didn't have any influence on musculoskeletal pain, whereas Shirzaei et al. (28) proved a lower average intensity of pain in students, who did stretching after the patients treatment. In the study of Sharma et al. (20) 80% of responding dentists declared, that the cause of their pain was the lack of physical activity. Yi et al. (16) showed that regular exercise decreases the prevalence of musculoskeletal pain. In this study 81.3% of the respondents declared regular physical activity at least once a week. This factor didn't have a statistically significant influence on the prevalence of musculoskeletal pain.

Only 1/5 of the students thought that dentistry studies had an influence on the initiation and development of their problems. Of the 1/5 of the students, more were women. The authors assume that the students had not realized the possible relationships between their future profession and the potential difficulties.

More than 1/2 of the students were aware of the fact that two out of three dentists suffer from MSDs, when they were making the decision about their future profession. This is an important negative aspect of the dental profession and the authors believe that young people considering to choose dentistry as their profession have the right to be informed in advance. Thus, all the students should have been aware of that.

Although the third year students mostly considered the ergonomic education as sufficient, the prevalence of musculoskeletal pain increased between the first and the third year. The authors assume that even if the students have a sufficient knowledge of dental ergonomics, they are not able to apply all the recommendations during the preclinical practical lessons. Several reasons may play a role, such as underestimation of MSDs in dentistry by students; stress, which was more frequently perceived by the third year students; and restricted possibility of work in the correct position and in an indirect vision, because the students work on the dental simulators alone, i.e. without an assisting person. During the preclinical years the students go through 60 hours of practical lessons in the phantom labs in each semester. The working conditions change in the clinical years, when students work in pairs on the patients, they are able to follow the ergonomic principles and this phase of the studies is less stressful. This may be the reason, why there is no significant increase in MSDs prevalence between the third and the fifth year.

When comparing pain intensity in different body regions with other factors, the answers no + mild and moderate + severe were combined. The reason for this was an effort to simplify the statistical analysis and a small number of answers in some categories, which was not sufficient to perform a statistical analysis.



Musculoskeletal pain was mostly solved by exercises, followed by visiting a specialist (rehabilitation physician or physiotherapist) and the usage of medicaments. The frequency of exercises and medicaments increased during the studies, conversely visiting specialists decreased.

A limitation of this study was that different students were involved in different years. For more precise evaluation of the evolution of musculoskeletal pain prevalence it would be useful to evaluate the same students gradually in the first, third and fifth year, followed by an evaluation of the same participants after a few years of dental practice.

## CONCLUSIONS

The prevalence of musculoskeletal pain among dental students in this study was 39%. The most frequent areas of pain were neck, lower back and upper back. Women suffered from musculoskeletal pain more often than men. The presence of a congenital disease of the musculoskeletal system increased the prevalence of the musculoskeletal pain, as well as an occurrence of musculoskeletal system disease among blood relatives.

The prevalence of musculoskeletal pain increased during the running of the studies, mainly during the preclinical phase.

## ACKNOWLEDGEMENTS

The authors declare that they have no competing interests. The authors declare that they are not associated in any way with the producer or distributor of the Spinal Mouse® device, and that the study was not supported by these companies.

The study was financially supported by the Charles University's programme PROGRES Q40/13.

The authors would like to thank Dr. Eva Čermáková from Computer Technology Center, Charles University, Faculty of Medicine in Hradec Králové, Czech Republic, for help with the statistical analysis, and Ms. Eva Vedralová, Ms. Sara Rezazadeh Siaghi and Ms. Eliska Charlotte Wurfel for a language revision of the manuscript.

## REFERENCES

- European agency for safety and health at work. OSH in figures: Work-related musculoskeletal disorders in the EU-Facts and figures. Luxembourg: Publications Office of the European Union; 2010.
- Abbas SB, Qazi SR, Iftikhar S, Iqbal MU. Musculoskeletal disorders among dentists and dental students. *Pakistan Oral & Dental Journal* 2015; 35: 461–5.
- Abduljabbar TA. Musculoskeletal disorders among dentists in Saudi Arabia. *Pakistan Oral & Dental Journal* 2008; 28: 135–44.
- Alexopoulos EC, Stathi IC, Charizani F. Prevalence of musculoskeletal disorders in dentists. *BMC Musculoskelet Disord* 2004; 9: 16.
- Hayes MJ, Cockrell D, Smith DR. A systematic review of musculoskeletal disorders among dental professionals. *Int J Dent Hyg* 2009; 7: 159–65.
- Hodacova L, Sustova Z, Cermakova E, Kapitan M, Smejkalova J. Self-reported Risk Factors Related to the Most Frequent Musculoskeletal Complaints among Czech Dentists. *Ind Health* 2015; 53: 48–55.
- Leggat PA, Smith DR. Musculoskeletal disorders self-reported by dentists in Queensland, Australia. *Aust Dent J* 2006; 51: 324–7.
- Pilbauerová N, Kapitán M, Šustová Z, Machač S. An evaluation of the occurrence of musculoskeletal disorders among dentists of the Department of Dentistry, Charles University, Faculty of Medicine in Hradec Králové, and University Hospital Hradec Králové—a pilot study. *LKS* 2017; 27: 8–12. [in Czech]
- Puriene A, Aleksejuniene J, Petrauskienė J, Balciuniene I, Janulyte V. Self-reported occupation health issues among Lithuanian dentists. *Ind Health* 2008; 46: 369–74.
- Šustová Z, Hodačová L, Kapitán M. The prevalence of musculoskeletal disorders among dentists in the Czech Republic. *Acta Medica (Hradec Kralove)* 2013; 56: 150–6.
- Harutunian K, Gargallo-Albiol J, Figueiredo R, Gay-Escoda C. Ergonomics and musculoskeletal pain among postgraduate students and faculty members of the School of Dentistry of the University of Barcelona (Spain). A cross-sectional study. *Med Oral Patol Oral Cir Bucal* 2011; 16: e425–9.
- Leggat PA, Kedjarune U, Smith DR. Occupational health problems in modern dentistry. A Review. *Ind Health* 2007; 45: 611–21.
- Puriene A, Janulyte V, Musteikyte M, Bendinskaite R. General health of dentists. Literature review. *Stomatologija* 2007; 9: 10–20.
- Shrestha BP, Singh GK, Niraula SR. Work related complaints among dentist. *JNMA J Nepal Med Assoc* 2008; 47: 77–81.
- Szymańska J. Disorders of the musculoskeletal system among dentists from the aspect of ergonomics and prophylaxis. *Ann Agric Environ Med* 2002; 9: 169–73.
- Yi J, Hu X, Yan B, Zheng W, Li Y, Zhao Z. High and specialty-related musculoskeletal disorders afflict dental professionals even since early training years. *J Appl Oral Sci* 2013; 21: 376–82.
- Alzahem AM, van der Molen HT, Alaujan AH, Schmidt HG, Zamakhshary MH. Stress amongst dental students: a systematic review. *Eur J Dent Educ* 2011; 15: 8–18.
- Myers HL, Myers LB. 'It's difficult being a dentist': stress and health in the general dental practitioner. *Br Dent J* 2004; 197: 89–93.
- Ohlendorf D, Erbe C, Nowak J, et al. Constrained posture in dentistry—a kinematic analysis of dentists. *BMC Musculoskelet Disord* 2017; 18(1): 291.
- Sharma P, Golchha V. Awareness among Indian dentist regarding the role of physical activity in prevention of work related musculoskeletal disorders. *Indian J dent Res* 2011; 22: 381–4.
- de Carvalho MV, Soriano EP, de França Caldas A Jr, Campello RI, de Miranda HF, Cavalcanti FI. Work-related musculoskeletal disorders among Brazilian dental students. *J Dent Educ* 2009; 73: 624–30.
- Díaz-Caballero AJ, Gómez-Palencia IP, Díaz-Cárdenas S. Ergonomic factors that cause the presence of pain muscle in students of dentistry. *Med Oral Patol Oral Cir Bucal* 2010; 15: e906–11.
- Khan SA, Chew KY. Effect of working characteristics and taught ergonomics on the prevalence of musculoskeletal disorders amongst dental students. *BMC Musculoskelet Disord* 2013; 14: 118.
- Melis M, Abou-Atme YS, Cottogno L, Pittau R. Upper body musculoskeletal symptoms in Sardinian dental students. *J Can Dent Assoc* 2004; 70: 306–10.
- Ng A, Hayes MJ, Polster A. Musculoskeletal Disorders and Working Posture among Dental and Oral Health Students. *Healthcare (Basel)* 2016; 4: E13.
- Rising DW, Bennett BC, Hursh K, Plesh O. Reports of body pain in a dental student population. *J Am Dent Assoc* 2005; 136: 81–6.
- Thornton LJ, Barr AE, Stuart-Buttle C, Gaughan JP, Wilson ER, Jackson AD, Wyszynski TC, Smarkola C. Perceived musculoskeletal symptoms among dental students in the clinic work environment. *Ergonomics* 2008; 51: 573–86.
- Shirzaei M, Mirzaei R, Khaje-Alizade A, Mohammadi M. Evaluation of ergonomic factors and postures that cause muscle pains in dentistry students' bodies. *J Clin Exp Dent* 2015; 7: e414–8.
- Kuorinka I, Jonsson B, Kilbom A, et al. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. *Appl Ergon* 1987; 18: 233–7.
- Czech Dental Chamber. Yearbook 2015. Prague: Czech Dental Chamber, 2016 Accessed May 7, 2017 at [https://img.dent.cz/a/e/e/df/972941/CSK\\_rocenka\\_2015\\_web.pdf](https://img.dent.cz/a/e/e/df/972941/CSK_rocenka_2015_web.pdf).
- Gorter R, Freeman R, Hammen S, Murtomaa H, Blinkhorn A, Humphris G. Psychological stress and health in undergraduate dental students: fifth year outcomes compared with first year baseline results from five European dental schools. *Eur J Dent Educ* 2008; 12: 61–8.