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Garima Pant

Ph.D. Scholar, Department of Family Resource Management, College of Home Science, GBPUAT, Pantnagar, U.S. Nagar, Uttarakhand, India

Deepa Vinay

Professor, Department of Family Resource Management, College of Home Science, GBPUAT, Pantnagar, U.S. Nagar, Uttarakhand, India

Corresponding Author

Garima Pant

Ph.D. Scholar, Department of Family Resource Management, College of Home Science, GBPUAT, Pantnagar, U.S. Nagar, Uttarakhand, India

Ergonomic risk assessment of musculoskeletal discomfort among dental practitioners of Uttarakhand

Garima Pant and Deepa Vinay

Abstract

Work-related musculoskeletal disorders are one of the most common occupational diseases among dentists. Dental work consists of static and demanding activities in which small instruments are repeatedly used. The purpose of this study was to investigate the prevalence of musculoskeletal pain, pain areas and risk factors associated with musculoskeletal pain among dental practitioners. To determine the prevalence and severity location of musculoskeletal pain, the Cornell Musculoskeletal Discomfort Questionnaire was administered among 80 dental practitioners. The majority of the respondents (72.5%) had experienced MS pain more than twice, while only 17.5 per cent experienced no musculoskeletal pain. According to the total discomfort score of Cornell Musculoskeletal Discomfort Questionnaire, it can be concluded that dental practitioners felt discomfort mostly in the neck (27.22%), right shoulder (16.43%), left shoulder (14.45%), right wrist (6.99%), right upper arm (9.75%) and upper back (9.71%). There is an association between the Age, BMI and years of experience with the musculoskeletal pain experienced by dental practitioners. The prevalence of pain among dental practitioners could be reduced by ergonomic working environment, regular breaks, maintenance of health, and performing specific exercises designed to dental workers.

Keywords: musculoskeletal pain, dental workers, prevalence, CMDQ, WMSD

Introduction

WMSDs are a group of inflammatory and degenerative diseases that affect muscles, tendons, ligaments, joints, peripheral nerves, and blood vessels. Tendonitis, epicondylitis, bursitis, nerve compression disorders, sciatica, osteoarthritis, myalgia, lower back pain, and other regional diseases are examples of this are pain syndrome, which often affect the lower back, neck, shoulders, hips, knees and ankles. Work-related diseases of the musculoskeletal system are one of the most common occupational diseases in dentists (Hayes *et al.*, 2009 and Melhorn, 2000) [10]. Previous studies reported that the incidence of musculoskeletal pain in dentists reached 93 per cent to 63 per cent (Isper *et al.*, 2017 and Nasl *et al.*, 2005) [12, 22]. Complaints in dentists have increased over the past decade and have become a very important issue in healthcare. Dentists can spend a lot of time statically in a rigid and unergonomic position when performing repetitive movements with heavy loads. The work factor is a major risk for MSD symptoms.

Musculoskeletal disorders are influenced by a variety of factors, including physical characteristics (height and weight), occupational and socio-psychological factors such as excessive use of body areas, uncomfortable posture, high work intensity, and inadequate rest periods (Cho *et al.*, 2014; Morse *et al.*, 2007; Punnett and Wegman, 2004 and Ylipää, *et al.*, 1997) [4, 20, 26, 39]. Although repetition does not cause inflammation or pain, if used too much, tissue does not have enough time to regenerate and micro-injuries occur on certain parts of the body (Colombini *et al.*, 2001; Novak, 1997 and Mackie, 2002) [5, 24]. In dentistry, MS pain is likely to decrease productivity in order to take a break from work, and some people experience disability that ends working life (Valachi and Valachi, 2003) [37].

Dental work consists of static and demanding tasks that involve repetitive grasping of small instruments that require precision; these and other risk factors contribute to the fact that dentists, along with other professional groups, have an increased risk of developing musculoskeletal disorder (Sanders and Michalak, 2004) [30]. A study by Oulakh and Vinay (2016) [25] concluded that most work forces are involved in the assembling units that are not designed to meet ergonomic requirements in the workplace and working environment. Adopting uncomfortable working postures can lead to musculoskeletal disorder (MSD) and occupational health hazards.

Also by Szymańska (2002) [35], found that prolonged incorrect work posture is the main cause of musculoskeletal problems in these workers and musculoskeletal and peripheral nervous system disorders.

Static work consists of long-term isotonic muscle contraction, in which muscle fibers stand static for prolonged intervals of time. During static muscle contraction, compression of blood vessels happens with inside the muscle tissue, which ends up in decreased blood flow and in the end decreased oxygen to the muscular tissues (Luopajarvi, 1990). Furthermore, it was concluded through Kroemer and Grandjean (1997) [14], that waste products accumulate in the muscles and result in fatigue and muscle pain, and the blood flow is reduced in proportion to the intensity and duration of the burden.

Studies among Slovenian dentists carried out between 1977 and 1978 showed a high incidence of occupational diseases (Rode *et al.*, 1978) [28]. It was found that 73.6 per cent of dentists suffer from chronic diseases of the spine (e.g. deviation, lower back pain, cervical spine, neuralgia and thoracic deviation); 60 per cent of the respondents had varicose veins in their legs, 30 per cent due to exertional dyspnea and almost 20 per cent due to edema of the arms and legs; only 6.8 per cent of them stated that they were physically active on a regular basis. In addition, Kumar *et al.* (2013) [15, 16], conducted a study on the prevalence of musculoskeletal disorder among dentists in India and found that the 536 dentists included in their study had at least one work-related MS symptom in the previous year, with an overall prevalence of 100%. Reported symptoms included pain (99.1%), stiffness (3.4%), fatigue (8.39%), discomfort (12.9%), clicks / noises (4.1%), and other neurological abnormalities (20.1%). Further it was also revealed that symptoms were predominantly found in the neck (75.7%), wrist / hand (73.1%), lower back (72.0%), shoulder (69.4%), hip (29.9%) regions, upper back (18.7%), ankle (12.3%) and elbows (7.5%). In a study Lin *et al.* (2012) also reported that Taiwanese participants had a lower prevalence (13% -15%) of pain in the hips / thighs / buttocks, knees, and ankles / feet.

Materials and Methods

The present study was carried out in four district of Uttarakhand. Non- probability sampling technique i.e. purposive sampling technique was used to select the area of study. For descriptive study sample size of 80 dental practitioners were selected with the help of snowball sampling technique.

The Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) was used to assess the symptoms. Professor Alan Hedge and Cornell University ergonomics students developed a well-designed data collection tool called the CMDQ. The existing CMDQ was adopted and modified after it was previously tested on a sample of 10 doctors. First, the level of discomfort recorded by the dentist during the survey was calculated as , "Never (0), 1 or 2 times / week (1.5), 3 or 4 times / week (3.5), every day (5) and several times a day (10). "In order to reach the level of the weighted musculoskeletal complaints, the result is multiplied by the degree of severity (not at all = 0," slightly uncomfortable = 1, moderately uncomfortable = 2, very uncomfortable = 3 ") and interference rating (" not at all = 0, slightly interfered= 1, substantially interfered= 2 ").

Statistical analysis

Appropriate statistics was employed for purpose of describing the demographics of the study population and relationship between age, BMI and years of experience to MS pain.

Results

Out of the total sample, 26 were women and 54 were men. The age of the participants ranged from 20 to 65 years, with the mean age of 37.63 ± 8.05 SD years (figure 1). The sample consisted of dentist with different field of practice as, general practice (40%), oral surgery (22.5%) and endodontics (13.75) (figure 2). The majority of the respondents (72.5%) had experienced musculoskeletal pain more than twice, while only 17.5% experienced no musculoskeletal pain (Table 1). There is an association between the Age, BMI and years of experience with the musculoskeletal pain (Table2,3 and 4) experienced by the dental practitioners.

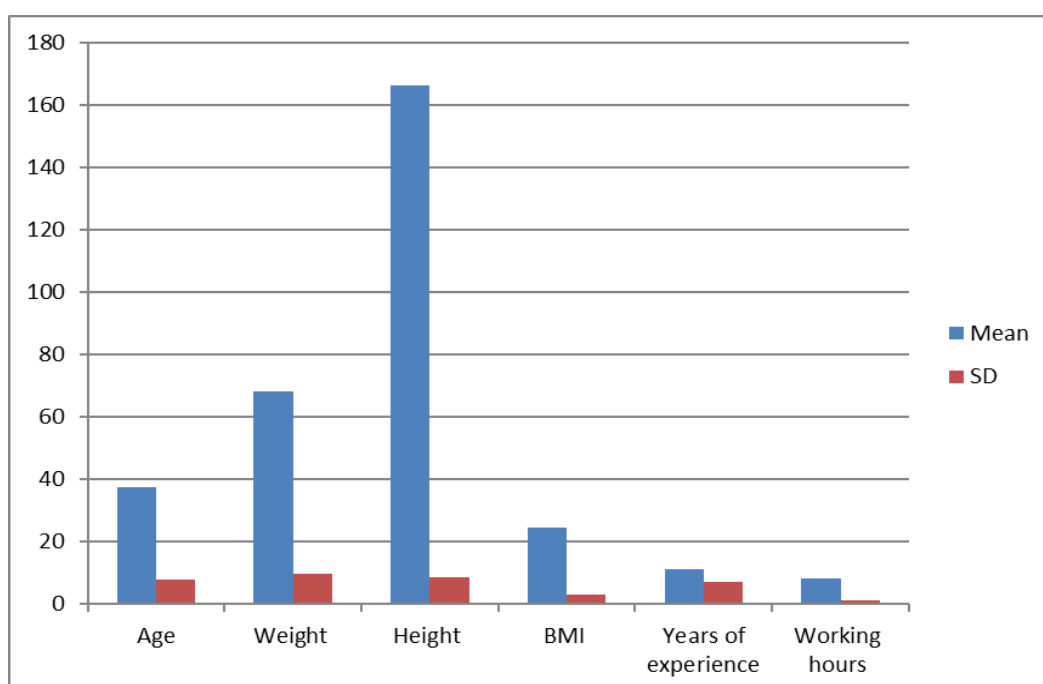


Fig 1: Demographic statistics

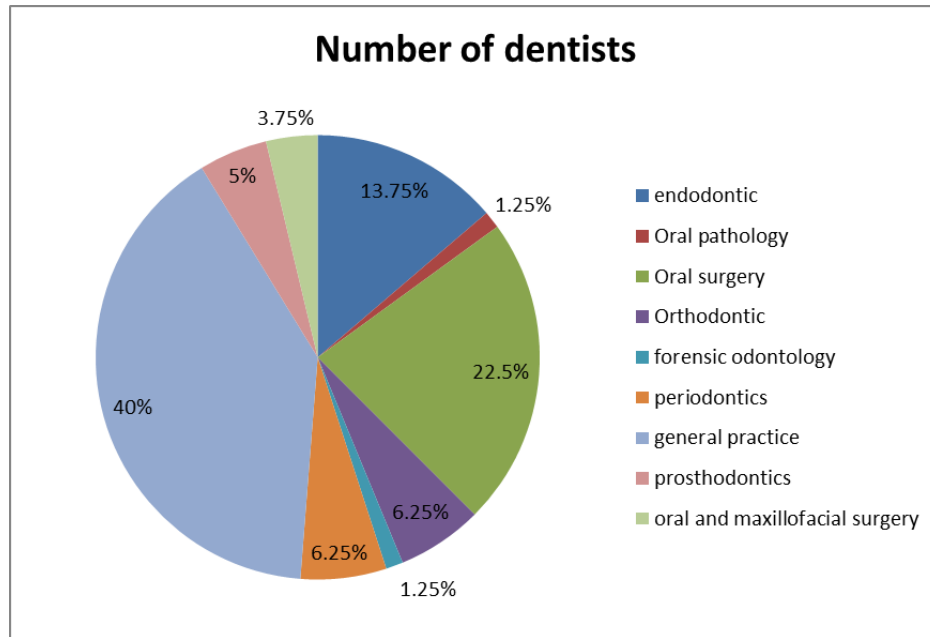


Fig 2: Field of practice of Dental Practitioners

Table 1: Distribution of dental practitioners as per the incidences of pain

Incident of pain	Frequency	Percentage
No incident reported so far	14	17.5
one to two times	8	10
more than two times	58	72.5

Table 2: Relationship between age and incidence of pain

Age groups	Incidence of pain			Total	χ^2 value
	Never	One to two times	More than twice		
20 to 35	12 (7.88)	7 (4.5)	26 (32.62)	45 (45)	χ^2 (cal)= 11.45
36 to 50	2 (5.08)	1 (2.9)	26 (21.02)	29 (29)	
51 to 65	0 (1.05)	0 (0.6)	6 (4.35)	6 (6)	
Total	14 (14.0)	8 (8.00)	58 (58.00)	80 (100)	

Note *expected count is given in brackets

All values are significant at 5% level and 4 degrees of freedom.

Table 3: Relationship between BMI and incidence of pain

BMI Range	Incidence of pain			Total	χ^2 value
	Never	One to two times	More than twice		
Below 18.5	2 (0.35)	0 (0.2)	0 (1.45)	2 (2)	χ^2 (cal)= 13.71
18.5-24.9	9(6.65)	4 (3.8)	25 (27.55)	38 (38)	
25.0-29.9	3 (6.65)	4 (3.8)	31 (27.55)	38 (38)	
30.0-34.9	0 (0.35)	0 (0.2)	2 (1.45)	2 (2)	
Total	14 (14)	8 (8)	58 (58)	80 (100)	

Note *Expected count is given in brackets

All values are significant at 5% level and 6 degrees of freedom.

Table 4: Relationship between years of experience and incidence of pain

Years of experience	Incidence of pain			Total	χ^2 value
	never	one to two times	more than twice		
≤5	9 (2.8)	1 (1.6)	6 (11.6)	16 (16)	χ^2 (cal)= 27.91
6-10 years	5 (5.95)	6 (3.4)	23 (24.65)	34 (34)	
> 10 years	0 (5.25)	1 (3)	29 (21.75)	30 (30)	
Total	14 (14)	8 (8)	58 (58)	80 (100)	

Note *Expected count is given in brackets

All values are significant at 5% level and 4 degrees of freedom.

The results of CMDQ reported total body discomfort and high impact long working hours and unfavorable working conditions. The studies of musculoskeletal disorders consider International Musculoskeletal Disorder (MSD) Questionnaire

as an essential feature (Erdinc *et al.*, 2011) [6]. Since the CMDQ examines discomfort levels according to frequency and severity and it also analyzes the rate at which work performances of individual are negatively influenced and this

statement was mentioned by previous recent studies (Habibi *et al.*, 2015 and Sethi *et al.*, 2011) [31].

According to the total discomfort score of CMDQ (table 5), dental practitioners felt discomfort mostly in the neck (27.22%), right shoulder (16.43%), left shoulder (14.45%), right wrist (6.99%), right upper arm (9.75%), upper back

(9.71%), lower back (4.93%), right forearm (4.38%), left upper arm (2.07%), left forearm (1.04%), right lower leg (1.03%), left lower leg (1.07%), hip (0.40%), right knee (0.13%), left knee (0.10%) and left and right thigh (0.10% and 0.09%).

Table 5: Total discomfort scores felt by dental practitioners for different body parts

Body parts	Frequency	Discomfort	Interference	Discomfort score	percentage
Neck	185	94	77	1339030	27.22
right shoulder	145	82	68	808520	16.43
left shoulder	134	78	68	710736	14.45
upper back	113.5	69	61	477721.5	9.71
right upper arm	109	71	62	479818	9.75
left upper arm	62.5	37	44	101750	2.07
lower back	83.5	57	51	242734.5	4.93
right forearm	84.5	51	50	215475	4.38
left forearm	50.5	29	35	51257.5	1.04
right wrist	108.5	66	48	343728	6.99
left wrist	23	11	20	5060	0.10
Hip	38	27	19	19494	0.40
right thigh	22	14	15	4620	0.09
left thigh	23.5	14	15	4935	0.10
right knee	26	15	17	6630	0.13
left knee	23	14	16	5152	0.10
right lower leg	53	30	32	50880	1.03
left lower leg	53	30	33	52470	1.07

More specifically, (table 6) the results indicated that 70 (87.5%) dental practitioners sensed discomfort in the neck 1–2 times per week or more and 41(51.25%) of them assessed that this discomfort had a minor effect on their ability to work. Also Sixty two (77.5%) dental practitioners assessed discomfort in their right shoulder 1-2 times per week or more and 34 (42.5%) of them assessed that this discomfort had a minor effect on their ability to work. The right wrist of dental practitioners was more loaded than left wrist; 45 (56.25%) dentists felt discomfort there 1–2 times per week or more and 20 (25%) of them sensed that this had a minor effect on their

work performance.







Further separate scores were also calculated for the areas of right hand and left hand using CMDQ, and it was revealed that, dental practitioners felt discomfort mostly in their dominant hand i.e. right hand , data revealed that Table 7 presents sites and frequency of musculoskeletal pain in the dominant hand of the dental practitioners. According to the site of the hand, 50 per cent of the respondents experienced pain in the hypothenar area (F area) and 43.75 per cent in the index finger, middle finger, and first half of ring finger area (A area).

Table 6: Subject Variations of estimating the feeling of discomfort by using CMDQ

Body Parts	During the last work week how often did you experience ache, pain, discomfort in:					If you experienced ache, pain, discomfort, how uncomfortable was this?				If you experienced ache, pain, discomfort, did this interfere with your ability to work?		
	never	1-2 Times/week	3-4 Times/week	OED	ST/D	NA	SL	Mod	VU	NA	SL	SUB
Neck	7 (8.75)	45 (56.25)	25 (31.25)	0 0	3 (3.75)	13 (16.25)	45 (56.25)	17 (21.25)	5 (6.25)	21 (26.25)	41 (51.25)	18 (22.5)
R shoulder	15 (18.75)	46 (57.5)	16 (20)	2 (2.5)	1 (1.25)	25 (31.25)	31 (38.75)	21 (26.25)	3 (3.75)	29 (36.25)	34 (42.5)	17 (21.25)
L shoulder	21 (26.25)	41 (51.25)	15 (18.75)	2 (2.5)	1 (1.25)	28 (35)	28 (35)	22 (27.5)	2 (2.5)	29 (36.25)	34 (42.5)	17 (21.25)
upper back	28 (35)	35 (43.75)	16 (20)	1 (1.25)	0	32 (40)	29 (36.25)	17 (21.25)	2 (2.5)	36 (45)	27 (33.75)	17 (21.25)
R upper arm	30 (37.5)	33 (41.25)	17 (21.25)	0 0	0	33 (41.25)	27 (33.75)	16 (20)	4 (5)	36 (45)	26 (32.5)	18 (22.5)
L upper arm	52 (65)	21 (26.25)	6 (7.5)	0 0	1 (1.25)	54 (67.5)	17 (21.25)	7 (8.75)	2 (2.5)	47 (58.75)	22 (27.5)	11 (13.75)
lower back	35 (43.75)	37 (46.25)	8 (10)	0 0	0	38 (47.5)	28 (35)	13 (16.25)	1 (1.25)	42 (52.5)	25 (31.25)	13 (16.25)
R forearm	37 (46.25)	33 (41.25)	10 (12.5)	0 0	0	33 (41.25)	26 (32.5)	11 (13.75)	10 (12.5)	44 (55)	22 (27.5)	14 (17.5)
L forearm	56 (70)	20 (25)	3 (3.75)	0 0	1 (1.25)	59 (73.75)	15 (18.75)	4 (5)	2 (2.5)	53 (66.25)	19 (23.75)	8 (10)
R wrist	31 (38.75)	37 (46.25)	8 (10)	3 (3.75)	1 (1.25)	34 (42.5)	30 (37.5)	12 (15)	4 (5)	46 (57.5)	20 (25)	14 (17.5)

L wrist	66 (82.5)	13 (16.25)	1 (1.25)	0 0	0 0	70 (87.5)	9 (11.25)	1 (1.25)	0 0	62 (77.5)	16 (20)	2 (2.5)
Hip	56 70	23 (28.75)	1 (1.25)	0 0	0 0	59 (73.75)	17 (21.25)	2 (2.5)	2 (2.5)	62 (77.5)	17 (21.25)	1 (1.25)
R thigh	68 (85)	10 (12.5)	2 (2.5)	0 0	0 0	68 (85)	10 (12.5)	2 (2.5)	0 0	65 (81.25)	10 (12.5)	5 (6.25)
L thigh	67 (83.75)	11 (13.75)	2 (2.5)	0 0	0 0	68 (85)	10 (12.5)	2 (2.5)	0 0	65 (81.25)	15 (18.75)	0 0
R knee	65 (81.25)	14 (17.5)	0 0	1 (1.25)	0 0	67 (83.75)	11 (13.75)	2 (2.5)	0 0	64 (80)	15 (18.75)	1 (1.25)
L knee	67 (83.75)	12 (15)	0 0	1 (1.25)	0 0	68 (85)	10 (12.5)	2 (2.5)	0 0	64 (80)	14 (17.5)	2 (2.5)
R lower leg	55 (68.75)	18 (22.5)	6 (7.5)	1 (1.25)	0 0	61 (76.25)	10 (12.5)	7 (8.75)	2 (2.5)	55 (68.75)	18 (22.5)	7 (8.75)
L lower leg	55 (68.75)	18 (22.5)	6 (7.5)	1 (1.25)	0 0	61 (76.25)	10 (12.5)	7 (8.75)	2 (2.5)	55 (68.75)	17 (21.25)	8 (10)

Table 7: The prevalence of musculoskeletal pain by Area in the dominant hand

Right Hand	Never	1-2 times/week	3-4 times/week	Once a day	Several times per day	Total
 <p>Area A</p>	45 (56.25)	29 (36.25)	5 (6.25)	1 (1.25)	0	35(43.75)
 <p>Area B</p>	53 (66.25)	26 (32.5)	1 (1.25)	0	0	(33.75)
 <p>Area C</p>	47 (58.75)	27 (33.75)	6 (7.5)	0	0	(41.25)
 <p>Area D</p>	46 (57.5)	28 (35)	6 (7.5)	0	0	(42.5)
 <p>Area E</p>	54 (67.5)	21 (26.25)	5 (6.25)	0	0	(32.5)
 <p>Area F</p>	40 (50.00)	34 (42.5)	5 (6.25)	1 (1.25)	0	(50)

Note. A = index finger, middle finger, and first half of ring finger; B = 2nd half of ring finger and little finger; C = thumb; D = palm area; E = thenar area; F = hypothenar area.

Discussion

This study looked at the level of work-related musculoskeletal pain in dentists employed in Uttarakhand and found that the majority of participants suffered from pain. The study results were similar to several previous research studies in which MS illnesses between 63% - 93% were reported (Cho *et al.*, 2016; Estrich, 2014; Hayes *et al.*, 2009; Kierklo *et al.* 2011; Leggat and Smith, 2006 ; Muralidharan *et al.*, 2012; Nasl Saraji *et al.*, 2005; Rabei *et al.*, 2011 and Simu *et al.*, 2014) [7, 10, 13, 22, 33]. The prevalence of MS disease has been reported among dentists (62%). MS pain most commonly present on the neck, upper back, shoulder, and wrist. Very often pain in the lower back, hip and buttocks also developed, similar to previous studies (Aminian *et al.*, 2012; Cho *et al.*, 2016; Estrich, 2014; Hayes *et al.*, 2013; Kierklo *et al.*, 2011, Muralidharan *et al.*, 2012, Rafeemanesh *et al.*, 2013, Rucker and Sunell, 2002, Shrestha *et al.*, 2008 and Tirgar *et al.*, 2015) [7, 11, 13, 29]. Kumar *et al.* (2013) [15, 16] found that around 15% of physicians, 40% of surgeons, and 60% of dentists had MSD problems in more than one location, which may be due to a complex posture during dental work, disorganized working conditions in most clinics and excessive working hours without interrupted rest periods. Szeto *et al.* (2009) and Stomberg *et al.* (2010) [34], also reported that the neck and lower back were most commonly affected by MSD in dentists (40% and 50%, respectively), while the hips, elbows, and knees were the least affected, possibly due to flexion of Neck and the back by dentists, especially when treating the maxillary teeth. Lower back, hips, knees, ankle and neck were the worst affected sites of MSD in surgeons, whereas upper back and elbows were least affected. This may be because of prolonged standing and bending posture during surgeries. The current study found association of age, BMI, and years of experience with the musculoskeletal pain these findings are in agreement with the results obtained by Woolf and Pflieger (2003) [38], who found Age seems to be an important factor in MSD pain. Prevalence of MSD pain increased with an increase in age. Grotle *et al.*, (2008) [8], reported that Overweight and obesity were found to be a significant risk factors for musculoskeletal pain. Subjects with body mass index (BMI) >24.9 suffered from MSD pain 1.7 times more than subjects with BMI <24.9.

Conclusion

This study found a high prevalence of musculoskeletal pain among the dental professionals of Uttarakhand, the most frequent areas of musculoskeletal pain among dental workers occurred in the neck, right shoulder, lower back, right wrist, hip and buttock. Statistically significant correlation between the occurrence of MS pain and Age, BMI and Years of experience was confirmed. It is necessary to introduce prevention programs into dental education to prevent MS discomfort during educational and professional years.

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