

Research article

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## Prevalence of musculoskeletal disorders in dentists

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### Abstract

**Background:** The prevalence of musculoskeletal complaints in dentists is high although relatively few studies had focus in this profession. The aim of this study was to investigate the relations between physical, psychosocial, and individual characteristics and different endpoints of musculoskeletal complaints of low back, neck, shoulders and hand/wrist.

**Methods:** A questionnaire survey was carried out among 430 dentists (response 88%) in Thessaloniki, Greece. Questions include data on physical and psychosocial workload, need for recovery, perceived general health and (i) the occurrence of musculoskeletal complaints in the past 12 months, (ii) chronic complaints during at least 1 month, complaints which led to (iii) sickness absence, and (iv) medical care seeking. In logistic regression analysis odds ratios were estimated for all relevant risk factors.

**Results:** 62% of dentists reported at least one musculoskeletal complaint, 30% chronic complaints, 16% had spells of absence and, 32% sought medical care. Self-reported factors of physical load were associated with the occurrence of back pain (OR = 1.59), shoulder pain (OR = 2.57) and, hand/wrist pain (OR = 3.46). With the exception of hand/wrist complaints, the physical factors were not associated with chronic complaints and musculoskeletal sickness absence. Physical load showed a trend with the number of musculoskeletal complaints with ORs of 2.50, 3.07 and 4.40 for two, three and four musculoskeletal complaints, respectively. No consistent influence of psychosocial factors on complaints, chronicity, sickness absence and medical care seeking was observed. A perceived moderate general health was a significant factor for chronic complaints, comorbidity and medical care seeking where high perceived exertion was significant for absenteeism. Living alone was also related with increased absenteeism due to shoulder pain (OR = 5.01) and hand/wrist (OR = 4.07).

**Conclusions:** The physical load among dentists seems to put them at risk for the occurrence of musculoskeletal disorders. More than one and severe complaints are related to perceived general health while high perceived exertion and social characteristics are associated with sickness absence. Chronic symptoms seem to determine medical care seeking. Ergonomic interventions may have a greater impact in prevention of hand/wrist complaints. When investigating the influence of work-related risk factors on musculoskeletal health, psychosocial and other personal characteristics should be taken into account.

## Background

Musculoskeletal disorders have become increasingly common worldwide during the past decades. It is a common cause of work-related disability among workers with substantial financial consequences due to workers' compensation and medical expenses [1]. Various work-related factors have been established as predisposing the disorders. In dentists, overstrained and awkward back postures for back pain, repetitiveness for neck and shoulder disorders, and psychosocial stressors for back, neck and shoulder complaints [2]. A slight hand neuropathy has also been reported caused by exposure to high frequency vibration tools [3].

In most studies only a few of these risk factors have been taken into account simultaneously [2,4]. This makes it difficult to appreciate the impact of specific risk factors since most studies did not control appropriately for concurrent risk factors. In Greece, very few studies have been undertaken in occupational groups with respect to the simultaneous occurrence of different musculoskeletal complaints and their interrelationships [5,6].

The first aim of this study was to investigate associations between personal characteristics, physical load, psychosocial factors and general health status with complaints of back, neck, shoulder and hand/wrist. The second aim was to analyse interrelations between these musculoskeletal complaints and its effect on associations between work-related risk factors and musculoskeletal complaints.

## Methods

### Study population

Four hundred and ninety members of Thessaloniki's Dental Association (1063 dentists) were randomly selected, and sent questionnaires. Eighty eight per cent responded. At least 1 year of work experience in the current position was the only criterion for eligibility to the study.

### Study design and data collection

A self-administered questionnaire was distributed by the researchers between March 2003 and June 2003. The questionnaire involved information on the respondent's job history, individual characteristics, physical and psychosocial risk factors at work, general health status, and the occurrence of musculoskeletal complaints. Prior to the study the questionnaire was tested for comprehensibility and relevance among six dentists.

Individual characteristics and work history included questions on age, anthropometry, gender, family situation, level of education, duration of employment, and previous jobs. Questions on physical work load concerned repetitive movements, awkward working postures in which the

back is bent or twisted, prolonged sitting or standing, and strenuous arm positions like working with hands in excessive tightening or arm abduction and elevated arms, and use of vibrating tools. A four-point scale was used with ratings 'seldom or never', 'now and then', 'often', and 'always' during a regular workday. The answers 'often' and 'always' were classified as high exposure. The study subjects also rated their perceived exertion on a Borg-scale ranging from 6 (very light) till 20 (very heavy), with a score of 16 or higher regarded as high perceived exertion [7].

Psychosocial aspects at work distinguished two principal areas: demands, and control [8]. Job demands were measured by 10 questions of the psychological demands dimension from the Demand/Control model from Karasek. The questions were scored on a four-point scale, yielding a sum score for job demands. High demands were related to items such as working fast and hard, excessive work, insufficient time to complete a duty, or conflicting demands. Lack of control (decision latitude) was measured by 10 questions of the Decision Latitude dimension from the Demand/Control model [8]. Six items referred to skill discretion, and 4 items to decision authority. The questions were related to creativity, skills, task variety, learning new things, and amount of repetitive work. All psychosocial factors were expressed as percentage of the highest possible score, with 0% indicating the best possible situation and 100% the worst possible situation. In the statistical analysis, scores above the median value considered as the presence of psychosocial risk.

The health status of each subject was ascertained with three different outcomes, i.e. perceived general health, need for recovery, and musculoskeletal complaints. Perceived general health status was ascertained by 13 dichotomized questions about subjective health complaints, such as respiratory complaints, stomach complaints, regular headache, and tiredness. A sum score was calculated to represent the worker's actual health situation. This scale had a good internal scale reliability (Cronbach's  $\alpha = 0.86$ ) and test-retest reliability (Pearson's  $r = 0.76$ ) [9]. Need for recovery was measured with 11 dichotomized questions to assess short-term health effects that reflect the worker's need for recovery at the end of a regular workday. These questions addressed items such as tiredness after work, fatigue, lack of concentration, putting interest in other people, the ability to recover from work, and the influence on work performance [10]. For both general health endpoints subjects with a score above the median value were considered to have a high need for recovery or a moderate/bad general health.

Musculoskeletal complaints were measured using the standardized Nordic questionnaire [11]. Four endpoints

**Table 1: Personal characteristics and working experience among dentists (n = 430)**

	Men (n = 231)	Women (n = 199)
Age (in years, mean (SD))	46.9 (10.1)	44.0 (10.3)
Height (cm, mean(SD))	178.1 (6.4)	165.0 (5.7)
Body mass index (kg/m <sup>2</sup> , mean (SD))	26.7 (3.2)	24.0 (4.3)
Educational level (%)		
Higher	41	37
Basic	59	63
Duration of employment (in years, mean (SD))	19.0 (10.0)	18.0 (10.4)
Family situation (%)		
Alone	14	29
Relatives/friends	86	71
Children/invalid persons (%)		
No	74	72
Yes	26	28

for each body site were defined: (i) musculoskeletal complaint of back, neck, shoulder or hand/wrist was defined as pain in the past 12 months, which had continued for at least a few hours during the past 12 months, (ii) chronic musculoskeletal pain in the past 12 months, referred to a complaint that was present almost every day in the preceding 12 months with a minimal presence for at least 1 month, (iii) musculoskeletal complaint which led to a period of sickness absence in the past 12 months, and (iv) musculoskeletal complaint which led to medical care seeking in the past 12 months.

#### Statistical analysis

Logistic regression analysis was performed to evaluate the influence of individual characteristics, physical and psychosocial risk factors at work, and health status on the occurrence of musculoskeletal complaints. Prevalence odds ratios (PORs) with 95% confidence intervals (95% CI) were calculated as measure of association, adjusted for age and gender. For the initial selection of potential risk factors for musculoskeletal complaints univariate logistic regression analysis was used with of significance level of  $P < 0.10$ . Subsequently, all independent variables that showed significant associations were included in the multivariate logistic regression model. The important confounders age and gender were always included in each model, regardless of their significance. These analyses were carried out separately for all four musculoskeletal complaints and their four definitions. Data analyses were conducted by means of the SPSS for Windows 10.1.0 statistical package.

#### Results Response

The response to participate in the study was 88% (430/490 respondents). The principal reasons for non-partici-

pation were: sickness leave, lack of time, and refusals. Our sample consisted from general dentists (92.1%) and specialists mainly orthodontists (4.4%), oral and maxillofacial surgeons, endodontists, periodontists and, specialists in paediatric dentistry. A significant proportion of general dentists had postgraduate studies (PhD or MSc degree). Dentists included in study population were mainly self employed and residence only to Thessaloniki Municipality, the second largest city in Greece.

#### Baseline characteristics

Table 1 shows the basic characteristics of the study population. The subjects consisted predominantly of men (53.7%), with age ranging from 24 to 70 years. The dentists had worked in average 18.5 years. Younger and dentists living alone had a lower BMI ( $P < 0.001$ ). 37% of dentists mostly women worked 30 or fewer hours per week while 25% worked more than 40 hours. Working long hours was related to higher educational status and male gender.

#### Physical load, psychosocial load and perceived health

The presence of self-reported risk factors for musculoskeletal complaints is reported in table 2. Strenuous shoulder/hand movements were reported by 15%, while repetitive movements of upper limb reported from 66% of the dentists. Awkward back posture, primarily flexion of the back, was reported by 52%. Frequent use of vibrating tools was often or always part of the job for 77% of the dentists. 57% reported prolonged sitting and/or standing. Most significant and consistent correlation coefficients were found between repetitive movements of shoulder/hand, excessive tightening of low back, and use of vibrating tools (Spearman rank correlation coefficients  $\theta = 0.28-0.30$ ). High job demands seemed more important psychosocial risk factor than low job control. The self-reported risk fac-

**Table 2: Presence of self-reported risk factors for musculoskeletal disorders**

	n	%	Mean	SD
<b>Physical load:</b>				
Repetitive shoulder/hand movements	284	66.0		
Strenuous (awkward) posture	225	52.3		
Strenuous shoulder/hand movements	66	15.3		
High exposure to vibrating tools	329	76.5		
<b>Psychosocial load:</b>				
Job control			28.58	19.83
Work demands			37.38	25.79
<b>General health:</b>				
Need for recovery			40.28	29.07
Perceived general health			31.22	22.76

tors were partly determined by personal characteristics. Dentists with basic education experienced a significantly higher job control and less demands compared with dentists with a higher educational level. Perhaps this reflect more demanding cases through referrals and higher expectations from clients. Higher job demands were also strongly related with higher perceived exertion, male gender and working long hours. Low job control showed a significant inverted trend for age and duration of employment.

The self-reported general health showed a moderate need for recovery (mean score of 40.3) and a moderate to good perceived general health status (mean score 31.2). Perceived general health and need for recovery were strongly associated with gender and body mass index. Having kids or invalid persons at home, high job demands and working long hours were associated with a higher need for recovery. Women and dentists with a lower BMI had a significantly higher need for recovery and lower perceived general health.

**Occurrence of musculoskeletal complaints**

Table 3 presents the 12-month prevalences of complaints of back, neck, shoulder and hand/wrist, stratified by the four definitions of complaints. Low-back pain was the most prevalent musculoskeletal complaint, reported by

46% of the subjects. Occupational as the only origin of disorders reported by 57% and 70% for low back and all the other disorders, respectively. Chronic low-back pain was experienced by 50 dentists, which implies that more than 25% of all subjects with back pain reported to suffer from chronic (severe) back pain. Prevalence of hand/wrist complaints followed low back disorders and resulted in a significant higher chronicity than any other complaint. Neck and shoulder complaints were less prevalent than back pain. 30% of dentists reported at least one complaint that lasted more than a month. Hand/wrist, neck and shoulder pain resulted significantly less in a spell of sickness absence than back pain. 15.8% had at least one spell of sickness absence, 11.2% had spells of sickness absence for complaint in one body site, 3.5% for two body sites and 1.2% for three body sites.

Specialists differed from general dentists in physical and psychosocial risk factors, in subjective health complaints and, in prevalence of complaints. The small numbers of specialists in each group did not allow drawing conclusions, except of orthodontists' group. Compared to general dentists, orthodontists worked fewer hours per week ( $p < 0.05$ ), reported lower perceived exertion and lower need for recovery ( $p < 0.05$ ). The 12-month prevalence of complaints of shoulder and hand/wrist differed significantly between orthodontists and general dentists. Hand/

**Table 3: Prevalence of musculoskeletal complaints and its consequences in the past 12 months among dentists (n = 430)**

	Neck		Shoulders		Low back		Hand/wrist	
	n	%	n	%	n	%	n	%
Occurrence in the past 12 months	112	26	85	20	198	46	113	26
Chronic complaints (>1 month)	44	10	29	7	50	12	54	13
Complaints with sickness absence	16	4	13	3	42	10	18	4
Medical care seeking	45	10	34	8	82	19	54	13

**Table 4: Univariate associations between low back and shoulder pain in past 12 months and self reported risk factors**

Self reported risk factors	Low back pain OR (95% CI)	Shoulder pain OR (95% CI)
Strenuous shoulder/hand movements	1.18 (0.69 to 2.01)	1.41 (0.75 to 2.66)
Often use of vibrating tools	1.51 (0.89 to 2.57)	2.89 (1.20 to 6.95) *
Strenuous back postures	1.78 (1.19 to 2.66) *	1.52 (0.91 to 2.53)
Repetitive shoulder/hand movements	1.67 (1.07 to 2.61) *	1.27 (0.73 to 2.22)
High perceived exertion	1.85 (1.25 to 2.72) *	2.46 (1.48 to 4.09) *
High job demand	1.48 (1.01 to 2.17) *	1.87 (1.15 to 3.04) *
Low job control	1.41 (0.78 to 1.67)	1.25 (0.78 to 2.01)
High need for recovery	2.00 (1.35 to 2.96) *	1.97 (1.19 to 3.24) *
Moderate perceived general health	3.19 (2.13 to 4.77) *	2.23 (1.37 to 3.26) *

\* $\chi^2$  test,  $p < 0.05$  OR = odds ratio; 95% CI = 95% confidence interval.

wrist complaints were more prevalent in orthodontists (42.1% vs. 25.5% in general dentists), where shoulder complaints reported significantly more often by general dentists (0% vs. 21.2%, respectively). Hand/wrist complaints account of more than 50% of total absences of orthodontists.

Musculoskeletal comorbidity was high. In the total population, 62% of all subjects reported at least one musculoskeletal complaint, 35% reported at least two musculoskeletal complaints, 15% reported at least three musculoskeletal complaints and 6% reported spells of all four complaints in the past 12 months. Subjects with back pain more often reported neck pain (41%) and hand/wrist pain (38%) than those without back pain (13% and 16%, respectively). Neck and hand/wrist pain was strongly associated since 50% of subjects with neck pain also experienced hand/wrist pain in the past 12 months. From those reported at least two musculoskeletal complaints, 26% suffered severe (chronic) complaints. With regard to musculoskeletal sickness absence when more than one symptoms were present, the probability of a period of sickness absence was significantly increased with odds ratios of 5.60 (95% CI 2.15–14.57), and 4.20 (95% CI 1.15–15.37) when back or hand/wrist complaints included, respectively. Chronic back pain and sickness absence were also significantly associated with odds ratios of 2.88 (95% CI 1.39–5.96).

One hundred thirty six dentists sought for medical care. By far they preferred to sought care from orthopedists (60% in cases of back and shoulder complaints and 50% for neck and hand/wrist complaints) followed by physical therapists. On the other hand, they visited less than two times for any problem an orthopedist while they visited more than six times a physical therapist (10 times for shoulder complaints). In total they paid more than 800 visits mainly in physical therapists (503) and orthopedists (272). 54 dentists paid visits for complaints in more than

one body site. GPs, neurologists, rheumatologists and others specialists have also been visited.

#### **Associations between risk factors and musculoskeletal complaints**

In tables 4 and 5 the univariate analyses for musculoskeletal disorders in the past 12 months adjusted for age are summarized. All risk factors were dichotomized before being entered into the logistic models. At least one physical risk factor was significantly related to the occurrence of low back, neck pain, shoulder, and hand/wrist. On the contrary, chronic complaints did not show any correlation with physical factors except hand/wrist complaints. Psychosocial aspects were less often associated with the occurrence of musculoskeletal complaints in the past 12 months than physical load. However lower job control was a significant factor of comorbidity of complaints. High need for recovery at the end of the workday and especially a perceived moderate/bad general health were significantly associated with most musculoskeletal complaints and sickness absence.

The results of the multivariate analyses on risk factors for the occurrence of back, shoulder and neck complaints are shown in tables 6 and 7. Perceived moderate/bad general health was the strongest risk factor with odds ratios varying from 2.69 to 3.35. For each musculoskeletal complaint at least one physical risk factor was important. None of the psychosocial factors remained significant after adjustment for other significant factors. Age and gender were significant only for neck pain. Educational level and working without breaks were significant factors for shoulder pain. Family situation (living alone) was significant for neck and shoulder pain. Height remained significant for hand/wrist complaints after adjustment for other significant factors.

**Table 5: Univariate associations between neck and hand/wrist pain in past 12 months and self reported risk factors**

Self reported risk factors	Neck pain OR (95% CI)	Hand/wrist OR (95% CI)
Strenuous shoulder movements	1.74 (0.99 to 3.06)	3.90 (2.24 to 6.79) *
Often use of vibrating tools	1.72 (0.90 to 3.30)	2.24 (1.13 to 4.44) *
Strenuous back postures	1.41 (0.90 to 2.22)	1.89 (1.19 to 3.01) *
Repetitive shoulder/hand movements	1.75 (1.03 to 2.97) *	2.31 (1.33 to 4.01) *
High perceived exertion	2.45 (1.55 to 3.86) *	2.09 (1.33 to 3.27) *
High job demand	1.36 (0.88 to 2.10)	1.18 (0.76 to 1.81)
Low job control	1.82 (1.17 to 2.82) *	1.45 (0.94 to 2.24)
High need for recovery	1.95 (1.24 to 3.07) *	1.85 (1.18 to 2.90) *
Moderate perceived general health	3.10 (1.98 to 4.85) *	3.35 (2.14 to 5.24) *

\*x<sup>2</sup> test, p < 0.05 OR = odds ratio; 95% CI = 95% confidence interval.

**Table 6: Self-reported risk factors and prevalence of musculoskeletal complaints in the past 12 months among dentists (n = 430) (multivariate analysis)**

Self reported risk factors	Low back pain OR (95% CI)	Shoulder pain OR (95% CI)
Age		
<40	1.00	1.00
40 – 50	0.72 (0.42 to 1.22)	1.31 (0.62 to 2.79)
50>	1.01 (0.57 to 1.78)	1.84 (0.92 to 3.67)
Higher educational level	NS	0.50 (0.28 to 0.90) *
Living alone	NS	2.65 (1.39 to 5.03) *
Working long hours	NS	3.68 (1.22 to 11.09) *
Exposure to Vibrating tools	NS	2.57 (1.01 to 6.51) *
Strenuous postures	1.59 (1.01 to 2.52) *	NS
Moderate perceived general health	3.35 (2.10 to 5.34) *	2.69 (1.50 to 4.81) *

\*x<sup>2</sup> test, p < 0.05 OR = prevalence ratio; 95% CI = 95% confidence interval.

**Table 7: Self-reported risk factors and prevalence of musculoskeletal complaints in the past 12 months among dentists (n = 430) (multivariate analysis)**

Self reported risk factors	Neck pain OR (95% CI)	Hand/wrist OR (95% CI)
Age		
<40	1.00	1.00
40 – 50	1.55 (0.78 to 3.05)	1.38 (0.72 to 2.65)
50>	2.12 (1.14 to 3.95) *	0.96 (0.53 to 1.75)
Sex		
men	1.00	NS
Women	2.41 (1.41 to 4.13) *	
Height		
<168 cm	NS	1.00
168 – 177		0.87 (0.48 to 1.60)
>177		0.47 (0.24 to 0.90) *
Living alone	1.87 (1.01 to 3.47) *	NS
High perceived exertion	1.92 (1.12 to 3.30) *	NS
Strenuous shoulder movements	NS	3.46 (1.85 to 6.45) *
Moderate perceived general health	2.95 (1.72 to 5.05) *	2.72 (1.62 to 4.55) *

\*x<sup>2</sup> test, p < 0.05 OR = prevalence ratio; 95% CI = 95% confidence interval.

The multivariate analysis on risk factors for chronic complaints and sickness absence showed different results from the analysis on musculoskeletal complaints in the past 12 months. For chronic complaints and absenteeism self-reported aspects of physical load were not found to be of any significance except for hand/wrist complaints (where strenuous shoulder/hand movements had significant OR between 3.27 for chronicity and 5.05 for absenteeism). Perceived moderate/bad health was the single most consistent and important risk factor for chronic back pain (OR = 2.48; 95% CI 1.26–4.87), chronic neck pain (OR = 3.93; 95% CI 1.96–7.88) and chronic hand/wrist pain (OR = 2.26; 95% CI 1.15–4.43). Living alone was also an important factor for chronic neck pain (OR = 4.86; 95% CI 2.35–10.03). For all complaints chronicity increased with age with significant odds ratios for those of 50 years or older varying from 2.15 to 2.69. Female gender was significantly related to chronic back pain (OR = 2.42; 95% CI 1.22–4.82) and chronic shoulder pain (OR = 4.51; 95% CI 1.72–11.85).

Comorbidity was elevated among those reported higher physical load, lower job control and working long hours. A bad/moderate perceived health, ageing and female gender was related with an increase not only in comorbidity but also in comorbidity of severe (chronic) complaints.

Age was not related in a constant way to absenteeism and female gender was related to absenteeism only due to low back pain (OR = 2.29; 95% CI 1.08–4.83). High perceived exertion did remain a significant factor in multivariate analysis for absenteeism due to low back pain (OR = 2.18; 95% CI 1.02–4.67), neck pain (OR = 4.00; 95% CI 1.09–14.64) and hand/wrist pain (OR = 4.37; 95% CI 1.18–16.26). Family situation (living alone) was the single most important risk factor for sickness absence due to shoulder pain (OR = 5.01; 95% CI 1.34–18.77) and hand/wrist pain (OR = 4.07; 95% CI 1.23–13.48). The hand/wrist related absenteeism increased also when kids younger than 13 years or invalid persons were present in home.

Ageing had a constant but mild influence in medical care seeking although had reached an OR of 4.5 in the oldest group of dentists. Especially for hand/wrist complaints, duration of employment had an additional effect. Comorbidity of severe (chronic) complaints was also a very important factor for medical care seeking with ORs between 2.27 and 4.20. Perceived exertion and high job demands were important factors for medical care seeking due to low back complaints.

## Discussion

In this cross-sectional study, we found high prevalences for back pain, neck, shoulder and hand/wrist complaints. Musculoskeletal comorbidity was high and a significant proportion of the subjects reported chronic complaints, medical care seeking and absenteeism. Self-reported physical risk factors were important for the occurrence of musculoskeletal complaints whereas age, gender and perceived moderate/bad general health were strongly associated with chronicity of complaints and medical care seeking. Musculoskeletal sickness absence was related to perceived exertion and family situation.

In this survey self-administered questionnaires were used to collect information about physical and psychosocial load and perceived health. The consistent inverted trend between age and all measures of physical load most likely reflects copying strategies, though experience and that is reflected in the lower need for recovery.

Occupational back pain among dentists had been reported between 37% and more than 55% [2,12-14]. For other body sites, data on prevalence of musculoskeletal complaints are sparse. Milerad and Ekewan found slightly higher prevalences than in our study, with 44% for neck and 51% for shoulder complaints [15]. However, in other reports similar to ours prevalences for neck and shoulder pain have been presented [16,17]. The sickness absence in our study is difficult to compare with absenteeism in similar studies because sparse and different absence rates have been reported. However, all studies confirm that sickness absence is much more frequent for back pain than for any other body site. Furthermore, our study showed higher prevalence of hand/wrist complaints in orthodontists while differences in prevalence of complaints between general dentists and specialists have been reported for many body sites [18].

Like most studies significant relations were found between self-reported physical risk factors and the occurrence of musculoskeletal disorders in various body sites. Since our study did control appropriately for concurrent risk factors, it was possible to disentangle the most important risk factors among the strongly interrelated factors of physical load, psychosocial load, and general health. The results demonstrate the importance to separate risk factors for the occurrence of musculoskeletal complaints from factors that determine their aggravation and consequences for disability. The occurrence of musculoskeletal complaints among dentists was associated with work-related physical load, which seems to be especially important for hand/wrist complaints. Work-related psychosocial factors played an inconsistent role in the development of chronicity of complaints. The strongest impacts in all outcomes under study i.e. occurrence, chronicity,

comorbidity and medical care seeking was held by perceived general health. Perceived health partly incorporate psychosocial factors as low control and working without breaks. High job demands increase the need for recovery, which is related to worst perceived health. This might reflect an influence particularly on more severe disease or an effect on people's ability to cope when symptoms occurred. The clear differences between work-related risk factors and general health with respect to the observed associations with different endpoints of musculoskeletal health calls for further exploration of these associations in various occupational groups and national settings. Compare with nurses in a similar study, dentists showed a significant lower need for recovery and much better perceived general health or subjective complaints [6].

These differences may reflect differences between socio-economic status and type of employment. Even though the cross-sectional design does not permit causal inference, the observed relations give valuable evidence for further research and policy making. It is advised in research projects to analyse in depth psychosocial factors and coping strategies involved in the occurrence and persistence of musculoskeletal complaints.

### Conclusions

The study results suggest that effective intervention strategies most likely have to take into account both ergonomic improvements and cognitive-behavioral aspects. Hand/wrist complaints are of most importance in terms of occupational related musculoskeletal disorder and ergonomic and educational interventions could hold a prominent role in its prevention.

Chronic complaints hold a central role in absenteeism and medical care seeking. Especially, comorbidity of chronic complaints is highly related to increase cost of disorders. Taking into account interrelations of perceived health as expressed by various complaints, psychosocial characteristics like lower job control and family situation hold also significant roles.

### Competing interests

None declared.

### Authors' contributions

EC Alexopoulos designed the study protocol, managed the co-ordination, performed the statistical analysis and drafted the manuscript.

IC Stathi participated in the design, managed the data collection and participated in the analysis.

F Charizani participated in the design, analysis and co-ordination.

All authors read and approved the final manuscript.

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