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Predictors of work-related musculoskeletal disorders among dental hygienists

Abstract: *Objectives:* Work-related musculoskeletal disorders (MSD) have been recognized as a considerable problem for the dental hygiene profession, with the majority of professionals reporting musculoskeletal pain. The aim of this study was to investigate which risk factors may help predict MSD among Australian dental hygienists. *Methods:* A modified version of the Standardised Nordic questionnaire was distributed to registered hygienists throughout Australia. *Results:* Logistic regression analysis revealed a variety of work-related and psychosocial factors that correlate with reported MSD, including scaling tasks, type of practice and work interference in home life. Statistical predictors for non-reporting of MSD included wearing loupes, ergonomics education and wage satisfaction. Concerning is the impact on the profession, with an association between MSD and hygienists considering reducing working hours or even alternate careers. *Conclusions:* In general, it appears as though the causes of MSD among dental hygienists may be multifactorial, as may be the solutions to this problem. Further research is required to objectively examine whether controllable variables can be implemented as preventive strategies or interventions for MSD.

Key words: musculoskeletal disorders; dental hygienists; occupational health

Introduction

Musculoskeletal disorders (MSD) are widely acknowledged as one of the most common workplace injuries, with health systems around the world spending billions of dollars annually on this occupational health issue (1, 2). Work-related MSD often occur as a result of cumulative trauma and can affect the bones, muscles and their attachments, as well as the nerves and blood supply (3). A significant body of research has identified that dental professionals in particular are at an increased risk of MSD, with prevalence rates reported at between 64% and 93% (4, 5). This negatively impacts on productivity and job satisfaction (6), leading to dental professionals considering alternate careers.

Work-related tasks are widely considered to be the chief cause of MSD in dental hygienists. It is postulated that the repetitive scaling tasks and awkward positioning are the main contributing factors for MSD (6, 7). In recent times however, it has come to light that psychosocial factors may also be contributing to MSD in health professionals (8–11), and this may be the case for dental hygienists. Despite these facts, there are very few studies examining which of the spectrum of risk factors are predictive of MSD in the dental hygiene profession. It is essential that predictors of

MSD are carefully investigated, so that preventive strategies and interventions can be appropriately targeted.

In Australia, the profession of dental hygiene is rapidly expanding, with a number of new baccalaureate programmes established in the last decade. This particular cluster of dental hygienists is ideal for surveying; mapping the epidemiological patterns of MSD in a young and growing profession will contribute significantly to existing research.

Hence, the aim of this study was to investigate which risk factors may help predict MSD among Australian dental hygienists.

Methods

The study was exploratory and descriptive in nature and was approved by a University Human Research and Ethics Committee.

Survey instrument

A five-page modified version of the Standardised Nordic Questionnaire (12) was completed by participants. The questionnaire was adapted from a version recently used among healthcare workers (11, 13, 14) and health sciences students (15–17), including dental hygiene students (18), and was peer-reviewed by a selection of dental hygienists and academics. The questionnaire consisted of a number of tick-box style questions and two short answer responses, covering demographic items, registration status, qualifications, current work habits, psychosocial factors, ergonomics education and musculoskeletal symptoms. To assist participants in answering questions focusing on musculoskeletal symptoms, an anatomical diagram was used to clearly identify body regions.

Procedures

All dental hygienists currently registered with their State Dental Board in September 2009 were recruited for this study. Where available, public lists of registered hygienists were used to recruit participants via post; where unavailable, State Dental Boards were contacted and agreed to complete a mail-out on behalf of the research team. Registered dental hygienists were sent a questionnaire and a participant information statement outlining the purpose of the research. Voluntary completion and return of the questionnaire implied informed consent.

Data analysis

Data were entered into a generic spreadsheet program and analysed using the STATA (version 10; College Station, TX, USA) statistical software package. Logistic regression analysis was performed to establish the predictors of MSD, with results expressed as odds rations (OR) with 95% confidence intervals (95% CI) and P values. The level of statistical significance was set at $P < 0.05$. All calculations were adjusted for age, gender, height and weight.

Results

Population under study

A total of 624 questionnaires were returned, with calculations estimating a 42% coverage rate. Comparison of demographic characteristics with National Labour force surveys indicates that the responders were representative of the entire profession (19). A number of questionnaires ($n = 64$) were excluded because of either participants not working predominantly as dental hygienists or incompleteness; as such, only 560 questionnaires could be used in the final analysis.

Predictors of MSD

Logistic regression analysis revealed a number of predictors of MSD, which are presented in Table 1. The type of practice respondents worked in correlated with the reports of MSD, with those hygienists working in a general private practice more likely to report shoulder pain (OR: 1.53, 95% CI 1.00–2.34, $P < 0.05$), while those working in periodontal practices were more likely to report forearm pain (OR: 2.42, 95% CI 1.19–4.90, $P < 0.01$). The types of scaling tasks performed in a typical working week were also influential, with hygienists who hand-scaled reporting neck pain (OR: 4.22, 95% CI 1.26–14.09, $P < 0.02$) and those using ultrasonic scalers reported pain lasting more than 2 days in the shoulder (OR 3.11, 95% CI 1.20–8.05, $P < 0.02$), upper back (OR: 3.43, 95% CI 1.24–9.44, $P < 0.02$) or lower back (OR: 2.76, 95% CI 1.07–7.13, $P < 0.04$) regions.

Protective effects against MSD

Table 2 presents those factors that were negatively correlated with MSD. Those hygienists who wear loupes were less likely to have any shoulder (OR: 0.46, 95% CI 0.27–0.78, $P < 0.01$) or wrist/hand pain (OR: 0.47, 95% CI 0.28–0.80, $P < 0.01$) than those not wearing loupes. Those wearing loupes were less likely to experience neck (OR: 0.55, 95% CI 0.33–0.92, $P < 0.02$) or upper back pain (OR: 0.58, 95% CI 0.34–0.99, $P < 0.05$) lasting more than 2 days.

Impact of MSD

Reporting of MSD was correlated with numerous workforce impacts, and these results are presented in Table 3. Hygienists reporting neck pain were more likely to have time off from work (OR: 2.4, 95% CI 1.27–4.41, $P < 0.01$) or to be considering reducing work hours (OR: 6.65, 95% CI 1.59–27.88, $P < 0.01$) than those without neck pain. Those reporting pain in the forearm region were also more likely to report time off than their healthy counterparts (OR: 1.86, 95% CI 1.19–2.89, $P < 0.01$) but were also more likely to be considering alternate careers (OR: 2.67, 95% CI 1.54–4.63, $P < 0.01$). Similarly, time off (OR: 2.11, 95% CI 1.35–3.29, $P < 0.01$) and considering changing careers (OR: 2.18, 95% CI 1.11–4.26, $P < 0.02$) were also predicted by reports of lower back pain.

Table 1. **Statistical correlates and predictors of MSD**

Body region	Type of pain	Predictors	Category	OR*	(95% CI)	*P*-value
Neck	Any pain	Work interference in home life†	Rarely	2.63	1.37–5.06	<0.01
			Sometimes	2.64	1.40–4.98	<0.01
			Often	3.36	1.31–8.61	0.01
	Any pain	Handscaling in a typical working week	Yes	4.22	1.26–14.09	0.02
Shoulder	Any pain	Working in a general private practice	Yes	1.53	1.00–2.34	0.05
	Any pain	Left previous employment owing to MSD	Yes	5.85	1.32–25.94	0.02
	Any pain	Involvement in practice decisions†	Rarely	4.05	1.96–8.37	<0.01
			Sometimes	2.33	1.37–3.96	0.02
			Often	1.80	1.05–3.07	0.03
	>2 days	Ultrasonic use in typical working week	Yes	3.11	1.20–8.05	0.02
Upper back	>2 days	Ultrasonic use in typical working week	Yes	3.43	1.24–9.44	0.02
	Any pain	Involvement in practice decisions†	Never	2.90	1.09–7.74	0.03
			Rarely	2.51	1.32–4.74	0.01
			Sometimes	2.93	1.73–4.94	<0.01
			Often	2.20	1.30–3.72	<0.01
Elbows	Any pain	Years practising	Increasing	1.05	1.00–1.09	0.04
Forearms	Any pain	Working in a periodontal practice	Yes	2.42	1.19–4.90	0.01
Wrist/hand	Any pain	Work interference in home life†	Rarely	1.70	1.02–2.83	0.04
			Sometimes	2.23	1.34–3.73	<0.01
	>2 days	Hours working per week	Increasing	1.17	1.01–1.35	0.04
Lower back	>2 days	Ultrasonic use in typical working week	Yes	2.76	1.07–7.13	0.04
Knees	Any pain	Support of dental assistants	Sometimes	2.96	1.16–7.54	0.02
Ankle/feet	Any pain	Left previous employment owing to MSD	Yes	3.93	1.42–10.86	0.01

MSD, musculoskeletal disorders.
*Expressed as adjusted odds ratios (OR) with 95% confidence intervals (95% CI) (all values adjusted for gender, age, weight and height).
†When 'nearly always' is used as the reference value.

Table 2. **Statistical predictors for non-reporting of MSD**

Factor	Body region	Type of pain	OR*	(95% CI)	*P*-value
Loupes	Neck	Pain lasting >2 days only	0.55	0.33–0.92	0.02
	Shoulder	Any pain	0.46	0.27–0.78	0.00
	Upper back	Pain lasting >2 days only	0.58	0.34–0.99	0.05
	Wrist/hand	Any pain	0.47	0.28–0.80	<0.01
Years practice (increasing)	Upper back	Any pain	0.96	0.93–0.99	0.01
Working with an assistant	Shoulder	Any pain	0.64	0.45–0.92	0.01
Working in an orthodontic practice	Wrist/hand	Any pain	0.58	0.38–0.90	0.02
	Lower back	Any pain	0.49	0.32–0.77	<0.01
Satisfied with wage	Upper back	Any pain	0.61	0.40–0.92	0.02
Education on operator chair position	Shoulder	Any pain	0.62	0.42–0.92	0.02
Education of patient chair position	Wrist hand	Any pain	0.64	0.49–0.98	0.04

MSD, musculoskeletal disorders.
*Expressed as adjusted odds ratios (OR) with 95% confidence intervals (95% CI) (all values adjusted for gender, age, weight and height).

Discussion

This study examined the variables that predict reported MSD in Australian dental hygienists. It is not surprising that work tasks such as handscaling and ultrasonic scaling were predictive of reported MSD, as this has been suggested previously. This finding is consistent with results reported in a study of practising hygienists in Sweden, in which scaling work predicted upper body pain (20), and also a study of dental hygiene students whereby increased hours using both manual and vibratory instruments correlated with MSD (21). It is also not unexpected that we identified a correlation between increasing work hours and wrist pain. A number of studies have found similar results, with heavy workloads often predictive of MSD; Canadian hygienists working 5–6 days per week reported more shoulder pain (22), while Israeli hygienists working more than 34 h per week reported cumulative trauma disorders (23). These findings are problematic, in that hygienists have a career that involves repeatedly performing scaling tasks over many working hours. Perhaps increasing the scope

Table 3. **Impact of pain (any)**

Impact	Body region	OR*	(95% CI)	*P*-value
Have reduced weekly hours	Elbows	4.12	2.33–7.30	<0.01
	Hips/thigh	2.06	1.15–3.68	0.02
Time off	Neck	2.4	1.27–4.41	0.01
	Lower back	2.11	1.35–3.29	<0.01
	Forearms	1.86	1.19–2.89	<0.01
	Hips/thigh	1.64	1.01–2.66	0.04
Considering reducing hours	Neck	6.65	1.59–27.88	0.01
	Shoulder	2.61	1.32–5.15	0.01
	Elbows	3.34	1.84–6.07	<0.01
	Wrist/hand	1.93	1.10–3.38	0.02
Considering alternate career	Upper back	3.71	1.78–7.73	<0.01
	Forearms	2.67	1.54–4.63	<0.01
	Lower back	2.18	1.11–4.26	0.02

*Expressed as adjusted odds ratios (OR) with 95% confidence intervals (95% CI) (all values adjusted for gender, age, weight and height).

of practice or encouraging hygienists to seek alternate career options such as teaching or research can reduce MSD in the profession.

An increasing body of research is investigating the effect of psychosocial factors on MSD. This study revealed that hygienists who perceived that work interfered in their home life, who were not involved in decision making or who felt unsupported by staff members were more likely to report MSD. Similarly, work and family overload has been previously correlated with Swedish hygienists reporting MSD, particularly in the neck and upper body (20). In a similar study, working relationships also impacted on reports of upper body MSD (24). A systematic review of upper extremity pain has found that perceived high levels of job stress and high job demands are consistently associated with upper limb problems, across a variety of professions (8).

In contrast to previous research, this study was the first to examine the effect of all types of work practice on reported MSD. It is not surprising, however, that working in a periodontal practice was predictive of forearm pain; hygienists in these practices work in a very repetitive nature (more so than other hygienists) performing a narrower range of tasks, usually restricted to periodontal maintenance therapy. It is also not extraordinary to find that working in an orthodontic practice has a protective effect; hygienists in these practices perform a greater range of duties and less repetitive scaling tasks than their professional counterparts. Nevertheless, it is beneficial to have such evidence to support what was postulated anecdotally. Earlier research in Canada has only examined the difference between general and 'other' practices and found that hygienists working in practices other than general practice reported more shoulder pain (22).

Like the present study, many other studies investigating predictors of MSD have examined a comprehensive list of factors and only found that a small handful of those predict MSD at a statistically significant level (6, 23). While it is clear that this occupational health issue is multifactorial, it is not clear why it is difficult to clearly define the predictors for this problem. Perhaps it needs to be considered whether certain individuals are at a higher risk of developing MSD. An individuals' general state of health may require more attention, possibly including a more detailed medical history or measures of hormone levels and blood pressure.

Several of the factors investigated displayed a protective effect against MSD. Participants who indicated that they regularly wore loupes were less likely to report MSD than those hygienists who do not. It has been shown in previous studies that wearing loupes improves posture (25, 26), and the theory is that this subsequently reduces the likelihood of suffering from a MSD (27); our finding supports this inference. A protective effect was also noted for those who reported receiving ergonomics education, in particular operator and patient chair positioning. While much of the research into MSD among dental hygienists has emphasized the importance of ergonomics education (21, 28–30), little research has investigated what aspects of ergonomics education are most important and whether these instructions are actually used to prevent MSD.

Conclusion

Overall, our study suggests that there are a number of risk factors that are predictors of MSD among Australian dental hygienists, including both work-related tasks and psychosocial factors. Equally important was the fact that a number of factors were elucidated to have a protective effect against reported MSD in this study. Further studies are now required; clinical trials need to objectively examine whether controllable variables such as wearing loupes and ergonomics education can be implemented as preventive strategies or interventions for MSD.

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