

Musculoskeletal disorders amongst practising South African oral hygienists

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S J Booyens: *Dip (MH) MSc (Odont), Pretoria BA (Unisa) Dip Spr (NKP), Department of Community Dentistry, School of Dentistry, University of Pretoria*

P J van Wyk: *BSc MChD PhD Dip Pupil, Admin (Pretoria), Department of Community Dentistry, University of School of Dentistry, University of Pretoria*

T C Postma: *BChD MChD DHSM (Pretoria), Department of Dental Management Sciences, School of Dentistry, University of Pretoria*

Corresponding Author:

S J Booyens: *Dip (MH) MSc (Odont), Pretoria BA (Unisa) Dip Spr (NKP), Department of Community Dentistry, School of Dentistry, University of Pretoria*

ABSTRACT

Objectives:

The study sought to determine the level of musculoskeletal disorders among working oral hygienists in South Africa and potential determinants that are associated with these disorders.

Methods:

Oral hygienists registered with the HPCSA were requested to complete an anonymous questionnaire. Apart from demographic information they were asked to report on any musculoskeletal symptoms experienced in the hands, neck, shoulders and lower back as well as details of workload, types of scaling procedures, size of instruments, the mobility of the operator's chair and the adjustability of patient chairs.

Results:

Of the 362 respondents, 61.3%, 66.5%, 56.6% and 59.6%, experienced hand, neck, shoulder and lower back symptoms respectively. Twenty-eight percent of the respondents performed hand-scaling for more than four hours per day. Twenty-six percent reported immobile operator chairs, while 12.6% reported patient chairs that were difficult to adjust. Employing multivariate analysis, excessive hand scaling was associated with hand and shoulder symptoms, while immobile operator's chairs and poorly adjustable patient chairs were respectively associated with neck and lower back problems.

Conclusions:

The prevalence of work-related musculoskeletal disorders in practising oral hygienists in South Africa appears to be similar to that in developed countries. Significant determinants of musculoskeletal disorders may be immobile operator stools, poorly adjustable patient chairs and excessive hand-scaling daily.

Keywords:

Occupational health and safety, musculoskeletal disorders, predisposing factors, developing country, South Africa

INTRODUCTION

Work-related musculoskeletal disorders constitute a common problem for oral health care workers¹ and the prevalence of these disorders is well researched among oral hygienists in the devel-

oped world²⁻⁶. Data in this regard, however, is lacking for developing nations such as South African oral hygienist / oral health care workers. Apart from a single minor article published on carpal tunnel syndrome in 1985⁷, no other empirical data exists for South Africa oral hygienists / oral health care workers. South Africa is a developing country with gross socio-economic disparities⁸ in which 949 registered oral hygienists work in both the private and the public sectors, the latter being often under-resourced. Distinct possibilities exist that some equipment used in clinics and dental practices in South Africa are not designed according to the latest ergonomic standards. This fact may subsequently impact on the well-being of oral health care workers, such as oral hygienists. A need therefore exists to examine the prevalence and causes of musculoskeletal disorders which affect oral hygienists engaged in active practice in South Africa.

Most of the studies from developed countries report a prevalence of work-related musculoskeletal disorders well in excess of 50%²⁻⁶. One of the main areas of complaint is the hands, which are often affected by carpal tunnel syndrome^{2,9}. Symptoms of musculoskeletal problems of the hands include tingling in the fingers, numbness and night pain². Factors that may have an influence on the severity of musculoskeletal symptoms in the hand are the use of hand pieces and vibratory instruments, the number of patients with heavy calculus treated per day, the number of working days per week and the numbers of years engaged in dental practice^{3, 10-13}. Medical problems such as diabetes mellitus⁵, osteo- or rheumatoid arthritis, recent pregnancy, hormonal and / or anti-inflammatory medication may also contribute to these problems¹³⁻¹⁵. Past or present history of trauma to the hand and / or wrist will also aggravate symptoms experienced in the hand¹⁵.

Musculoskeletal symptoms related to the shoulders, neck and lower back^{3,14,16} are also commonly reported. Predisposing factors such as repetitive motion, pinch grip, force, and prolonged awkward positions, and monotonous work that demands utmost precision, concentration and visual fixation¹⁷, may lead to the development of musculoskeletal disorders. The prevention of musculoskeletal disorders in the dental practice should focus on the avoidance of repetitive work such as hand scaling¹⁸, correct working posture and sitting positions¹⁹, as well as the use of ergonomically designed equipment²⁰⁻²¹.

In the absence of such empirical evidence for South Africa, this study was conducted to investigate the prevalence and potential determinants of musculoskeletal symptoms affecting practising oral hygienists in South Africa.

METHODS

Questionnaire

Following a thorough literature review a questionnaire was designed to determine the prevalence and potential determinants of work-related musculoskeletal symptoms affecting oral hygienists in South Africa. The questionnaire included demographic information such as geographical location (per province [Table 1]) and age of respondents, which was categorized in 10-year cohorts starting at 20-29 years. Similarly, the number of years in practice as an oral hygienist and the number of patients treated per day were recorded in intervals of five, as well as the number of days per week involved in practice. The weekly workload was calculated by multiplying the number of days worked per week with the number of patients treated per day (using the minimum number of the interval). The type of practice was recorded either as a general dental practice, periodontics, orthodontics, prosthodontics, oral-facial surgery or "other", which had to be specified. Symptoms, which included pain during working hours, pain at night, morning stiffness, numbness and tingling feelings, were all recorded. In terms of the hand, loss of strength and problems with instrument grip were also enquired about and were considered negative symptoms.

Characteristics of the operator's chair were examined in terms of its mobility and the presence or absence of wheels, arm- and back support. Adjustability of the patient's chair was determined either by a 'yes' or a 'no' response. Respondents also had to indicate whether they were engaged in hand scaling and subsequently had to indicate the number of hours per day in which they were involved in this type of activity. Similar responses were anticipated for questions on sonic/ultrasonic scaling, polishing of teeth with a polishing hand piece and orthodontic treatment (specifically assisting with banding). Respondents were asked to indicate whether they rested between patients and if so, for what period and how often they exercised their hands, backs, necks and shoulders. They also had to indicate how many times per week they were engaged in any other type of exercise such as jogging, walking and whether they exercised in a gymnasium. Respondents were finally requested to complete a medical questionnaire, on which they were to indicate whether they suffered from arthritis, diabetes, gout, and whether or not they were receiving oestrogen therapy; whether they were pregnant or using contraceptives. Previous incidents of trauma and/or treatment (type of treatment was not specified) to the fingers, hands, wrist, shoulder neck and lower back were also recorded.

It must be noted that the custom designed questionnaire was not tested for its psychometric properties and the result of this study will hence provide the first evidence of whether the questionnaire may be valid or not.

Data collection

Questionnaires were sent to the 949 oral hygienists registered with the Health Professions Council of South Africa (HPCSA) during 2005/2006²². An accompanying letter explained the purpose of the study and assured anonymity of respondents' responses. In order to maximise the response rate, the oral hygienists were subsequently reminded at three occasions of three months intervals during the

Table 1: Geographical distribution of the respondents compared with the total registered oral hygiene work force in South Africa

Province	HPCSA registrations	Respondents	%
Gauteng	365	155	42
Eastern Cape	39	14	36
Free State	45	14	31
Kwa-Zulu Natal	80	36	45
Limpopo	36	10	28
Northern Cape	12	4	33
Mpumalanga	44	15	34
Western Cape	297	98	33
Northern Cape	31	12	39
Total	949	358	37.7

Chi-square, $p = 0.76$

study period to complete and return their questionnaire. Responses were returned in sealed envelopes provided by the researcher and the data captured and analysed by the Biostatistics Unit of the Medical Research Council of South Africa.

Statistical analysis

The Chi-squared method of statistics was used to assess the geographical representation of the respondents. Logistical regression models were constructed to examine the independent association between any neck, shoulder, lower back and hand symptoms and the variables: age, number of years in practice, the presence of a medical history related to the respective body part which may have an influence on an adjacent body part; reporting of hours of exercise as well as hand- and sonic/ultrasonic scaling, operator chair mobility, arm and back support and the adjustability of the patient chair. Only variables that had a p-value of less than 0.3 were retained in the model. For the purpose of the analysis the fingers and wrist were considered to be part of the hand. The level of statistical significance was set at $p < 0.05$.

RESULTS

The response rate for this study was 38% ($n=362$). The geographical distribution (Table 1) of the oral hygienists registered with the HPCSA and that of the respondents did not differ significantly, $p=0.76$.

Ninety-two percent of the respondents were employed in private dental practices, while the remaining 8% worked either in the public sector or as representatives of dental companies. Of those working in private practices, 75.2% were employed by general dental practitioners while 40.5% worked for dental specialists. These figures do not add up to a 100% since a large portion of the oral hygienists worked in both general dental practices as well as for dental specialists. Of those working for dental specialists, 70.2% were employed by orthodontists. The distributions of the respondent's age, number of years in practice, number of working days per week in practice, and patients treated per day are summarized in Table 2.

About 76.9% participated in general exercise such as jogging, regular exercise in a gymnasium or walking. Most of the oral hygienists (34.2%) exercise three times a week while 24.1% exercise twice a week.

Bivariate analysis (Chi-squared test) did not show any significant association between any of the musculoskeletal symptoms and

Table 2: Percentage distribution: Age of the respondents, years in practice, and days per week in practice

	n	%
Age (Years)		
20-29	120	33.1
30-39	136	37.3
40-49	87	24.0
50-59	20	5.5
60+	0	0.0
Years in Practice		
1-5	106	29.4
6-10	74	20.6
11-15	72	20.0
16-20	53	14.7
22-25	37	10.3
26+	18	5.0
Working days per week in practice		
1	9	2.5
2	23	6.4
3	45	12.6
4	52	14.6
5	202	56.6
6	26	7.3
Number of patients treated per day		
0-5	52	14.4
6-10	138	38.3
11-15	92	25.6
16-20	36	10.0
21-25	18	5.0
26+	24	6.7

medical history reports of pregnancy (or recent pregnancy), oestrogen therapy, the use of contraceptives or diabetes, and hence these factors were not included in the logistical regression models.

Hand

At least 61.3% of the respondents indicated that they had experienced one of the hand symptoms, while 17.9% reported that they had either suffered from arthritis, gout, trauma or had had treatment to the hands, fingers or wrists. Twenty-eight percent of the respondents performed hand scaling in excess of four hours per day, 39.2% hand scaled between one to four hours per day and 32.8% of the sample did not engage in hand scaling at all. Of the respondents, 41% and 34.3% respectively, spent one to four hours, and five or more hours on sonic/ultrasonic scaling. Moreover, 24.8% did not perform sonic/ultrasonic scaling at all. Only 25% of the respondents exercised their hands.

The multivariate analysis showed that hand scaling for five or more hours per day and the number of patients per week significantly ($p < 0.05$) increased the likelihood for a positive report of hand symptoms (Table 3).

Neck and shoulder

Of the respondents, 66.5% reported at least one of the neck symptoms, 56.6% reported a shoulder symptom, while 23.9% and 7.2% reported trauma or previous treatment to the neck and shoulders, respectively. More than a quarter (26%) of the respondents worked on immobile operator chairs, 9.7% of the chairs having no back support and 21.4% had no arm support.

A medical history of trauma or treatment to the neck, the presence of shoulder symptoms and the limited mobility of the operator chair, showed independent associations with the presence of neck symptoms (Table 4). Conversely, neck symptoms and hand scaling for five hours or more per day were independently associated with shoulder symptoms (Table 5).

Table 3: The multivariate association between potential predisposing factors and hand symptoms

	Presence of a hand symptom OR (95% CI)
Medical history (yes=1/no=0)	1.52 (0.84-2.73)
Hand exercises (yes=1/no=0)	1.29 (0.84-1.98)
Workload (patients per week)	1.01 (1.00-1.02)*
Hand scaling	
<1 hour (0)	Reference
1-4 hours (half-day) (1)	1.78 (0.99-3.23)
5-8+ hours (full day) (2)	2.10 (1.13-3.92)*

* $p < 0.05$

Table 4: The multivariate association between potential predisposing factors and neck, shoulder and lower back symptoms

	Presence of symptoms in the		
	Neck	Shoulder	Lower Back
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Age (years)	0.97 (0.94-1.01)	1.02 (0.99-1.06)	0.98 (0.95-1.01)
Medical history (yes=1/no=0)	5.74 (2.42-13.64)*	dropped	2.96 (1.41-6.23)*
Shoulder impact (yes=1/no=0)	6.13 (3.53-10.65)*	dropped	dropped
Neck impact (yes=1/no=0)	dropped	7.56 (4.40-13.00)*	dropped
Workload (patients per week)	dropped	dropped	1.01 (0.99-1.02)
Hand scaling			
<1 hour (0)	Reference	Reference	Reference
1-4 hours (1)	1.02 (0.54-1.91)	1.43 (0.80-2.56)	0.86 (0.47-1.56)
5-8+ hours (2)	0.57 (0.29-1.13)	2.22 (1.15-4.26)*	0.70 (0.38-1.29)
Sonic/Ultrasonic scaling			
<1 hour (0)	dropped	dropped	Reference
1-4 hours (1)	dropped	dropped	1.86 (0.98-3.51)
5-8+ hours (2)	dropped	dropped	1.34 (0.71-2.51)
Operator chair			
Immobility (yes=1/no=0)	1.90 (1.01-3.57)*	dropped	dropped
Lack of arm support (yes=1/no=0)	dropped	1.67 (0.92-3.04)	dropped
Patient chair			
Difficult to adjust (yes=1/no=0)	dropped	dropped	3.82 (1.51-9.70)*

* $p < 0.05$

Lower back

Approximately 59.6% indicated lower back symptoms and 15.4% reported trauma or previous treatment to the lower back.

A medical history (Table 4) of trauma or lower back treatment and a patient chair that is difficult to adjust, independently increased the likelihood of lower back symptoms. It was noted that 12.6% of patient chairs were difficult to adjust.

DISCUSSION

Although the response rate of this study was relatively low, the results of the study show that the geographical distribution of the oral hygienists who responded to the questionnaire does not differ significantly from the geographical distribution of the total population of registered oral hygienists in South Africa and that

the group who responded to the questionnaire could therefore be regarded representative of oral hygienists in South Africa.

The results of the current study confirm a prevalence of musculoskeletal symptoms in excess of 50%, which was also the level measured in a number of other similar studies¹⁴. As in a previous study³ age was not identified as an independent risk factor for musculoskeletal problems. Unlike previous studies^{3,10-13} factors such as years of experience in practice was not associated with musculoskeletal symptoms when subjected to multivariate analysis in the current study. Only workload (number of patients per week) was shown to have a significant association with hand symptoms.

The results of this study also show that hand scaling was significantly associated with musculoskeletal symptoms in the hand and that the "level" of such symptoms is directly proportional to the time spent on hand scaling (Table 3). This is probably related to the number of patients with heavy calculus treated per day; hand scaling entails a repetitive motion accompanied by a forceful grasp and has been identified as a predisposing factor in previous studies^{3,11-14}. Most alarming is the high percentage (28%) of oral hygienists who still perform hand scaling for extended periods of time. Unlike previous studies^{5,12} a medical history of hand problems and treatment did not show significant correlation.

Excessive hand scaling was not only associated with hand symptoms but also with shoulders symptoms. This association between excessive hand scaling and shoulder symptoms may be explained by the fact that the oral hygienists are performing precision work which requires a certain amount of static loading on the neck and shoulder muscles¹⁷. To perform the task, the limb must therefore be stabilized by isometric muscular contractions around the proximal (shoulder) joints. The greater the precision in the work, the more stability is needed¹⁷. Constant muscle contractions have therefore the potential to cause musculoskeletal disorders.

The current study shows that at least one in four oral hygienists is using an immobile operator stool and that one in eight uses a patient chair that is difficult to adjust. The evidence gained from this study suggests that the immobility of the operator chair may play a significant role in the development of neck pain, whereas a patient chair that is difficult to adjust may predispose neck and lower back symptoms. In order to improve the design of dental stools, Marklin²³ studied the working postures of dentists and oral hygienists. He found that both dentists and oral hygienists spent at least half of their time working with their necks flexed 60° or more, their trunks flexed 30° or greater and one of their shoulders abducted. The typical working position for right-handed dentists and oral hygienists is to abduct the left shoulder and to hold the right arm close to the trunk. Because of the mechanical disadvantage of the muscles with respect to their joints, flexed and abducted joint postures require high muscle forces to hold these static postures. The high muscle forces then produce high compression loads on the joint²³. Postures assumed by dentists and oral hygienists can require sizeable muscle forces, and concomitantly, high compression loads on the joint. The clinical consequences of prolonged, flexed or abducted postures of the joints may be muscle- or even neuromusculoskeletal pain in the neck, shoulder and lower back. Neck and the back symptoms may originate from the forward bending of the head or trunk to compensate for an operator chair which is not mobile or a patient chair that is difficult to adjust, thereby placing a static load on the head, shoulders and arms plus the joints which are in an unnatural posture and with underlying muscular weakness it can lead to dys-

function of various structures. Because of this static contraction of the muscles there is virtually no change in the muscle fibres length, which in turn may lead to musculoskeletal complaints²³. Moreover, the sustained static muscle contraction stretches the tendons and compresses the vascular supply to the muscle and surrounding tissues, thereby reducing the nutrient and oxygen supply. Lactic acid and other metabolites subsequently accumulate in the muscle tissues²⁴, which may result in muscle damage or a painful sensation.

Gerwatowski *et al*, Caruso *et al* and Jones^{18-19,25} recommended prevention and rehabilitation using specific exercises. This study failed to show any association with general exercise, exercises of the hands or rest periods.

The results of this study appear logical and correspond with data already published. Hence, the questionnaire appears to be valid although improvements could be made. The anatomical boundaries were not visually defined by means of a body chart in the questionnaire in order for the respondents to clearly distinguish the areas described. Therefore some measurement bias might have occurred, for example, between shoulder and neck symptoms. This bias was, however, partly addressed by controlling for the symptoms in the adjacent body part in the logistical regression model, for example, by including shoulder symptoms in evaluating neck symptoms and vice versa. In both cases significant associations were shown, thereby indicating a requirement for the provision of anatomical boundaries in other similar studies. Furthermore, the cross-sectional nature limits the extent to which cause and effect may be established. Nevertheless this "one of a kind" study in South Africa provides valuable empirical evidence regarding potential predisposing factors for musculoskeletal disorders suffered by practising oral hygienists.

CONCLUSION

The prevalence of work-related musculoskeletal symptoms in the responding South African oral hygienist population appeared to be similar to that reported in developed countries. Disconcertingly high percentages of the respondents were utilising immobile operator stools and patient chairs that were difficult to adjust. These factors in addition to hand scaling in excess of five or more hours per day may contribute to preventable work-related musculoskeletal disorders in practising oral hygienists in South Africa.

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Additional references (5-25) are available on www.sada.co.za