Work Environment of Dental Hygienists

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Objective: *We sought to evaluate how musculoskeletal disorders and workplace psychosocial factors affect dental hygienists' work hours and productivity.* ***Methods:*** *We mailed a survey to dental hygienists in Los Angeles and Orange Counties, California.* ***Results:*** *Musculoskeletal pain caused 27% of hygienists to decrease work hours and 8.7% to change office locations. Hand/wrist pain caused the most missed workdays. Conversely, conflicts with the dentist caused 28.2% of dental hygienists to change jobs and 12.7% to decrease work hours. Conflicts with staff caused 17.1% to change office locations but only 7.0% to decrease work hours. This pattern was confirmed with multiple logistic regression analyses.* ***Conclusions:*** *Musculoskeletal and psychosocial factors affect dental hygienists differently: musculoskeletal discomfort is more likely to cause dental hygienists to decrease their working hours, whereas professional and social conflicts are more likely to lead to change in work location.* (J Occup Environ Med. *2005;47:633–639*)

Dental hygienists are health professionals who specialize in oral hygiene. In 2002, 148,000 were employed in the United States according to the Bureau of Labor Statistics.[1] Studies have shown that musculoskeletal disorders are frequent; common problems include carpal tunnel syndrome[2–8] and neck, arm, shoulder, and back pain.[7,9–12]

Ergonomics and work organization factors are likely to contribute to musculoskeletal pain. The nature of the profession requires a dental hygienist to maneuver his or her body in asymmetric positions, exert forces with awkward body postures, and hold his or her trunk and neck in static positions for prolonged periods. Novel but more limited research has assessed mental well-being[13,14] and its relationships with work organization and structure.[15,16]

We previously conducted a qualitative research study (focus-groups) to identify the range of workplace concerns of dental hygienists.[41] The analysis indicated that work organizational and psychosocial factors were at least as frequent as musculoskeletal concerns. The current formal survey study therefore assessed the relationship between musculoskeletal pains, ergonomic factors, work organization, and work-related psychosocial dynamics in Southern California dental hygienists. In particular, this study explored the relationships between workplace factors and productivity.

Materials and Methods

A mail survey was implemented to evaluate the frequency of adverse health outcomes, describe dental hygiene work, and assess frequency of adverse conditions. The question-

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naire was distributed via mail to all members of the California Dental Hygienists Association who live in the Los Angeles and Orange Counties.

Based upon review of the published literature as well as five focus groups,[41] a 158-item questionnaire was developed and pilot tested. The focus group research project had suggested several distinct outcomes: musculoskeletal discomfort, reducing work hours, missing workdays, and changing work locations. Therefore, these outcomes were assessed independently. Particular emphasis was placed on topics uncovered during the focus groups but not previously investigated in detail. Musculoskeletal questions were based upon a modified Nordic musculoskeletal questionnaire [11]. The major domains and examples of items included are shown in Table 1.

Data were managed in Microsoft Access 2000, a relational database. SAS Version 8 (SAS Institute, Cary, NC) was used for statistical analysis. Microsoft Excel 2000 was used for generation of tables and graphs. Pearson correlation coefficient, Spearmen correlation coefficient, and chi-square analyses with test for trend were performed where relevant.

Several composite indices were created. The size of the office (Size) was the sum of the number of dentists and hygienists associated with the office. Satisfaction with the social aspects of the office (SatSoc) was the sum of responses to seven questions about conflicts (with staff and patients), attitudes (of dentists, dental assistants, and office staff), management skills of dentists, and interpersonal skills of dentists. Participation in decision-making (Decision) was the sum of responses to questions about clinical and practice management decision-making. Satisfaction with salary and benefits (SatSalBen) was based on two questions.

Two summary pain indices were created based upon nine questions about regional musculoskeletal pain during the preceding 12 months: Pain12Sum is the number of positive responses and Pain12Any is a dichotomous variable based upon having 0 or $\geq$1 pain in any area. Similarly, the nine questions about pain during the preceding 7 days were summarized.

Impact responses were summarized into four composite variables: ImpactHrsMsc summed six questions about impact of musculoskeletal factors upon reduction in work hours and ImpactHrsSoc summed five questions about effect of social factors on work hours. Analogously, ImpactLocMsc and ImpactLocSoc summed responses about effects on changing office locations.

TABLE 1
Major Questionnaire Domains and Examples

1. Personal characteristics
2. Current work situation:
   Hours of work, frequency of tasks, practices setting type
3. Satisfaction with aspects of current work. The questions used a five-point Satisfaction Scale (1 = strongly satisfied . . . 3 = neutral, 5 = strongly dissatisfied). For analysis, these were collapsed into three categories (satisfied, neutral, and dissatisfied). The major subdomains were:
   3a. Work organization and social environment (including 20 items such as overall work hr, work breaks, overall quality of the work setting, participation in decisions about the practice)
   3b. Chairs (five items)
   3c. Instruments (two items)
   3d. Workspace physical environment (five items such as lighting)
   3e. Other (salary, benefits, work hr, scope of practice, quality of patient interaction)
4. Musculoskeletal discomfort from nine body areas; using 7-day and 12 month recalls
5. Impact of work conditions: "in the past five yr have any of the following caused you .." ".. to decrease work hr", " .. to change office locations", " .. to miss at least 2 full days of work"? (20 items, such as neck pain, attitude of dental assistants, patient chair)
6. Work impact:
   Number of missed workdays over the course of 5 years because of specific items
   Workers compensation claims
7. Ergonomics education and programs

TABLE 2
Characteristics of Dental Hygienists

	Mean	Standard Deviation	Range
Age (years)	45.3	11.6	21–83
Weight (lbs)	141.0	25.2	67–250
Height (inches)	64.5	2.7	57–78
Body Mass Index (kg/m^2)*	23.7	4.1	17.2–42.4
Years in Clinical Practice	18.1	12.3	0–49.0
Years in current office†	9.7	8.5	0.2–40
Offices worked each week‡	1.6	0.8	1.0–5.0

*A total of 7.3% (n = 37) had a body mass index of 30 or greater.
†A total of 5.0% (n = 26) were not currently working.
‡A total of 50.5% (n = 250) were working full-time.

Results

Subjects

Analyses were based upon the 529 questionnaires returned within 10 weeks after mailing (37.3% response rate). There were insufficient demographic data on nonrespondents to compare respondents to nonrespondents in a meaningful fashion. Table 2 summarizes characteristics of respondents; there was only one male hygienist. The mean age of subjects was 45.3 (SD, 11.6) years. Although the average duration of clinical practice was 18.6 years (SD, 12.3 years), they worked an average of 9.7 years in the current office; office size was positively associated with tenure ($P < 0.05$).

The hygienists often worked in several offices each week; only 50.0% worked in a single office. Among those who worked in more than one office, 17.2% ($n = 80$) stated it was because of insufficient work in the primary office. About half (50.5%) of dental hygienists were working full-time.

Work Activities

Figure 1 shows the percent of time dental hygienists spent performing various tasks. Most of the time (57%) was spent scaling. Patient education accounted for 11% of the dental hygienists' time. The actual time spent with each patient (mean, 53.8 minutes; SD, 8.8) was similar to the average time dental hygienists considered optimal (mean, 56.2 minutes; SD, 8.7). Nevertheless, 31.8% of dental hygienists stated they did not have enough time with the patients.

Satisfaction

Overall, the hygienists were satisfied with their work (78% were either "strongly satisfied" or "satisfied" with the overall work environment). Only 0.4% ($n = 2$) of subjects were "strongly dissatisfied," 6.2% ($n = 32$) "dissatisfied," and 14.6% ($n = 75$) "neutral" about the overall quality of their work environment.

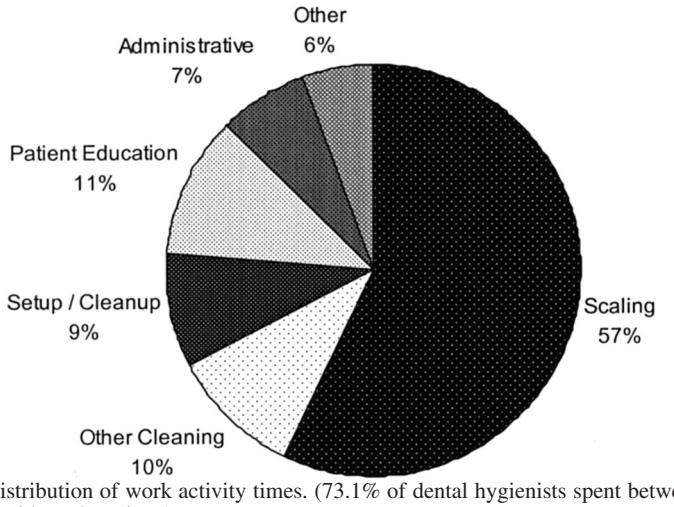

Fig. 1. Distribution of work activity times. (73.1% of dental hygienists spent between 45 and 60 minutes with each patient.)

TABLE 3
Satisfaction and Dissatisfaction With Work

	Satisfied (%)	Neutral (%)	Dissatisfied (%)
High-satisfaction factors			
Quality of patient interactions	94.5	4.3	1.2
Overall work hr	90.6	4.3	5.1
Protection from infections	89.6	6.9	3.5
Respect of DH's clinical ability	89.0	6.5	4.5
Competence of DDS	85.9	8.6	5.5
Low-satisfaction factors			
Employment benefits	25.9	18.2	55.8
Number of work breaks	40.9	28.7	30.3
Management skill of DDS	51.1	22.1	26.6
Ability to adjust DH's chair	58.4	16.1	25.5
Overall quality of DH's chair	58.4	20.2	21.4

The table shows percentage with each response on a five-point satisfaction scale, where "satisfied" = 1 (strongly satisfied) or 2 (satisfied); "dissatisfied" = 4 (dissatisfied) or 5 (strongly dissatisfied).

DH indicates dental hygienist. DDS, dentist.

Table 3 illustrates that subjects were most satisfied with the quality of patient interactions (94.5%) and overall work hours (90.6%). They were most dissatisfied with their employment benefits (55.8%), management skills of dentists and the number of work breaks (30.3%).

The relationship between responses to several related questions were evaluated by Spearman rank correlation to assess internal consistency. For example, satisfaction with "equipment" versus "your chair" had a correlation of 0.61. Satisfaction with "dentist's attitude" and "dentist's interpersonal skills" had a correlation of 0.64 ($P < 0.01$ for both).

Regional Body Pain and Ergonomics

Table 4 shows that in the last 12 months, neck and hand/wrist pain were common (74.7% and 66.9% respectively). Many dental hygienists complained of discomfort in multiple body regions. Dental hygienists received ergonomic training from more than one source (Table 5) and most frequently during their formal education. Twenty-one percent had received no ergonomic training.

Impact on Work

Impact upon work is summarized in Table 6. Reduction in work hours was common (46.9%). Musculoskeletal discomfort was cited by 27.2% as a cause of reduced work hours; hand pain and neck pain were cited most frequently. The hygienist's chair and the patient's chair were other common causes.

Table 6 also shows that 27.8% missed at least 2 full days of work over the course of 5 years. Musculoskeletal discomfort caused 14.6% of subjects to miss workdays, with hand (7.0%) and lower back (7.0%) being the most common reasons. Hand/wrist pain accounted for the greatest total number of loss workdays (1618 days during the course of 5 years among subjects who lost ≥2 days).

Change in office location was quite common and was more often because

TABLE 4
Musculoskeletal Discomfort in Previous 12 Months

	Percent
Any*	91.1
Neck	74.7
Upper back	61.1
Low back	62.6
Shoulders	60.7
Elbows	29.1
Wrist/hands	67.0

*Refers to any musculoskeletal discomfort.

TABLE 5
Ergonomic Training

Ergonomic Training	Frequency (%)
None	103 (21)
Any	387 (79)
Dentist	34 (6.3)
Association*	179 (33.8)
During education†	256 (49.2)

*Dental Hygienists' Association.
†Formal dental hygiene education.

of social factors than musculoskeletal pain. Approximately one in three hygienists had changed office locations in the past 5 years. Conflicts with dentists (28.2%) and office staff (17.1%) were the most prominent reasons for leaving an office.

Logistic regression analyses were conducted to evaluate the determinants of reduced work hours and of changing office locations due to either musculoskeletal pain or to any of the social factors. Predictor variables included age, years in office, social satisfaction (SatSoc), involvement in decision-making, and pain (PainSum12). Odds ratio results are summarized in Table 7. Notably, low involvement in decision-making was associated with greater likelihood of reducing work hours due to musculoskeletal pain.

Handedness

Of the respondents, 7.8% ($n = 41$) were left handed, 90.5% ($n = 475$) right handed, and 1.7% ($n = 9$) ambidextrous. The side of upper-extremity pain was determined by handedness (Table 8). Overall, right-handed dental hygienists were more likely to get right hand/wrist pain (odds ratio [OR] = 7.1, $P < 0.001$) and right elbow pain (OR = 3.1, $P = 0.026$) than left sided pain. A left-handed dental hygienist was more likely to report left hand/wrist pain (OR = 4.8, $P < 0.001$), shoulder pain (OR = 3.7, $P < 0.001$), and elbow pain (OR = 3.7, $P < 0.001$) compared to the opposite side. Left- and right-handed dental hygienists did not differ in likelihood of acquiring neck, upper back, or low-back pain.

TABLE 6
Impact of Musculoskeletal, Work Structure, and Work-Related Psychosocial Dynamics

Impact	Decrease Hours (%)	Days of work (%)	Change Office Locations (%)
Any reason	46.9	27.8	35.0
Any musculoskeletal pain	27.2	14.6	8.7
Neck pain	16.4	5.7	6.1
Shoulder pain	16.0	5.5	4.9
Upper-back pain	12.7	3.4	5.7
Lower-back pain	12.1	7.0	4.4
Elbow pain	8.5	3.6	2.1
Hand/wrist pain	16.6	7.0	5.1
Other factors			
Too many hours of work each week	19.7	3.2	8.2
Too many hours of work each day	9.9	1.5	7.4
Insufficient time per patient	7.2	0.4	13.6
Insufficient flexibility of hours	6.2	2.1	9.9
Attitude of dentist	12.7	4.9	28.2
Attitude of office staff	5.6	2.1	15.5
Attitude of dental assistants	3.5	1.1	9.0
Conflict with staff	7.0	2.8	17.1
Conflict with patients	0.6	0.0	1.3
Dental hygienists chair	3.9	0.6	4.4
Patients chair	3.7	0.8	7.3
Lighting	0.4	0.0	2.5
Chemical or infection exposure	2.1	0.6	2.7
Personal matters	17.5	13.9	7.2

Respondents were asked whether the physical or social stressor had impacted them for ≥2 days during the past 5 years.

Discussion

Dental hygienists face both ergonomic and psychosocial workplace hazards. Previous studies used both epidemiologic and ergonomic methods to assess these factors.[17–19] This study was conducted to evaluate workplace factors and their impacts. Several of the areas investigated have received only limited prior attention in research studies but were suggested by our focus groups of dental hygienists.[41] Our study evaluated satisfaction with both physical and psychosocial domains of workplace conditions, as well as impact upon musculoskeletal discomfort and productivity impacts (such as reducing work hours or changing office location). Job retention is an important issue;[20,21] 42% of dental hygienists believe there are too few in the profession.[22] The California Dental Hygienists Association found many are considering leaving the field.[21]

Satisfaction

The data show that the hygienists are generally satisfied (78%) with their job, particularly with patient interactions (94.5%). However, they were dissatisfied with the number of work breaks (30.3%), management skills of dentists (26%), and employment benefits (55.8%). These results are consistent with our focus group study,[41] which found these factors to

TABLE 7
Logistic Regression Results: Determinants of Impact

	Age		Years Office		Size		Decision		PainSum12		SaTSoc	
	OR	CI	OR	CI	OR	CI	OR	CI	OR	CI	OR	CI
Impact on work hours												
ImpactHrsMsc							1.17	1.007–1.350	1.41	1.26–1.59		
ImpactHrsSoc											1.08	1.02–1.14
Impact on changing location												
ImpactLocMsc	1.05	1.01–1.08	0.92	0.86–0.97					1.18	1.02–1.38		
ImpactLocSoc			0.89	0.86–0.93			1.28	1.11–1.47				

Odds ratios (OR) for the regression models predictors and associated confidence intervals (CI) are shown.

TABLE 8
Percentage of Hygienists Reporting Musculoskeletal Pain in the Previous 12 Months by Handedness

	Handedness (%)	
	Right	Left
Either shoulder	61	68
Right shoulder	52	38
Left shoulder	33	64
Either elbow	29	28
Right elbow	26	11
Left elbow	10	28
Either hand	67	69
Right hand	65	21
Left hand	32	69
Neck	74	77
Upper back	62	64
Lower back	63	67

be major concerns. Hicks and George found only 46% satisfied with their benefits.[23] Although workplace ergonomic factors have received considerable attention,[24,25] participants considered psychosocial factors, such as management skills of the dentists (26%), to be as unsatisfactory as ergonomic factors.

The dental hygienists report a high degree of overall satisfaction despite dissatisfaction with their involvement in decision-making and with many other psychosocial aspects of the workplace. There are several theoretical models of workplace stress. One emphasizes the disparity between work demand and decision latitude.[26] Under this model, dental hygienists would be described as having limited decision latitude but high demand. Their high overall satisfaction despite this combination suggests that an alternative model may be applicable in this occupation: The effort-reward model considers stress as a consequence of an imbalance between the effort and reward.[27] In this theory, reward has four domains: financial reward, esteem reward, promotion prospects, and job security. Financial reward in dental hygiene practice is relatively high. Most believed they are held in good esteem by their patients, although they feel they lack esteem from the perspective of some office staff. The promotion prospects are relatively limited. Job security, while not absolute, is enhanced by the multiplicity of potential work locations and ease of moving from one to another. Thus, the effort-reward model may explain their general satisfaction.

Musculoskeletal Effects

Studies have shown that many dental personnel experience musculoskeletal pain. Dentists report frequent low-back and neck pain (55% and 38%, respectively, during the past 12 months).[28] They frequently experience carpal tunnel syndrome.[2,6,8] For example, in one study up to 42% of dental hygienists had carpal tunnel syndrome as defined by symptoms alone, and 93% of dental hygienists reported at least one musculoskeletal disorder.[2]

Our study also found that musculoskeletal pain was common; 91% reported having had a musculoskeletal pain in the past 12 months; back, hand/wrist, shoulders, and neck pain were each reported by at least 60% of the subjects. Elbow pain was less frequent (29.1%), which is consistent with Werner et al,[8] who found that only 6% of dental hygienists experienced elbow tendonitis. The relatively low frequency of elbow symptoms is consistent with our observations that pronation, supination, and lifting are relatively infrequent motions for the hygienists.

The frequency of reported pain is considerably greater than in the general population, and the site distribution differs. For example, pain was reported by the general population in the Netherlands primarily in the back (27%), shoulder (21%) and neck 21%.[29] Dental hygienists appear to experience pain at least as frequently as others who work in static postures; among full time Video Display Terminal operators, 66% experience some sort of physical discomfort.[30]

Ergonomic factors are strongly correlated with musculoskeletal symptoms,[18,31] and improving ergonomics can reduce pain symptoms.[32,33] The pattern of body areas affected in our study suggests that awkward posturing of the shoulders and fine hand motions are major ergonomic considerations. Hand/wrist pain is largely limited to the dominant hand; therefore, the origin of the hand and wrist symptoms is likely caused by intrinsic hand motions rather than awkward postures necessitated by workstation design. Assuming that most use their domi-

nant hand for work such as scaling, these results suggest a dose–response relationship between usage and pain. If workstation design were the predominant cause of the hand and wrist symptoms, one would expect a significantly higher frequency among the left handed dominant hygienists because equipment is typically designed for right handed operators. Orbak et al[34] found that right and left handed dentists scale better when using a right and left-handed chair, respectively.

Impact Upon Productivity

Outcomes other than pain alone were used to assess the impact of workplace hazards. In particular, productivity is reflected by reduced working hours and by the frequency of job changes. Dental hygienists reported reducing their work hours due to occupationally related musculoskeletal pain. As shown in Table 6, almost half reported reducing work hours in the past 5 years. Musculoskeletal pain was the most frequent cause of reducing work hours, reported by 27.8% of respondents. Although the hygienists reported frequent reduction of work hours because of musculoskeletal pain, they did not identify specific factors. Specific ergonomic factors, such as the hygienist's chair and patient's chair, were cited infrequently (<5%) as reasons to reduce working hours. This indicates that hygienists do not directly attribute their pain to ergonomic factors although studies suggest that physical factors predominately cause musculoskeletal complaints.[14]

Dental hygienists reported a high frequency of changing jobs during the course of 5 years as the result of work conditions (35.0%). Our study found the studied hygienists were at their current job for 9.7 years despite an average of 18 years of clinical practice. A British study noted that hygienists remained in an office for only 5 years,[35] whereas Calley et al[16] found that 63.3% of the United States dental hygienists had been working in the same office for greater than 5 years. Many changed jobs due to personal matters or management issues.[36,37] Johns et al[38] studied those leaving the field of dental hygiene; major reasons were family responsibility, boredom, salary, and inadequate benefits. Although many change offices, Cox et al[39] found that dental hygienists value career longevity. Inadequate involvement in decision-making was a significant determinant of changing office locations in our logistic regression analyses, and it also affected work hours.

In contrast to reduction in work hours, for which musculoskeletal pain is the predominant cause, changing work locations is mainly caused by workplace social factors. The most frequently cited reasons for changing jobs were workplace psychosocial factors (34.4%) rather than musculoskeletal discomfort (8.7%). By contrast, we found that personal matters were only cited 7.2% of the time as a reason to change a job. Johns et al[38] found that the prime reasons why dental hygienists leave the workforce are family issues. Our findings are consistent with the results of Bader and Sams, [36] who noted that "management issues" were the most important reasons why hygienists change jobs. In our study, issues specifically relating to the dentist were often cited (28.2%) as the reason for changing jobs. Dibaggio et al[40] believe interpersonal relationships in a dental office are an important responsibility of the dentist.

This study was based on a mail questionnaire sent to all California Dental Hygienists Association members in two counties; the response rate was relatively low (37.3%). This study employs a cross-sectional design and, therefore, measures current job, whereas a subject may have changed jobs because of conditions in a prior job. However, questions about impact explicitly identified causes of previous job transfers and work hour reduction which apply specifically to the job in which they occurred. The study was limited to current members of the California Dental Hygiene Association; those who had permanently left the field were not included. This limitation may lead to underestimation of adverse impacts. Furthermore, it is possible that respondents differ from nonrespondents, that California is not typical for the United States or that practicing hygienists who are not members of the Association differ significantly from those who are members. The consistency of some of our results to those of other studies suggests validity and generalizability. Results are also consistent with our focus group study conclusions.[41]

In summary, this study has confirmed several previous studies showing a high frequency of musculoskeletal discomfort in dental hygiene practice. Notably, the study shows that psychosocial factors have significant impact upon job retention. The study also quantitatively validates findings from the earlier focus group analysis.[41] which suggested unique employment patterns in this occupation including frequent multiple part-time jobs. There are clear implications for prevention. Improved communication within the practice settings and greater involvement in decision-making should lead to reduction in adverse effects and improvement in overall professional productivity. Attention to workplace social factors and training of dentists and hygienists about social dynamics are needed. Formal and worksite education should address ergonomics and work organizational issues. Professional associations should emphasize these areas since only 6% reported having received such training at work and only 49% did during their formal education.

Conclusion

Most importantly, this study demonstrates that psychosocial workplace factors play a major role in retention, whereas musculoskeletal pain lends to reduction in work hours. Poor relationships at work, in

particular with the dentist, were the primary reason dental hygienists change jobs. The study demonstrates that dental hygienists continue to work with work-induced pain.

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