Original Article

Insights into Ergonomics Among Dental Professionals of a Dental Institute and Private Practitioners in Hubli–Dharwad Twin Cities, India

Shrivardhan Kalghatgi1,*, Kakarla Veera Venkata Prasad1, Kumar Gaurav Chhabra2, Shrvani Deolia3, Chaya Chhabra4

1 Department of Public Health Dentistry, Sri Dharmasthala Manjunatheshwara College of Dental Sciences and Hospital, Sattur, Dharwad, Karnataka, India
2 Department of Public Health Dentistry, Jodhpur Dental College General Hospital, Jodhpur, Rajasthan, India
3 Department of Public Health Dentistry, Sharad Pawar Dental College and Hospital, Wardha, Maharashtra, India
4 Department of Pedodontics and Preventive Dentistry, Jodhpur Dental College General Hospital, Jodhpur, Rajasthan, India

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ABSTRACT

Background: To assess the knowledge, attitude, and practice of ergonomics among dental professionals of Hubli–Dharwad twin cities, India.

Methods: Investigator-developed, self-administered, closed-ended questionnaire assessing knowledge, attitude, and practices regarding ergonomics during dental practice was filled in by undergraduates, house surgeons, postgraduates, and faculty members of dental institutions and private practitioners from Hubli–Dharwad twin cities.

Results: Data were collected from a total of 250 participants, 50 belonging to each academic group. Overall mean knowledge, attitude, and practice scores were 52%, 75%, and 55%, respectively. Significant correlation was found for age with attitude ($\chi^2 = 10.734, p = 0.030$) and behavior ($\chi^2 = 12.984, p = 0.011$). Marital status was significantly associated with all the three domains; knowledge ($\chi^2 = 29.369, p = 0.000$), attitude ($\chi^2 = 29.023, p = 0.000$), and practices ($\chi^2 = 13.648, p = 0.009$).

Conclusion: Participants had considerable awareness and behavior toward ergonomics in dental practice. The high attitude score indicates stronger acceptance of ergonomics principles and guidelines during routine dental procedures. The current study highlights the situation of ergonomics in dental practice in the form of knowledge, attitude, and practices.

1. Introduction

Ergonomics is the scientific study of people and their working conditions, especially done in order to improve effectiveness [1]. In Greek, “Ergo” means work, and “Nomos” means natural laws or systems. Ergonomics, therefore, is an applied science concerned with designing products and procedures for maximum efficiency and safety [2]. Dentistry is a profession that generally produces various musculoskeletal pains and soreness, which are slow to appear; consequently, the symptoms are usually ignored until they become chronic and permanent lesions become evident [3]. It is very important to maintain an adequate work posture and that the instruments and furniture that the dentist is working with have adequate working characteristics [4].

Among the wide range of musculoskeletal disorders, back pain was the most common among dentists, followed by neck pain, high muscle tension on the trapezoids, tendinitis, carpal tunnel syndrome, nerve trapping, early arthrosis, myopia, and auditory alterations [5].

Pargali and Jowkar [6] in 2010 reported that 73% of dentists complained of back and neck pain. Even though the practice of four-handed dentistry and the use of ergonomically well-adjusted...
equipment are on the rise, literature reports have reported a rise in back, neck, shoulder, and arm pain, in almost 81% of dental professionals [6]. Work-related stress, tension, and awkward postural positions can add to back and neck problems for the dentist [7–11]. There is always a neutral zone of movement for every joint and muscle. Injury risks increase whenever work requires a person to perform tasks with body segments outside of his or her neutral range in a deviated posture [12].

In Indian scenario, abrupt mushrooming of dental institutions is occurring. The total number of dental institutions in India is currently 300. The number of students enrolling for a Bachelor of Dental Surgery (BDS) degree in various dental institutions across India is approximately 24,700 [13] and is on the rise.

According to the syllabus for BDS proposed by the Dental Council of India (DCI), undergraduates are exposed to clinical working conditions for the very first time during the 3rd year of courses, during which every student undergoes training in various subjects on a rotating basis for a fixed amount of time. This is the time during which ergonomics, as a part of the regular curriculum, should be taught to students, so that its importance in practice is emphasized and various guidelines followed. For this reason, undergraduates, i.e., both 3rd- and 4th-year BDS students, were included as study participants.

Most of the graduates end up in private practice and few are involved in academia; the faculties of dental colleges are also engaged in private practice [14]. Hence, the dentists who are in private practice should place special emphasis on ergonomic habits to improve their longevity. The age of the dentist is closely related to how many years the dentist has been practicing. One study observed increasing years of practice to be related to an increased prevalence of musculoskeletal problems [15]. Female dentists are more likely than men to experience musculoskeletal pain [17]. Therefore, education is needed regarding various musculoskeletal problems that occur because of unhealthy postural habits during delivery of oral health services, and preventive and corrective measures for healthy lifestyles during professional practice should be promoted. In the Indian set-up there is a severe dearth of information related to ergonomics in dentistry either from the Internet or scientific journals, used dental loupes for magnification purposes, made an effort to maintain neutral posture while working, attended any workshop/lecture on ergonomics in dental career, or performed stretching exercises in between patient appointments. The range of possible scores for knowledge, attitude, and behavior were 0–21, 8–40, and 8–40, respectively.

The questions underwent subsequent revisions prior to the main study. The revisions were related to the clarity of 10 questions of knowledge, and five and three questions each from attitude and behavior. The results of the pilot study were not included in the main study; only the reliability and validity was assessed. The pilot study participants did not take part in the main study.

The data were entered into the MS Excel (MS Office version 2007, Microsoft, Redmond, WA, USA) and Intercooled STATA version 9.2 (Stata Corp., College Station, TX, USA) was used to perform statistical analysis. One-way analysis of variance was used to assess the differences in knowledge, attitude, and behavior among academic positions. Scheffe’s test was used to assess pairwise differences in the knowledge of study participants with respect to academic positions. Pearson’s correlation analysis was used to assess associations between knowledge, attitude, and behavior of study participants. Chi-square test was used to assess associations of age, sex, religion, and marital status with knowledge, attitude, and behavior of study participants.
3. Results

The questionnaires were completed by a total of 112 male (44.8%) and 138 female (55.2%) dental professionals belonging to various academic positions (Fig. 1).

For ease of understanding, responses given by participants were divided into three categories: good, fair, and poor. The mean ± standard deviation (SD) for knowledge was 10.99 ± 3.98; for attitude was 30.25 ± 5.21; and for practices was 22.04 ± 6.09. The most respondents were categorized as fair for all three variables (Table 1).

Participants’ responses are categorized as good, fair, and poor based on mean ± SD.

The highest scores for knowledge were found in private practitioners (12.40 ± 2.94), for attitude was found in postgraduates (6.09 ± 3.98), and for practices were found in house surgeons (5.21 ± 2.81) (Table 2). A statistically significant difference for knowledge, attitude, and practices was observed between the academic positions. Pair-wise comparison using Scheffe post hoc test revealed that the difference between undergraduate—house surgeon, house surgeon—postgraduate, and house surgeon—private practitioner was significant for knowledge and practices. Between the house surgeons and the postgraduates, a significant difference was observed for all three variables of the study (Table 2).

Pearson’s correlation analysis was conducted (Table 3), and showed a positive significant correlation of knowledge with attitude ($r = 0.399$, $p = 0.000$) and a negative significant correlation with practices ($r = -0.363$, $p = 0.000$). Correlation of attitude with practices was not statistically significant ($r = -0.035$, $p = 0.582$).

To assess correlation between various sociodemographic variables with knowledge, attitude, and practices, the Chi-square test was used (Table 4). A significant correlation of age with attitude ($\chi^2 = 10.734$, $p = 0.030$) and practices ($\chi^2 = 12.984$, $p = 0.011$) was observed. Marital status was significantly correlated with knowledge ($\chi^2 = 29.369$, $p = 0.000$), attitude ($\chi^2 = 29.023$, $p = 0.000$), and practices ($\chi^2 = 13.648$, $p = 0.009$).

4. Discussion

Musculoskeletal pain is a major problem among dental personnel that affects efficiency and job satisfaction; the prime reason for this may be attributed to inappropriate workplace ergonomics. In the Indian context where numbers of practicing dentists are steadily increasing, there is a continued increase in prevalence of musculoskeletal problems. The ergonomically incorrect and correct positions to work are illustrated in Figs. 2 and 3, respectively. Ergonomics has been always neglected, from both a...

### Table 1
Knowledge, attitude, and behavior of respondents

| Variables | N  | %  |
|-----------|----|----|
| Knowledge | ≤ 7 (poor) | 50 | 20 |
|           | 8–14 (fair) | 143 | 57.2 |
|           | ≥ 15 (good) | 57 | 22.8 |
| Attitude  | ≤ 25 (poor) | 46 | 18.4 |
|           | 26–35 (fair) | 161 | 64.4 |
|           | ≥ 36 (good) | 43 | 17.2 |
| Behavior  | ≤ 15 (poor) | 45 | 18 |
|           | 16–28 (fair) | 159 | 63.6 |
|           | ≥ 29 (good) | 46 | 18.4 |

### Table 2
Knowledge, attitude, and behavior among different academic positions

| Academic position knowledge | Knowledge | Attitude | Behavior |
|----------------------------|-----------|----------|----------|
| Mean | SD | Mean | SD | Mean | SD |
| Undergraduate | 11.58 | 3.42 | 30.25 | 5.21 | 22.04 | 6.09 |
| House surgeon | 7.82 | 2.81 | 28.36 | 3.15 | 26.86 | 4.48 |
| Postgraduate | 11.84 | 4.43 | 31.58 | 5.62 | 20.28 | 5.58 |
| Faculty | 11.30 | 4.37 | 29.72 | 5.26 | 22.30 | 4.57 |
| Private practitioner | 12.40 | 2.94 | 31.30 | 6.50 | 21.52 | 6.24 |
| F value | 12.318 | 3.207 | 14.010 | 0.000 | 0.014 | 0.000 |
| p | 0.000 | 0.045 | 0.000 |

### Table 3
Pearson correlation analysis of knowledge, attitude, and behavior among respondents

| Variables | Knowledge | Attitude | Behavior |
|-----------|-----------|----------|----------|
| r value   | p         | r value  | p         | r value  | p         |
| Knowledge | 0.399     | 0.000    |
| Attitude  | -0.363    | 0.000    |
| Behavior  | -0.035    | 0.582    |

* Correlation is significant at 0.01 levels.

### Table 4
Correlation analysis of demographic variables with knowledge, attitude, and behavior concerning ergonomics among study participants by using the Chi-square test

| Demographic variables | Knowledge | Attitude | Behavior |
|-----------------------|-----------|----------|----------|
| χ² | p | χ² | p | χ² | p |
| Age | 3.807 | 0.433 | 10.734 | 0.030 | 12.984 | 0.011 |
| Sex | 0.648 | 0.723 | 1.131 | 0.568 | 2.060 | 0.357 |
| Religion | 7.022 | 0.319 | 6.853 | 0.335 | 10.046 | 0.123 |
| Marital status | 29.369 | 0.000 | 29.023 | 0.000 | 13.648 | 0.009 |

* Significance level at $p \leq 0.05$, Chi-square test.
knowledge and practice point of view during clinical work. In addition, ergonomics is not part of the syllabus proposed by the DCI for both undergraduates and postgraduates [13]; as a result, the knowledge of ergonomics is disseminated using informal means only. This necessitates assessment of awareness, attitude, and practices toward ergonomic principles during routine dental procedures among dental professionals at different academic positions; i.e., undergraduates, house surgeons, postgraduates, and faculty members.

Results showed that knowledge scores were 52%, which are similar to results found in a study conducted by Garhin et al [19], in which the knowledge of ergonomics was satisfactory among 55.1% of dental students; Bârlean et al [20] observed respondents’ self-perceived knowledge about correct working posture to be 52.6%. Whereas in the Indian context, the study conducted by Madaan and Chaudhari [21] regarding overall awareness of ergonomics in dentistry among 3rd- and 4th-year students and house surgeons, showed much lower scores (19%) compared to the current study. The level of attitude found in the current study is 75%, which is a good reflection of acceptability and willingness to adopt the ergonomic principles in routine dental practice by the study participants.

Compared to attitude scores, the practice scores in the current study were low, i.e., 55%, but are slightly higher than the 38.6% found in the study conducted by Mailoa and Rovani [22]. The slightly higher scores of practices for ergonomics than knowledge during routine dental practice is probably because of informal training and years of clinical experience leading to self-acquired optimal neutral posture.

Among the five different academic positions, the overall mean knowledge was highest among private practitioners (Table 3), which can be explained based on the study results of Leggat and Smith [23] and Akesson et al [24]; that years of clinical experience and the various musculoskeletal disorders necessitates them to revise and update their knowledge regarding ergonomics related to clinical dentistry. The probable reason for the high positive attitude toward ergonomics among postgraduates compared to other academic positions could be because of the likelihood of being affected by various musculoskeletal disorders during undergraduate clinical working periods. Such high positive attitude not only shows room for infusion of awareness but also willingness to put this awareness into practice (Table 3). Among all academic groups, house surgeons showed highest scores of practices, which could be because of the strict supervision of faculty where enough emphasis is placed on ensuring that house surgeons follow ergonomic principles and guidelines during clinical procedures.

The correlation analysis revealed significant positive association between knowledge and attitude ($r = 0.399$; Table 4). However, there was a significant negative correlation between knowledge and practices ($r = -0.363$). This signifies that despite the presence of awareness and positive attitude toward ergonomics during dental procedures, there is a lack of practice of the same. Furthermore, knowledge, attitude, and practice might not share a linear relationship and additional qualitative studies involving in-depth interviews are warranted to explore the relationships among these variables for ergonomics.

Apart from the knowledge, attitude, and practices, the questionnaire form also comprised certain questions pertaining to participants’ sociodemographic information such as age, sex, religion, and marital status. There was a significant correlation of age with attitude and practices ($p = 0.030$ and $p = 0.011$, respectively). Ratzon et al [25] explained that, with increasing age, dental professionals experience more pain and suffering from various musculoskeletal disorders, leading to subsequent adoption of new ergonomics practices. A study conducted by Kanteshwari et al [26] showed no correlation between age and musculoskeletal problems.

Marital status was found to be significantly correlated with all three domains. According to Wyke and Ford [27], the negative behavior of health and a sense of responsibility for family among married people might have accounted for these positive correlations.

In the Indian scenario, according to the syllabus proposed by DCI, ergonomics is not an inherent aspect of each and every disciplinary syllabi of dentistry to be followed in a respective manner at both the under- and postgraduate level [28]. Many textbooks and academic materials comprise various aspects of ergonomics to be used during routine dental procedures, but the lack of significant emphasis on these ergonomic principles can be one of the reasons for the low levels of awareness and practices found in the current study.

Research conducted to date regarding ergonomics in clinical dentistry in India has listed some of the important and most prevalent musculoskeletal disorders, such as low back pain, neck pain, pain in the wrist and hand joints or shoulder, etc., affecting full- or part-time dental practitioners. Neck pain, wrist pain, and back pain are the most common complaints. These musculoskeletal disorders affect as many as one-third of dental practitioners, and Muralidharan et al [29] reported that such musculoskeletal
disorders absorb approximately 40% of all costs related to treatment of work-related injuries.

Emerging trends related to these musculoskeletal disorders calls for a need to concentrate more on ergonomic awareness and practices in clinical dentistry. Also, specific stretching exercises for dentists, including those specifically designed for the trunk, shoulder girdle, hands, and neck, should be encouraged. Selection of the dental professional’s stool, patient chair, hand instruments, etc., should be considered from an ergonomics point of view. Policy makers such as DCI and syllabus regulatory bodies of health universities should devise ways to include ergonomics as part of a syllabus, both theoretically and practically.

The inclusion of only one dental institute and dental professionals of only one selected twin city might limit the generalizability of the study results. The possibility of answering affirmatively or acquiescence bias, deviation or faking bad bias, and social desirability or faking good bias, should be considered. Likert scales might be subjected to the halo effect, positive skew, and end-aversion bias. Because the current study was questionnaire based, the representing ability of assessment of awareness, attitudes, and practices of ergonomics in routine dental procedures may not be an accurate reflection of the current situation.

In conclusion, the current study provides an insight into ergonomics for dental professionals during routine dental procedures. There is a requirement for the inclusion of ergonomics in the dental curriculum, and also stressing theoretical knowledge and practical implication during various dental procedures.

Every dental graduate should receive sufficient knowledge and training regarding ergonomics to be used during routine dental procedures, for which DCI can add the topic of ergonomics under the group of Must Know; the faculty should guide the students on ergonomic principles and ensure implementation during the clinical hours. Recognition of these musculoskeletal diseases at early stages and prompt treatment will help in reversing the disease process and preventing various disabilities.

Conflicts of interest

All authors declare no conflicts of interest.

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