Research Paper

Awareness of Ergonomic Principles and Implementation of Asana Practices Among Dental Clinic Professions in Iran

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ABSTRACT

Purpose: Musculoskeletal disorders are among the most common complications associated with dental professions. This study aims to assess awareness of ergonomic principles and the application of asana-based exercises as a preventive rehabilitation approach among dentists in dental clinics in Ardabil City, Iran.

Methods: This analytical, descriptive, cross-sectional study involved 227 participants, including clinical dental students, general dentists, and specialists in Ardabil City. Convenience sampling was used to collect data. An online questionnaire, divided into three sections, was utilized: The first section collected demographic information, the second addressed ergonomic principles related to proper postures, and the third provided images of exercises compliant with Asana principles. The results were analyzed using factor analysis and regression with SPSS software, version 21.

Results: A total of 108 students, 54 dentists, and 34 specialized dentists participated, of whom 51.5% were men and 48.5% were women. The awareness levels dental students, dentists, and specialists regarding ergonomic principles were 73.35%, 92.36%, and 71.39%, respectively. No statistically significant differences were observed in the mean score of awareness and the performance of asana exercises based on the clinical profession of the participants in this study (P>0.05). However, no significant relationships were observed between knowledge and gender (P=0.58), age (P=0.22), work experience, or academic term for students (P=0.28). Most participants did not engage in physical activity outside the dental clinical practice (78.9%), and no significant relationship was observed between the clinical profession and physical activity (P>0.05).

Conclusion: Awareness of ergonomic principles and engagement rates in preventive exercises for musculoskeletal disorders among students and dentists are low. By focusing on the education of asana principles and increasing the awareness levels of dental students and dentists, it is possible to prevent the occurrence of musculoskeletal disorders in these individuals, thereby improving their productivity and the quality of dental services.

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Highlights

• The level of awareness among students and dentists regarding ergonomic principles and the rate of engagement in preventive exercises for musculoskeletal disorders is low.

• By focusing on the education of asana principles and increasing the awareness levels of dental students and dentists, it is possible to prevent the occurrence of musculoskeletal disorders in these individuals, thereby improving their productivity and the quality of dental services.

Plain Language Summary

Musculoskeletal disorders are among the most common complications associated with dental professions. This study aimed to assess the awareness of ergonomic principles and the application of asana-based exercises as a preventive rehabilitation approach among dentists in dental clinics in Ardabil City. Given the low level of awareness among students and dentists regarding ergonomic principles and the infrequent practice of exercises that prevent musculoskeletal disorders, focusing on teaching asana principles to increase awareness among these individuals could reduce the incidence of musculoskeletal disorders. This issue could lead to an increase in their working lifespan and improve the quality of dental services.

Introduction

Musculoskeletal disorders are among the most common issues in workplace environments [1, 2]. These disorders refer to tissue damage to the nervous, muscular, and skeletal systems, which disrupts their function. Due to the nature of their duties, dentists are at a higher risk of developing musculoskeletal disorders as reported, 62% of dentists experience at least one musculoskeletal complaint, 30% have chronic disorders, and 32% require medical care [3, 4]. It manifests as painful symptoms in various body areas, such as the neck, shoulders, elbows, wrists, lower back, and hip joints. Also, it causes organic lesions in certain areas and organs [5, 6]. Additionally, dentists often lack sufficient awareness of the effects of ergonomic factors on their health. Approximately 30.2% of dentists are in a very high-risk body position while working, and 51.7% find themselves in risky postures that necessitate urgent corrections and assessments [7]. Musculoskeletal disorders are also highly prevalent among students, with 85% of them experiencing these disorders in at least one body part. In terms of ergonomics, final-year dental students exhibited the highest percentage of improper posture (68%), while the majority of students had acceptable body postures [8]. Furthermore, according to another study, 58% of dentists reported upper limb pain, 22% reported arm pain, 21% reported back pain, 20% reported neck pain, and 17% reported shoulder pain, with 26% of these cases experiencing pain daily and 40% reporting it as moderate to severe [7]. These complications are primarily attributed to specific characteristics of the dental profession, such as the use of precise instruments in a confined environment, the necessity of performing delicate manual tasks, and maintaining unfavorable positions for extended hours. Such issues generally require treatment [8]. Given the nature of dental work, which requires high levels of concentration and precision for extended periods, continuous pressure is exerted on the body's organs, particularly in the neck, shoulders, and arms. To prevent this, dentists must change their working positions and receive adequate training to adhere to safety principles [9]. Awareness of proper postures during work can reduce musculoskeletal disorders, consequently increasing work longevity, decreasing work-related costs, and reducing human injuries.

Yoga is a system of physical, mental, and spiritual practices that promote well-being. Asana-based exercises, rooted in yoga, are particularly effective for addressing ergonomic challenges because they focus on alignment, flexibility, strength, and relaxation. These exercises are designed to counteract the physical and mental strain caused by prolonged sitting, repetitive movements, and poor posture, which are common in modern workplaces. Asana-based exercises are a natural fit for ergonomics because they address workplace discomfort's root causes, including poor posture, muscle tension, stress, and inactivity. Incorporating these exercises into a daily routine can improve posture and alignment, reduce pain and stiffness, enhance flexibility and mobility, boost energy and focus, and promote relaxation and stress relief. These benefits make asana-based exercises a practical

and effective tool for maintaining health and productivity in any workplace. It is limited to physical postures (asanas), breathing techniques, and meditation. The targeted areas of the devised asana concern the lower part of the body, specifically the lower back and intervertebral articulations, and the release of the involved muscles [10]. It can be performed in a dental office using a dental stool, a dental unit chair, or office walls. There is some evidence to support the effectiveness of yoga in reducing work-related musculoskeletal disorders [11]. This study aimed to assess the awareness of ergonomic principles and the application of asana-based exercises as a preventive rehabilitation approach among dentists in dental clinics in Ardabil City.

Materials and Methods

In this descriptive-analytical study, 227 individuals participated, including clinical students from the Faculty of Dentistry, general dentists, and specialists working in Ardabil City. Data were collected using convenience sampling.

Morgan's table was used to determine the sample size, considering that the population size was 467 people. An online three-part questionnaire was utilized, with the first part containing demographic information, the second part addressing ergonomic principles related to proper postures, and the third part featuring images related to exercises aligned with asana principles (Figure 1). First, the methods were explained to each participant, and all participants provided consent to participate in the study. The first part of the questionnaire included demographic information, such as sex, age, clinical profession (student, general dentist, or specialist dentist), work experience or academic term for students, daily working hours, physical activity, stretching exercises between patient treatments, and dominant hand. The inclusion criterion included a minimum of 8 hours of work per day, while the exclusion criterion was a history of musculoskeletal disorders.

The second part included eight questions to assess the interviewees' awareness of ergonomic principles. The current research questionnaire included 8 questions about the principles of ergonomics in dentistry, which were developed by consulting professors with experience in the dental ergonomic field and informed by similar articles [10, 12]. Each correct answer was given a score of 1, and incorrect answers were given a score of 0; the final score was obtained by summing the total scores. A pilot study was conducted among 15 students and 15 dentists to assess the reliability and validity of the questionnaire. The observed Cronbach's α was 0.75, which was acceptable. To determine the level of awareness among students about ergonomic postures, the percentage of correct answers and the total score were measured.

The third part contained a checklist to evaluate the extent to which the interviewees performed exercises according to Asana principles. It describes 60 asana position images to be performed on dental stools or using the walls of a dental office or a dental unit chair. The participants were asked to specify what they did [10].

The results are expressed as numbers and percentages. Data were analyzed using SPSS software, version 21. One-way analysis of variance (ANOVA) and Pearson's correlation coefficient were used for data analysis. The significance level for the tests was set at 0.05.

Results

A total of 108 students, 54 dentists, and 34 specialized dentists participated, comprising 51.5% males and 48.5% females. The mean ages of the students, dentists, and specialists were 25.82, 28.54, and 35.59 years, respectively. The results showed that 90.7% of the participants were right-handed, 8.8% were left-handed, and 0.5% were ambidextrous. Most participants did not engage in physical activity outside the dental clinical practice (78.9%), and no significant relationship was observed between the clinical profession and physical activity (P>0.05).

We analyzed to explore the knowledge of dental professionals about working posture. Table 1 presents the findings. The majority of correct answers (58.1%) expressed this question "How many degrees should the angle between thigh and leg be while sitting?" The question "When working, the angle of the arms to the body towards the front and side, respectively, should be how many degrees?" received an 86% negative answer.

Table 2 indicates no statistically significant difference in the mean scores of awareness and performance of asana exercises based on the clinical profession of the participants (P>0.05). However, no significant relationships were observed between knowledge and gender (P=0.58), age (P=0.22), work experience, or academic term for students (P=0.28).

Figure 1. Asana exercises

Table 1. Knowledge related to dental ergonomics and proper postures

No.	Questions	Options	No. (%)
1	When sitting, how many degrees should the body lean forward?	<10	92(40.5)
		<20*	95(41.9)
		<30	32(14.1)
		<40	8(3.5)
2	How many degrees should the head tilt forward and the head tilt (rotate or other modes) to the side, respectively?	<20 to 25; <15*	106(46.7)
		<20 to 25; <25	94(41.4)
		<30 to 35; <15	16(0.7)
		<30 to 35; <25	11(8.4)
3	When working, the angle of the arms to the body, towards the front and side, respectively, should be how many degrees?	<20; <15	90(39.6)
		<20; <25	44(4.19)
		<10; <15	77(33.9)
		<10; <25*	44(4.19)
4	How many degrees should be the angle between the forearm and the arms while working?	>90*	32(14.1)
		80 to 110	98(30)
		90 to 110	109(48)
		90 to 120	18(7.9)
5	How many degrees should the angle be between the thigh and the leg while sitting?	80 to 100	52(22.9)
		80 to 110	32(14.1)
		90 to 110*	132(58.1)
		90 to 120	11(4.8)
6	How many degrees should the angle between the legs be when sitting?	<25	25(11)
		<35	62(27.3)
		<45*	101(44.5)
		<55	39(17.2)
7	What angle should the leg make with the ground when sitting?	90*	120(52.9)
		100	63(27.8)
		110	41(18.1)
		120	3(1.3)
8	What should be the position of the legs while sitting?	Feet on the floor and slightly angled outward	71(31.3)
		Feet on the floor and straight*	69(30.4)
		Feet on the floor and slightly angled inward	12(5.3)
		Both options A and B can be correct	75(33)

*Correct answers.

PHYSICAL TREATMENTS

Table 2. Mean scores of ergonomics awareness and performance of asana variables by clinical profession of participants

Variables	Clinical Profession	Mean±SD	P
Awareness	Dentist	36.92±16.43	0.483
	Dental specialist	39.71±16.99	
	Dental student	35.73±15.57	
Application rate of asana exercises	Dentist	9.01±6.05	0.168
	Dental specialist	10.83±7.09	
	Dental student	7.08±5.57	

PHYSICAL TREATMENTS

Table 3 presents the frequency and percentage of responses from participants regarding their practice of asana exercises. No statistically significant differences were observed in the mean scores of the application of asana exercises based on work experience or academic term for students, nor in the working hours of the participants in the study (P>0.05). More than half of the participants did not perform any asana exercises.

Discussion

Ergonomics is often overlooked in clinical occupations regarding knowledge and practice. Furthermore, ergonomics may not be included in the dental curriculum. Musculoskeletal disorders are the most significant issue among dental professionals, impacting their work. To minimize work-related musculoskeletal disorders, physicians must be aware of and adopt appropriate ergonomic postures early in their careers [13]. Ergonomics is fundamental in dentistry to ensure the well-being of practitioners and optimize clinical outcomes [14]. Stretching activities, particularly yoga, have been demonstrated to be beneficial for work-related musculoskeletal disorders by promoting circulation and reducing muscle tension [15, 16]. Asanas (physical postures) are a component of yoga that is commonly applied for health benefits [10, 11].

In this study, 78.9% of participants are not engaged in physical exercise. Koneru et al. [11] found a significant decrease in the frequency of musculoskeletal disorders among dentists who practiced yoga or were engaged in regular physical exercise compared to those who did not. Khandan et al [17] is proven if muscle skeletal disease is decrease improve job performance. According to a study by El-Sallamy et al. [18], the rate of performing stretching exercises and physical activities as part of the daily routine was 56.2% among students. Additionally, 17.3% of the participants engaged in these movements and exercises. Meanwhile, 25.6% of students reported that they did not perform any stretching or physical exercises between patient sessions. In a study by Rashidi et al. [19], 27% of dentists in Yazd performed stretching exercises between two visits, which is consistent with the results of the current study.

The results of this study indicated that although no statistically significant correlation was observed between the frequency of stretching movements during patient treatment and the clinical profession, the percentages of stretching movements were 15.3%, 25%, and 29.4% among students, dentists, and specialists, respectively. Considering that, the work experience of specialists (9.21 years) was greater than that of general dentists (2.95 years) in this study, and the treatment activity history of both groups exceeded that of students, it appears that performing stretching movements may be associated with an increased risk of musculoskeletal disorders with greater work experience. It is also influenced by aging and the need for more rest during work.

In this study, although no significant difference was observed in the awareness of clinical professionals regarding ergonomic principles, specialists had the highest level of awareness. These results are consistent with those of Kalghatgi et al. [20], Alyahya et al. [21], and Galla et al. [22]. It is worth mentioning that the ergonomics awareness scores obtained in this study were lower than the average awareness score of students in the study by Karghahi et al. [12] (23.6 out of 10) and the average awareness score of dentists in the study by Rashidi et al. [19] (22.377 out of 30), which may be due to differences in questionnaire items. In this study, the lowest percentage of correct responses to the questionnaire items was related to the correct angle between the forearm and upper arm (14.1%) and the angle of the arms relative to the body (19.4%). As a result, the interviewees had the

Table 3. Comparison of practice scores among the study participants related to asana exercises aligned

Options Based on Figure 1		No. (%)		
		Dentist	Dental Specialist	Dental Student
Wrists, palms, and fingers	a	14(13)	1(2.9)	7(8.2)
	b and c	9(8.3)	4(11.8)	7(8.2)
	d and e	8(7.4)	4(11.8)	5(5.9)
	f to i	4(3.7)	6(17.6)	3(3.5)
	None	75(69.4)	24(70.6)	66(77.6)
Neck	a to d1	36(33.3)	13(38.2)	15(17.6)
	e	9(8.3)	3(8.8)	4(4.7)
	f to j	4(3.7)	3(8.8)	3(3.5)
	None	60(55.6)	17(50)	63(74.1)
Shoulder girdle	a	0(0)	1(2.9)	4(4.7)
	b	3(2.8)	0(0)	3(3.5)
	c and d	12(11.1)	4(11.8)	8(9.4)
	e	5(4.6)	1(2.9)	3(3.5)
	f	2(1.9)	1(2.9)	4(4.7)
	g	13(12)	5(14.7)	7(8.2)
	h	27(25)	6(17.6)	15(17.6)
	i	11(10.2)	5(14.7)	10(11.8)
	J	2(1.9)	1(2.9)	2(2.4)
	None	55(50.9)	20(58.8)	55(64.7)
Shoulder mobilization	a and b	8(7.4)	3(8.8)	7(8.2)
	c	1(0.9)	0(0)	1(1.2)
	d and e	7(6.5)	3(8.8)	4(4.7)
	f and g	24(22.2)	7(20.6)	18(21.2)
	h and i	5(4.6)	3(8.8)	2(2.4)
	None	69(63.9)	21(61.8)	61(71.8)

Options Based on Figure 1		No. (%)		
		Dentist	Dental Specialist	Dental Student
Shoulder, chest, and thoracic spine	a and b	37(34.3)	12(35.3)	20(23.5)
	c	9(8.3)	2(5.9)	5(5.9)
	d	14(13)	4(11.8)	5(5.9)
	e	4(3.7)	3(8.8)	2(2.4)
	f	2(1.9)	3(8.8)	3(3.5)
	g	4(3.7)	1(2.9)	2(2.4)
	h	2(1.9)	1(2.9)	3(3.5)
	None	56(51.9)	17(50)	58(68.2)
Chest, shoulders, and trunk side	a	19(17.6)	6(17.6)	13(15.3)
	b and c	7(6.5)	3(8.8)	4(4.7)
	d	14(13)	4(11.8)	7(8.2)
	e	9(8.3)	3(8.8)	6(7.1)
	f and g	11(10.2)	10(29.4)	10(11.8)
	h	2(1.9)	2(5.9)	3(3.5)
	None	62(57.4)	14(41.2)	55(46.7)
Spine twist and side bending	a and b	28(25.9)	7(20.6)	15(17.6)
	c and d	11(10.2)	4(11.8)	6(7.1)
	e	6(5.6)	2(5.9)	4(4.7)
	f	11(10.2)	5(14.7)	8(9.4)
	g	6(5.6)	2(5.9)	6(7.1)
	h	5(4.6)	1(2.9)	3(3.5)
	None	60(55.6)	19(55.9)	58(68.2)
Side bending	a	13(12)	3(8.8)	5(5.9)
	b	4(3.7)	1(2.9)	4(4.7)
	c and d	10(9.3)	6(17.6)	7(8.2)
	e	8(7.4)	6(17.6)	3(3.5)
	f	7(6.5)	8(23.5)	4(4.7)
	g	2(1.9)	0(0)	0(0)
	h	4(3.7)	0(0)	3(3.5)
	None	74(68.5)	18(52.9)	66(77.6)

least awareness of the correct arm posture. The highest correct responses were related to the angle between the thigh and lower leg (58.1%) and the angle of the lower leg with the ground (52.9%). The interviewees had relatively more awareness of the correct leg postures. It is worth mentioning that neck pain is one of the most common musculoskeletal pains among dentists [23]. Also, more than half of the participants answered the question regarding head angles incorrectly. Possible causes for lack of awareness regarding the work environment and posture include insufficient education and training in ergonomic work positions.

Several studies did not find a significant relationship between sex on musculoskeletal disorders [23, 24]. No significant differences were observed between the demographic variables (age, sex, working hours, and years of experience) of the participants. Some studies have reported that female dentists seem to rank the importance of ergonomics in dental practice higher than male dentists [21, 25].

The results of this study showed that, although the use of asana exercises was higher among specialists than general dentists, and higher than among general dentists than among students, this relationship was not statistically significant. The occurrence of musculoskeletal disorders may also influence the increased use of asana exercises among specialists due to their longer work history and pain. Additionally, although the use of asana exercises increased with the participants' working hours, this relationship was not statistically significant.

In this study, the highest rate of performing asana exercises, at 35.3%, was related to neck and chest stretching exercises and shoulder, and chest mobility and stretching exercises. Conversely, the lowest rate of performing asana exercises (22.4%) was observed for exercises involving the wrist, palm, and fingers, as well as spinal exercises.

To avoid the potential physical and mental shortcomings of the activity both as students and in a future career in dentistry, it is crucial to have a specialized and appropriate exercise program, as well as effective break management. All asana exercises are performed while seated on a stool, making them easier to execute than other exercises.

Specific recommendations include integrating ergonomic principles and asana exercises into the dental curriculum. Develop workplace interventions tailored to each professional group.

Conclusion

Based on this study, more than half of the participants did not engage in physical activity outside work. They did not acquire adequate knowledge of the principles of asana. It is vital to focus on training both theoretical and practical asana principles, such as "Mandatory ergonomic workshops during dental training could be implemented to address this gap", to increase the awareness of students and dentists and minimize the risks of musculoskeletal disorders throughout their future careers. This issue could lead to an increase in their working lifespan and improve the quality of dental services.

The limitations of this study include the self-report questionnaire-based nature of the study, which may be subject to reporting bias, and the limited clinical experience of students, which poses challenges in answering. Future research should conduct longitudinal studies to evaluate the long-term effects of asana principles on the physical and mental health of dentists.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Ardabil University of Medical Sciences, Ardabil, Iran (Code: IR.ARUMS.REC.1402.198).

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Authors' contributions

All authors contributed equally to the conception and design of the study, data collection and analysis, interception of the results and drafting of the manuscript. Each author approved the final version of the manuscript for submission.

Conflict of interest

The authors declared no conflict of interests.

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