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Knowledge and Perception of Artificial Intelligence Among Dental Students: A Cross-Sectional Study in Chennai, India

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ABSTRACT

Background: Artificial Intelligence (AI) is rapidly transforming healthcare, including dentistry. While AI offers potential benefits and its integration is still emerging, research on dental students' understanding of AI remains limited, especially in developing nations like India. This study aims to assess dental students' knowledge and perception regarding AI.

Methods: A cross-sectional study was conducted among a representative sample of undergraduate and postgraduate dental students from a private dental institution. A structured questionnaire was administered to assess participants' knowledge and perception of artificial intelligence. Descriptive and inferential statistics were used to analyze the data.

Results: The study findings reveal that 63.8% of participants demonstrated moderate knowledge of artificial intelligence, while only 19.1% had received formal training in the subject. Participants perceived improved diagnostic accuracy (47.9%) as a primary benefit of AI integration, yet identified lack of awareness (43.9%) and associated costs (45.1%) as significant barriers to adoption. Dental professionals exhibited a neutral stance toward AI adoption (46.5%) and its integration into the curriculum (46.7%). A gender disparity was evident, with males demonstrating higher AI knowledge levels (19.8%) and expressing greater concern for patient data privacy (32.7%) than female counterparts.

Conclusion: As AI continues to evolve and integrated into healthcare, ongoing assessment of educational needs and knowledge gaps among dental students is essential. This will ensure that future practitioners are not only aware of AI's capabilities but also equipped to leverage them for improving patient care and advancing dental practice.

Keywords: Ethical considerations, AI integration, Dental curriculum, Barriers

INTRODUCTION

Artificial intelligence (AI) is revolutionizing the field of medicine and dentistry, driven by advancements in science and technology (1). This technology has its roots in the 1956 Dartmouth Conference, where researchers like John McCarthy and Marvin Minsky laid the groundwork for AI's exploration (2). AI has enhanced efficiency and quality across various fields, including games, car driving, medical image analysis (MRI, brain tumors), financial analysis, and more (3).

Dentistry is no exception. From a dental perspective, AI applications can be categorized into diagnosis, decision-making, treatment planning, and predicting treatment outcomes. Additionally, AI automates tasks, freeing up dentists' time for patient interaction and reducing paperwork (3).

Recent years have seen a surge in AI applications for dentistry, particularly in radiology. These applications range from diagnosing caries and detecting various pathologies to planning orthodontic treatment for crowded teeth (3). Image processing techniques have significantly impacted dental radiology studies, with AI aiding in areas like gingival diseases, automatic anatomical structure marking, cephalometric analysis, and even diagnosing osteoporosis from jaw radiographs (3). This technology improves surgical accuracy and optimizes treatment outcomes. AI-powered systems can also educate patients about periodontal health and proper oral hygiene. Virtual assistants and mobile apps powered by AI can provide personalized recommendations, reminders for oral care routines, and monitor patient adherence to treatment plans (3).

Digital dentistry, encompassing technologies like CAD/CAM, intraoral scanners, and 3D printing, are all examples of AI's influence (5). The COVID-19 pandemic further highlighted the crucial role of telemedicine and AI in patient care and disease prediction (6).

AI-based applications will fundamentally change patient care. They will relieve dental professionals of tedious routine tasks, improve overall health outcomes at lower costs for a broader population, and ultimately contribute to the advancement of prognostic, preventive, and participatory dentistry. AI utilizes specialized algorithms and computational techniques to analyze vast amounts of data quickly and efficiently. Studies have shown that many doctors, dentists, and dental students lack a comprehensive understanding of AI concepts (3, 4). A thorough understanding of AI is crucial for developing plans to integrate this technology into dental practice and education effectively.

Medical and dental students, future dental professionals, will practice in a world heavily reliant on information technology. Although India is a rapidly developing nation in the technological sphere, it has yet to fully unlock the potential of AI and its impact on personal and professional lives (4). This study aims to assess the knowledge, attitude, and perception of artificial intelligence among dental students in Chennai, India.

MATERIALS AND METHODS

This study employed a cross-sectional/descriptive research design to evaluate the level of awareness regarding artificial intelligence among dental students in Chennai, India. Spanning from January 2024 to June 2024, the study encompassed comprehensive phases of data collection, rigorous analysis, and meticulous compilation of findings. Ethical clearance for the research was obtained from the Dr MGR Educational and Research Institute in Chennai, ensuring adherence to ethical standards throughout the study.

The target population consisted of dental students enrolled in various years of study from a private dental college in Chennai, India. A sample size of 398 participants was determined using continuous random

sampling techniques to ensure a representative cross-section of the student community. Demographic details gathered included gender and educational qualifications, including specialization in post-graduate studies.

Data collection was facilitated through the distribution of a structured questionnaire via Google Forms. Prior permission was secured from the institutional authorities, emphasizing the non-intrusive nature of data collection to respect participants' academic commitments. Each participant provided informed consent before participating in the study, ensuring transparency and voluntary participation. Anonymity and confidentiality were strictly maintained throughout the research process to safeguard participant privacy and encourage candid responses.

Statistical analysis: To analyse the data SPSS (IBM SPSS Statistics for Windows, Version 23.0, Armonk, NY: IBM Corp. Released 2015) was used to calculate frequency and percentage of the variables. The level of significance was fixed as 5% ($\alpha = 0.05$).

RESULTS

In this cross-sectional study conducted at a private dental college, we investigated 398 participants aged between 18 to 30 years. The mean age of the cohort was 23.40(+3.93) years. The gender distribution revealed that 25.4% (101) were male and 74.6% (297) were female, reflecting a predominance of female participants in the study. Regarding educational qualifications, undergraduate students comprised the majority, with 21.1% (84) in their first year and 3.3% (13) postgraduate students specializing in prosthodontics. (Table 1)

This study surveyed dental students to assess their perceptions and readiness regarding the integration of artificial intelligence (AI) in dentistry. Out of 398 respondents, only 76(19.1%) reported having received formal education or training on AI. Participants rated their general knowledge about AI variably, with majority 63.8% (254) rating moderate knowledge; less than quarter of the population, 95(23.9%), having personally used AI-based tools or technologies. Regarding perceived benefits of AI in dentistry, respondents highlighted improved accuracy in diagnosis 191(47.9%) and enhanced treatment planning 187(46.9). The participants felt Lack of awareness and understanding among practitioners, 175(43.9%), and cost of implementing AI technologies, 180(45.1%), as the major limitations and risk associated with integrating AI in Dentistry.

Privacy and confidentiality of patient data, 96(24.1%), was considered as the major ethical consideration that needed to be implemented.

Respondents emphasized the need for training and education programs 171(43.0%), access to reliable AI tools 80(20.1%), and clear regulatory guidelines 9624.1%) to support AI implementation in dental practice. Views on AI's impact varied, with 133(33.4%) expecting it to reduce routine tasks. Regarding future developments, 145(36.4%) anticipated incremental improvements from AI, while 87(21.9%) believed in its revolutionary potential for dentistry. The majority 184(46.2%) perceived dentistry as on par with other healthcare fields in AI integration. To stay informed, professionals primarily relied on social media platforms 188(47.2%). Regarding willingness to adopt AI-assisted tools and its integration into dental curriculum, 185(46.5%) and 186(46.7%) expressed neutrality respectively and factors influencing adoption included accuracy 130(32.7%), ease of integration 91(22.9%), and cost-effectiveness 94(23.6%). A notable proportion of participants, specifically 186 (46.7%), acknowledged the moderate importance of collaboration between dental professionals and AI experts. Similarly, 177 participants (44.5%) expressed moderate concerns regarding the potential for AI to replace traditional roles within dentistry.

A gender disparity emerged in the study of knowledge, attitudes, and practices regarding artificial intelligence. Males reported a higher self-rated knowledge of AI (19.8%) and a greater preference for prioritizing patient data privacy and confidentiality (32.7%) as an ethical consideration. Additionally, males were more likely to utilize online forums and discussion groups (35.6%) to stay updated on AI advancements, reported a higher personal use rate of AI-based technologies (36.6%) and believed AI will reduce certain routine tasks of dental practitioners (36.6).

Table 1. Distribution of respondents based on demographic details

		MEAN	**STANDARD DEVIATION**
AGE	18-30	23.40	3.929
		FREQUENCY (N)	**PERCENTAGE (%)**
GENDER	MALES	101	25.4
	FEMALES	297	74.6
QUALIFICATION	1st year UG	84	21.1
	2nd year UG	59	14.8
	3rd year UG	76	19.1
	4th year UG	81	20.4
	Intern	49	12.3
POST-GRADUATE SPECIALIZATION	**Conservative Dentistry**	5	1.3
	Oral and maxillofacial surgery	9	2.3
	Oral Medicine and radiology	1	0.3
	Oral Pathology	4	1.0
	Orthodontics	7	1.8
	Pediatric Dentistry	1	0.3
	Periodontics	9	2.3
	Prosthodontics	13	3.3

Table 2: Distribution of respondents according to knowledge and perception of artificial intelligence in dentistry

Question	**Options**	**Frequency (N)**	**Percentages (%)**
Have you received any formal education or training on artificial intelligence?	Yes	76	19.1
	No	322	80.9
	Low	100	25.1
	Moderate	254	63.9

How would you rate your general knowledge about Artificial Intelligence?	High	44	11.0
Have you personally used any AI based tools or technologies	Yes	95	23.9
	No	303	76.1
What are your opinions on the potential benefits of AI in Dentistry	Improved accuracy in diagnosis	191	47.9
	Enhanced treatment planning	187	46.9
	Streamlined administrative task	89	22.3
	Increased efficiency in patient care	129	32.3
	Virtual consultation	112	28.1
	Robotic surgeries	73	18.3
	Do not know	62	15.6
What are the limitations and risk do you associate with integrating AI in Dentistry	Lack of awareness and understanding among practitioners	175	43.9
	Cost of implementing AI technologies	180	45.1
	Data privacy and security concerns	125	31.3
	Lack of human touch	155	38.8
	Potential biases in algorithms	67	16.8
	Technical errors	160	40.1
	None	37	9.3
Are there any Ethical Considerations that you think need to be implemented or considered	Privacy and confidentiality of patient data	96	24.1
	Bias in AI algorithms and potential inequalities in treatment	61	15.3
	Transparency in how AI systems make decision	71	17.8
	Accountability and responsibility for AI generated diagnosis or treatment plans	64	16.1
	Do not know	106	26.6
What resources or support do you think dental practitioners	Training and education programs on AI in dentistry	171	43.0

need in implanting AI in dental practice?	Access to reliable and user-friendly AI tools	80	20.1
	Clear guidelines and regulation on AI use in dentistry	96	24.1
	Collaboration and knowledge sharing among dental professionals	50	12.6
	No	1	0.3
What impact do you believe AI will have on the role of dental practitioners?	Augmenting dental practitioners' capabilities	84	21.1
	Reducing the need for certain routine tasks	133	33.4
	Shifting the focus to more complex treatments and patient interactions	106	26.6
	Changing the role of dental practitioners significantly	75	18.8
What are your expectations regarding the future developments in Ai in dentistry	AI will revolutionize the dental field	87	21.9
	AI will bring incremental improvements to dental practice	145	36.4
	AI will have limited impact in dentistry	84	21.1
	Unsure, need more information and evidence other	82	20.6
How would you rate the current level of AI integration in dentistry	Dentistry is ahead of other healthcare fields	107	26.9
	Dentistry is on par with other healthcare fields	184	46.2
	Dentistry is lagging behind other healthcare fields	107	26.9
How do you stay informed about the latest advancements	Professional dental journals and publications	106	26.6
	Online forums and discussion groups	104	26.1
	Social media platforms	188	47.2
	Not at all willing	42	10.6

Would you be open to using AI assisted tools in your future	Somewhat willing	89	22.4
	Neutral	185	46.5
	Very willing	57	14.3
	Extremely willing	25	6.3
Do you believe that AI related topics should be integrated into the dental curriculum?	Strongly	35	8.8
	Disagree	21	5.3
	Neutral	186	46.7
	Agree	127	31.9
	Strongly Agree	35	8.8
Which will be the most important factor that would influence your decision to adopt AI in your dental practice?	Accuracy of AI systems	130	32.7
	Ease of integration	91	22.9
	Cost-effectiveness	94	23.6
	Trust in AI technology	44	11.1
	Training availability	39	9.8
How important is collaboration between dental professionals, AI developers, and public health experts in implementing AI-driven solutions for oral health?	Not important at all	30	7.5
	Somewhat important	76	19.1
	Moderately important	186	46.7
	Very important	81	20.4
	Extremely important	25	6.3
Are you concerned about AI replacing traditional roles in dentistry?	Not concerned at all	51	12..8
	Slightly concerned	89	22.4
	Moderately concerned	177	44.5
	Very concerned	56	14.1
	Extremely concerned	25	6.3

Table 3: Gender comparison of respondents according to knowledge and perception of artificial intelligence in dentistry

Question	Options	MALE N (%)	FEMALE N (%)	p-value
How would you rate your general knowledge about Artificial Intelligence?	Low	29(28.7)	71(23.9)	.002
	Moderate	52 (51.5)	202(68.0)	
	High	20 (19.8)	24 (8.1)	
Have you personally used any AI based tools or technologies	Yes	37 (36.6)	50 (15.5)	.001
	No	64 (63.4)	239(80.5)	
Are there any Ethical	Privacy and confidentiality of patient data	33 (32.7)	63 (21.2)	.000

Considerations that you think need to be implemented or considered	Bias in AI algorithms and potential inequalities in treatment	23 (22.8)	38 (12.8)	
	Transparency in how AI systems make decisions	16 (15.8)	55 (18.5)	
	Accountability and responsibility for AI-generated diagnoses or treatment plans	18 (17.8)	46 (15.5)	
	Do not know	11 (10.9)	95 (32.0)	
What impact do you believe AI will have on the role of dental practitioners?	Augmenting dental practitioners' capabilities	29(28.7)	55 (18.5)	.005
	Reducing the need for certain routine tasks	37(36.6)	96 (32.3)	
	Shifting the focus to more complex treatments and patient interactions	27 (26.7)	79 (26.6)	
	Changing the role of dental practitioners significantly	8 (7.9)	67 (22.6)	
How do you stay informed about the latest advancements in AI	Professional dental journals and publications	23 (22.8)	83 (27.9)	.042
	Online forums and discussion groups	36 (35.6)	68 (22.9)	
	Social media platforms	42 (41.6)	146 (49.2)	
Would you be open to using AI assisted tools in your future	Not at all willing	12 (11.9)	17 (5.7)	.042
	Somewhat willing	2 (2.0)	19 (6.4)	
	Neutral	40 (39.6)	146 (49.2)	
	Very willing	40 (39.6)	87 (29.3)	
	Extremely willing	7 (6.9)	28 (9.4)	

DISCUSSION

In the present study, a significant majority of dental students had not received formal education or training on AI; 80.9%. This suggests a gap in the curriculum where AI education is concerned, potentially leaving students underprepared for its integration into dental practice. In the present study, 25.1% of the surveyed students assessed their overall understanding of AI as limited, while 74.9% considered it to be moderate to advanced. This contrasts with findings from a study involving dental undergraduates in Chennai by Ganta L et al (7) where 73.43% demonstrated awareness of Artificial Intelligence in dentistry, suggesting a generally average level of knowledge and awareness regarding AI. In the present study males reported higher levels of knowledge about AI compared to females. males rated their knowledge as high (19.8%) while only 8.1% of females did so. This disparity suggests that there may be factors influencing how AI information is accessed or perceived differently by genders within the dental student population. In our study, privacy and confidentiality of patient data emerged as a concern for 24.1% of the respondents. Interestingly, a higher proportion of males (32.7%) expressed apprehension regarding this issue, indicating a heightened concern among male participants towards safeguarding patient information. Furthermore,

bias in AI algorithms and the potential for resulting inequalities in treatment were identified as ethical concerns by 12.8% of the female respondents. Among males, this concern was notably higher, with 22.8% highlighting these issues. This suggests that male participants are more attuned to the ethical implications of AI technologies in dental practice, particularly regarding fairness and bias in algorithmic decision-making. Additionally, a significant segment of the respondents (26.6%) expressed uncertainty about ethical considerations surrounding AI in dentistry. However, males (10.9%) were less likely than the females (32.0%) to report uncertainty, indicating a clearer stance or better understanding among males regarding the ethical complexities associated with AI use in dental settings. Karan-Romero M et al (8) study revealed a strong sense of optimism and positive outlook among dental students regarding the influence of AI in dentistry. According to the study (8), a substantial majority of surveyed dental students, 86%, expressed agreement that AI will lead to significant advancements within their field which is almost similar to the present study. This indicates a widespread belief among the participants that AI holds substantial promise for transforming various aspects of dental practice, potentially enhancing diagnostics, treatment planning, patient care, and administrative processes. Similarly in a study by Dinesh T et al. (9) dental students demonstrated positive attitudes towards Artificial Intelligence (AI) in dentistry despite lacking sufficient knowledge. The research emphasizes the necessity for increased awareness and education to effectively implement AI in dental practice. Additionally, a study by Yüzbaşıoğlu E et al. (10) indicates that dental students exhibit a willingness to learn about AI, even though their current knowledge is limited. Approximately 48.4% possess basic AI knowledge, and a significant 85.7% believe AI has the potential to revolutionize dentistry. The majority of students surveyed also support the integration of AI into dental education. Ghorbanifarajzadeh M et al. (11) emphasize the importance of AI awareness among dental students, highlighting that integrating AI into dental education can enhance learning outcomes, aid in clinical decision-making, improve the interpretation of radiographs, and ultimately elevate the quality of patient care. In a study by Thurzo A et al. (12), it was noted that dental students required fundamental knowledge of AI due to its significant impact on the field of dentistry. The research suggests that many educators currently lack proficiency in AI, underscoring the need for curriculum revisions to integrate AI principles and applications to prepare future dental professionals effectively.

In this study, 177 participants (44.5%) expressed moderate concerns regarding the potential for AI to replace traditional roles within dentistry. These findings underscore the nuanced perspectives and readiness of dental professionals towards AI integration, highlighting opportunities and challenges for future implementation in dental practice.

CONCLUSION

As artificial intelligence continues to integrate into the healthcare landscape, including dentistry, it is imperative to continually assess the knowledge and educational needs of dental students. This ongoing evaluation will ensure that future dental practitioners are not only cognizant of AI's capabilities but also proficient in leveraging them to enhance patient care and advance the field of dentistry.

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