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KNOWLEDGE, ATTITUDE, AND PRACTICE REGARDING ARTIFICIAL INTELLIGENCE (AI) AND ITS USAGE IN DENTAL ACADEMICS CURRICULUM AMONG DENTAL UNDERGRADUATES AND POSTGRADUATES

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ABSTRACT

Background: *Artificial intelligence (AI) is increasingly being recognized for its potential to revolutionize dental education and practice. However, the extent of knowledge, attitudes, and practices (KAP) regarding AI among dental undergraduates and postgraduates remains underexplored.*

Objectives: *This study aims to assess the knowledge, attitudes, and practices related to AI and its integration into the dental academic curriculum among dental undergraduates and postgraduates.*

Methods: *A cross-sectional questionnaire-based study was conducted among 545 participants, including final-year dental undergraduates and postgraduate dental students . The structured questionnaire covered demographics, knowledge of AI, attitudes towards its integration into dental education, and current practices involving AI.*

Results: *The study found significant variations in knowledge levels, with postgraduates demonstrating a more comprehensive understanding of AI applications in dentistry compared to undergraduates. Attitudes towards AI were generally positive across both groups, with participants recognizing its potential to enhance diagnostic accuracy and streamline administrative tasks. However, there were concerns about the reliability of AI systems and the potential for reduced human oversight. Practical application of AI was limited, particularly among undergraduates, highlighting a gap between theoretical knowledge and practical use.*

Conclusion: *The study underscores the need for integrating comprehensive AI education into the dental curriculum, encompassing both theoretical knowledge and practical training. Continuous professional development and a balanced approach to AI use in dental practice are essential to prepare future dental professionals for an AI-driven healthcare landscape. Gender-wise, the survey reveals consistent support across male and female dental professionals for AI's potential in enhancing dental research, with minimal variation in beliefs.*

KEYWORDS: *Artificial intelligence, dental education, knowledge, attitudes, practices, dental undergraduates, postgraduates.*

INTRODUCTION

Artificial Intelligence (AI) refers to the development of computer systems that can perform tasks that would typically require human intelligence. In the context of dental academics, AI has the potential to revolutionize various aspects of dentistry, such as diagnosis, treatment planning, and patient care. The integration of AI into the dental curriculum aims to equip dental students with the knowledge and skills needed to leverage AI technologies in their future practice. This includes understanding AI algorithms, machine learning, and data analysis techniques that can assist in making accurate diagnoses, predicting treatment outcomes, and optimizing patient care.[1,2]

By incorporating AI into dental education, students can develop a better understanding of its capabilities, limitations, and ethical considerations. This prepares them to effectively utilize AI tools and technologies to enhance their clinical decision-making and provide more precise and personalized dental care to patients.[3]

In recent years, the integration of artificial intelligence (AI) into various fields has sparked considerable interest and transformation, including within dental academia. The convergence of AI technologies with dental sciences presents a promising avenue for enhancing diagnostic accuracy, treatment planning, and patient care. However, the successful adoption and utilization of AI in dental practice hinge not only on

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technological advancements but also on the knowledge, attitudes, and practices (KAP) of dental professionals.[4,5]

Among dental undergraduates and postgraduates, understanding their KAP regarding AI in dental academics is crucial for shaping future educational strategies and professional development. Knowledge encompasses the understanding of AI principles, its applications in dentistry, and the potential benefits and challenges. Attitudes reflect their perceptions, beliefs, and receptivity toward integrating AI into dental education and practice. Practices refer to the actual implementation and utilization of AI tools and techniques in clinical settings and academic research.

This study aims to explore the current KAP regarding AI among dental students and residents, identifying gaps in knowledge, assessing attitudes towards AI adoption, and evaluating the extent of AI integration into dental curricula. By elucidating these factors, this research seeks to provide insights into optimizing AI education in dental academia, fostering proficient use of AI technologies among future dental professionals, and ultimately enhancing patient care outcomes in dentistry.

MATERIALS AND METHODS

Study Design

This cross-sectional study was conducted to evaluate the knowledge, attitudes, and practices (KAP) regarding artificial intelligence (AI) and its integration into the dental academic curriculum among dental undergraduates and postgraduates.

Study Population

The study included dental undergraduates in their final year and postgraduate dental students from various dental institutions. A total of 545 participants were recruited using stratified random sampling to ensure representation across the two groups.

Questionnaire Design

A structured questionnaire was developed based on a comprehensive review of existing literature and expert input. The questionnaire was divided into four sections:

1. Demographics: Information on age, gender, level of education, and academic institution.
2. Knowledge: Multiple-choice and true/false questions assessing the understanding of AI concepts, applications in dentistry, and familiarity with AI technologies.
3. Attitude: Likert scale questions evaluating perceptions, beliefs, and attitudes towards the integration of AI in dental education and practice.
4. Practice: Questions about the current use of AI tools in their studies, clinical training, and any involvement in AI-related research projects.

The questionnaire was pre-tested on a small sample of dental students to ensure clarity, relevance, and reliability. Based on feedback, necessary adjustments were made to improve the questionnaire.

Data Collection

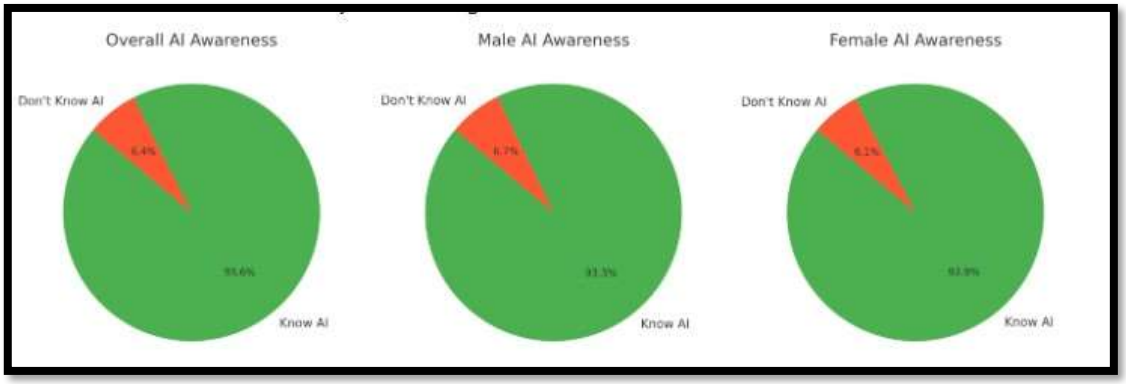
Participants were approached both in-person and via email, depending on the institution's preferred mode of communication. The digital version of the questionnaire was created using an online survey tool, while printed versions were distributed where appropriate. Participants were given an explanation of the study's purpose and instructions on how to complete the questionnaire. Consent was obtained before participation, and responses were anonymized to maintain confidentiality.

Data Analysis

Data from the completed questionnaires were entered into a database and analyzed using SPSS software. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated to summarize the data.

RESULTS

The survey results reveal a significant awareness of artificial intelligence (AI) among the respondents, with 93.6% indicating that they know what AI is, representing 510 individuals. Only a small minority of 6.4%, or 35 individuals, expressed a lack of knowledge about AI. When analyzed by gender, the awareness remains consistently high. Among male respondents, 93.3% (280 individuals) reported knowing about AI, while 6.7% (20 individuals) did not. Similarly, among female respondents, 93.9% (230 individuals) affirmed their understanding of AI, with only 6.1% (15 individuals) indicating otherwise. These findings highlight a strong overall understanding of AI across both genders, with slight variations in percentages but an overall consistent trend of high awareness.

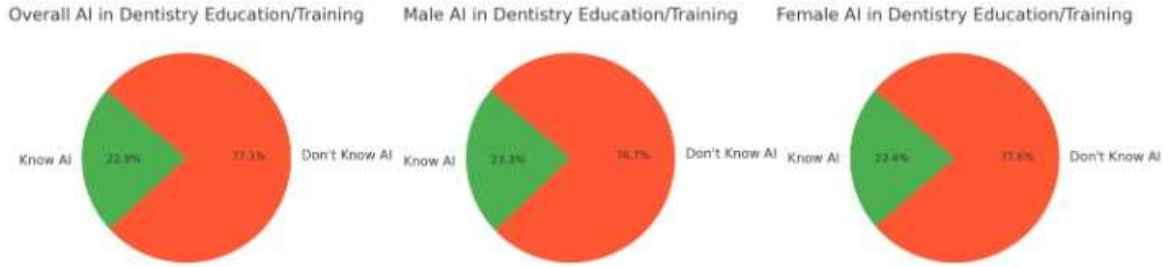


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Awareness of AI (%)	Total Respondents	Male Respondents	Female Respondents
Yes	93.6% (510)	93.3% (280)	93.9% (230)
No	6.4% (35)	6.7% (20)	6.1% (15)

The survey results indicate that a significant majority of respondents (77.1%) have not received formal education or training on artificial intelligence (AI) in dentistry, while a smaller proportion (22.9%) have received such education or training. When examined by gender, the data reveals similar trends. Among male respondents, 23.3% have received formal education or training on AI in dentistry, compared to 22.4% of female respondents. Conversely, 76.7% of males and 77.6% of females have not received any formal education or training in this area. These findings suggest a consistent lack of formal education or training on AI in dentistry across both genders, highlighting a potential area for educational development and improvement.

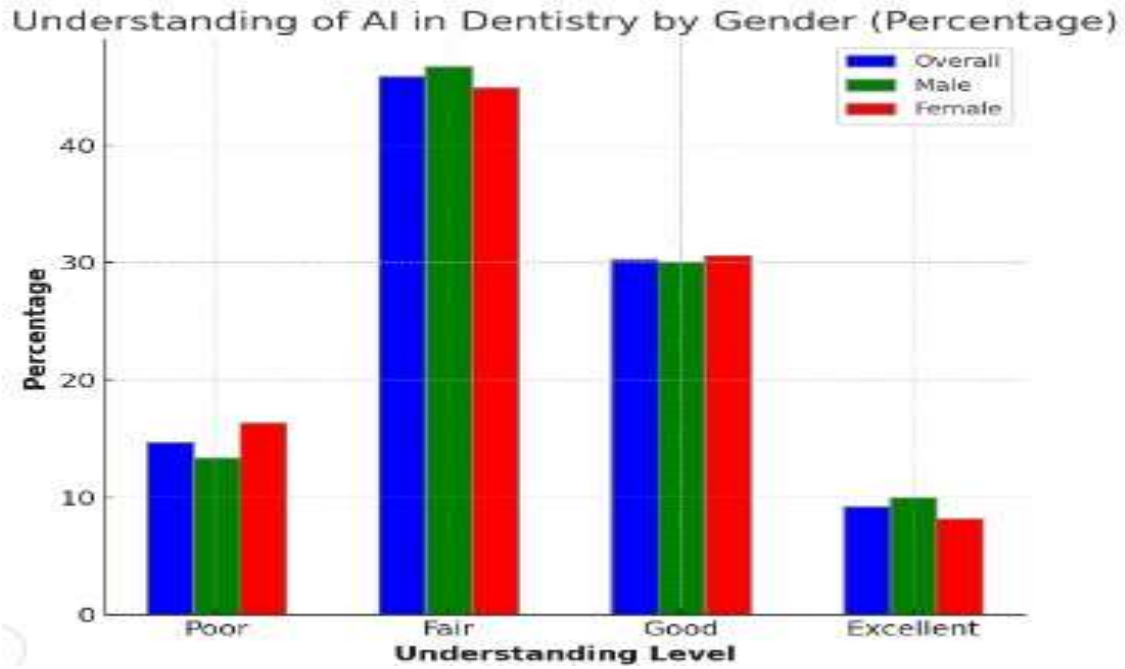
Education/Training on AI in Dentistry (%)	Total Respondents	Male Respondents	Female Respondents
Yes	22.9%	23.3%	22.4%
No	77.1%	76.7%	77.6%



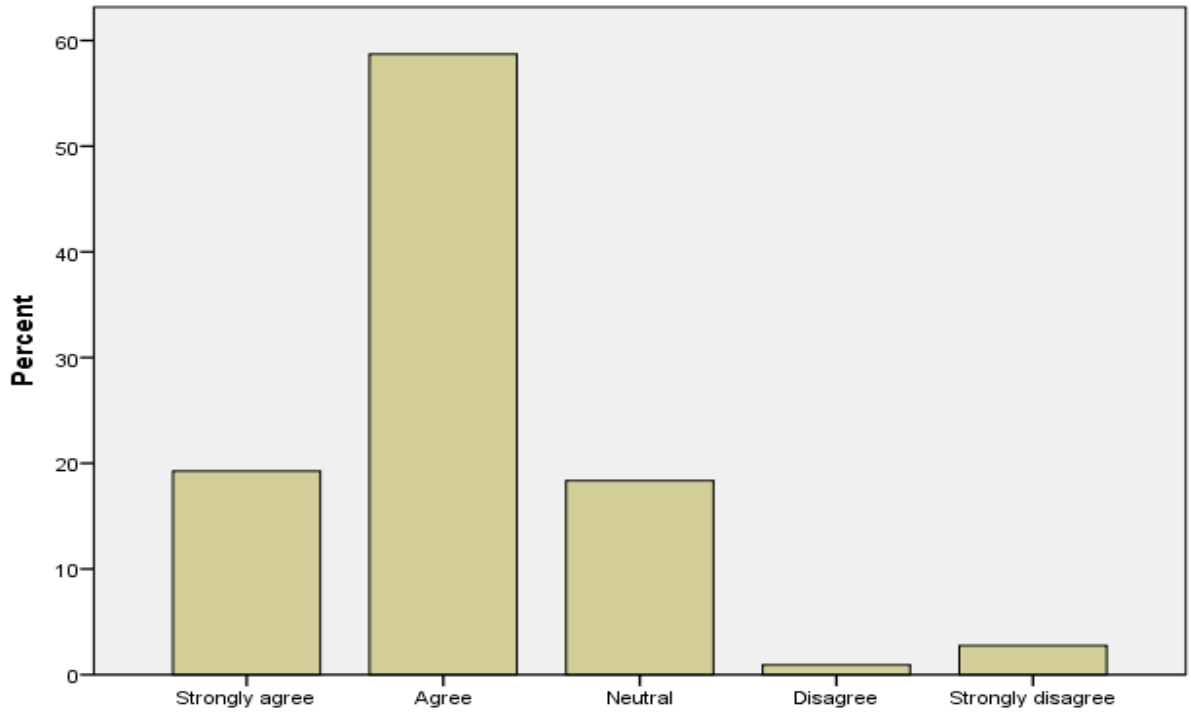
The survey results reveal varied levels of understanding of AI in dentistry among respondents, with notable differences based on gender. Overall, 14.7% of respondents rated their understanding as poor, while the majority rated their knowledge as fair (45.9%) or good (30.3%). Only 9.2% of respondents considered their understanding to be excellent. When broken down by gender, 13.3% of male respondents rated their understanding as poor, compared to 16.3% of females. For the fair category, 46.7% of males and 44.9% of females fell into this group, showing a moderate level of AI knowledge. Among those who rated their understanding as good, 30.0% were males and 30.6% were females, indicating a similar level of confidence across genders. The percentage of respondents who rated their understanding as excellent was slightly higher among males (10.0%) than females (8.2%). These results suggest that while a significant portion of both male and female respondents have a fair to good understanding of AI in dentistry, there remains a gap in achieving excellent knowledge, pointing to a potential need for targeted educational initiatives to enhance expertise in this area.

Understanding of AI in Dentistry (%)	Total Respondents	Male Respondents	Female Respondents
Poor	14.7%	13.3%	16.3%
Fair	45.9%	46.7%	44.9%
Good	30.3%	30.0%	30.6%
Excellent	9.2%	10.0%	8.2%

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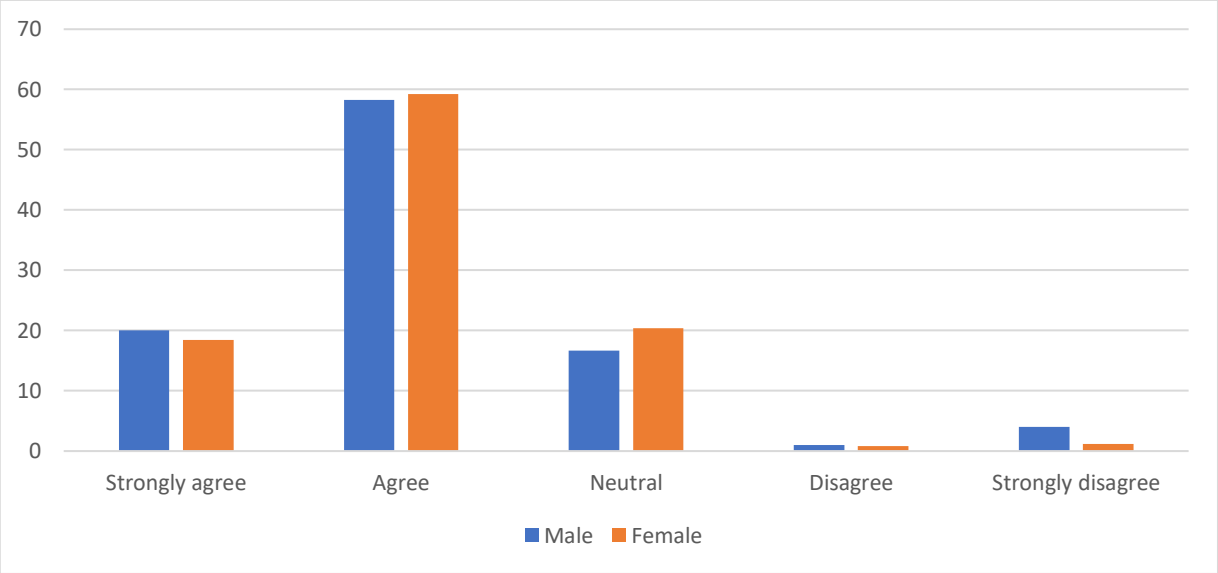


The survey results indicate that a majority of respondents (58.7%) agree that AI has the potential to revolutionize dental education, with a significant portion (19.3%) strongly agreeing. A smaller group remains neutral (18.3%), while a very small percentage disagrees (0.9%) or strongly disagrees (2.8%). When broken down by gender, the results show slight variations. Among male respondents, 20.0% strongly agree and 58.3% agree, while 16.7% remain neutral. A small percentage of males disagree (1.0%) or strongly disagree (4.0%). For female respondents, 18.4% strongly agree and 59.2% agree, with 20.4% remaining neutral. Only 0.8% of females disagree and 1.2% strongly disagree. Overall, these findings reflect a generally positive attitude towards the impact of AI on dental education, with most respondents, both male and female, expressing agreement or strong agreement with its potential benefits.



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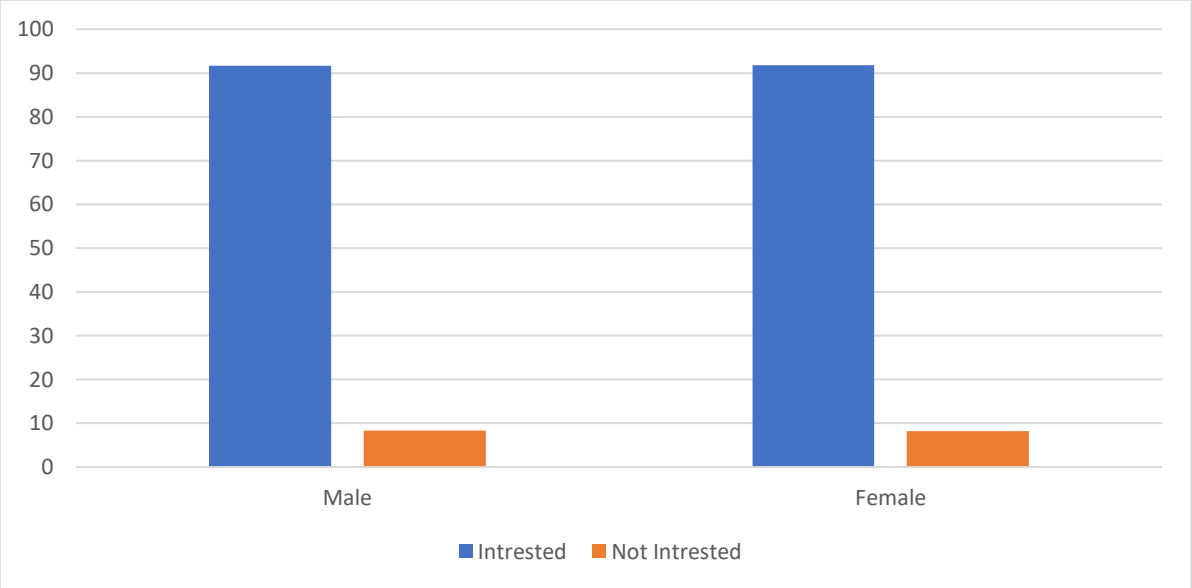
Attitude towards AI in Dental Education (%)	Total Respondents	Male Respondents	Female Respondents
Strongly Agree	19.3%	20.0%	18.4%
Agree	39.4%	58.3%	59.2%
Neutral	18.3%	16.7%	20.4%
Disagree	0.9%	1.0%	0.8%
Strongly Disagree	2.8%	4.0%	1.2%



The survey results indicate a strong interest among respondents in learning more about AI in dentistry, with 91.7% expressing interest and only 8.3% indicating no interest. When broken down by gender, the results are quite similar. Among male respondents, 91.7% are interested in learning more about AI in dentistry, while 8.3% are not interested. For female respondents, 91.8% show interest, with only 8.2% not interested. These results suggest a high level of curiosity and potential acceptance of AI-driven innovations in dentistry among both male and female respondents, pointing to a favorable outlook for educational initiatives and advancements in this field

Interest in AI in Dentistry (%)	Total Respondents	Male Respondents	Female Respondents
Interested	91.7%	91.7%	91.8%
Not Interested	8.3%	8.3%	8.2%

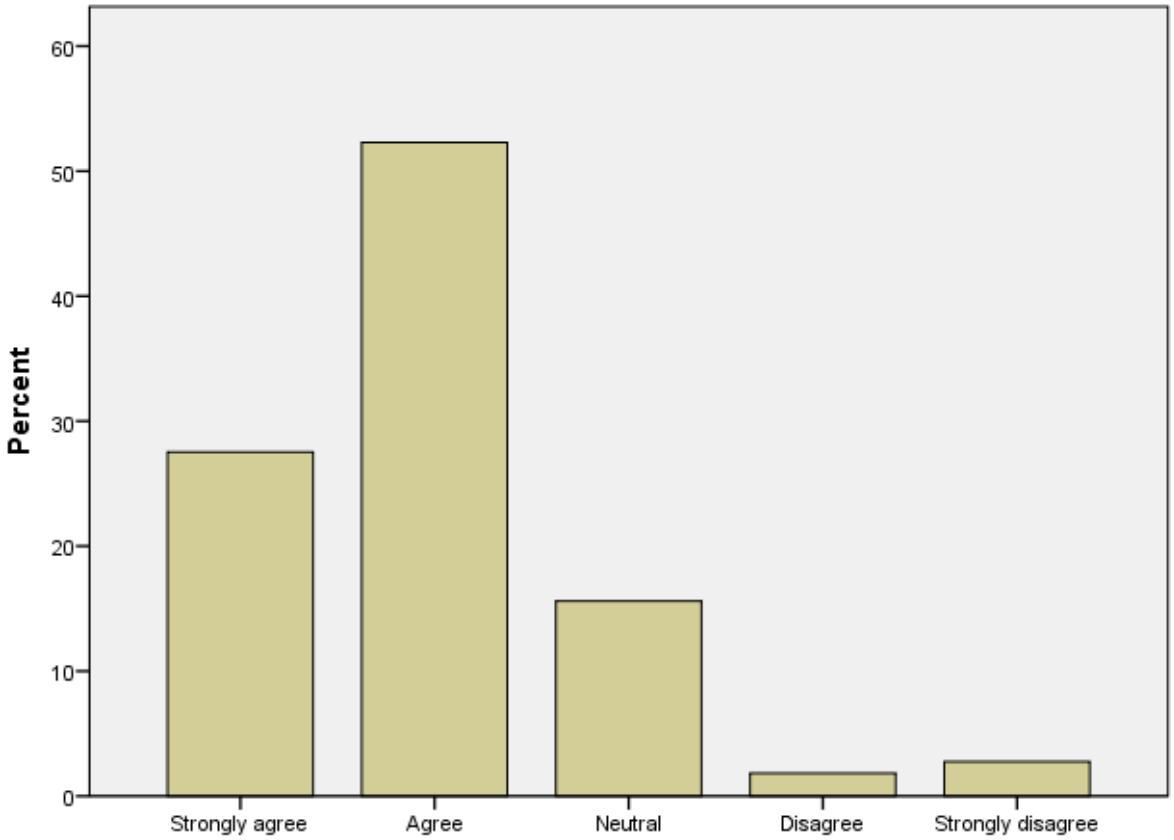
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The survey results reveal a strong belief among respondents that incorporating AI into the dental curriculum would significantly enhance their learning experience. Overall, 27.5% of respondents strongly agree with this notion, and 52.3% agree, indicating a positive attitude towards the integration of AI in dental education. When broken down by gender, the results show that 26.7% of male respondents strongly agree and 53.3% agree, while 28.6% of female respondents strongly agree and 51.0% agree. This suggests a high level of support for AI integration among both male and female respondents. Neutral responses account for 15.6% overall, with 13.3% of males and 18.4% of females remaining neutral. A small number of respondents, 1.8% overall, disagree with the integration of AI, with 2.3% of males and 1.2% of females holding this view. Similarly, 2.8% overall strongly disagree, with 4.3% of males and 0.8% of females expressing strong opposition. These findings highlight a generally favorable outlook towards the adoption of AI in dental education among the surveyed individuals.

Attitude towards AI Integration in Dental Curriculum (%)	Total Respondents	Male Respondents	Female Respondents
Strongly Agree	27.5%	26.7%	28.6%
Agree	52.3%	53.3%	51.0%
Neutral	15.6%	13.3%	18.4%
Disagree	1.8%	2.3%	1.2%
Strongly Disagree	2.8%	4.3%	0.8%

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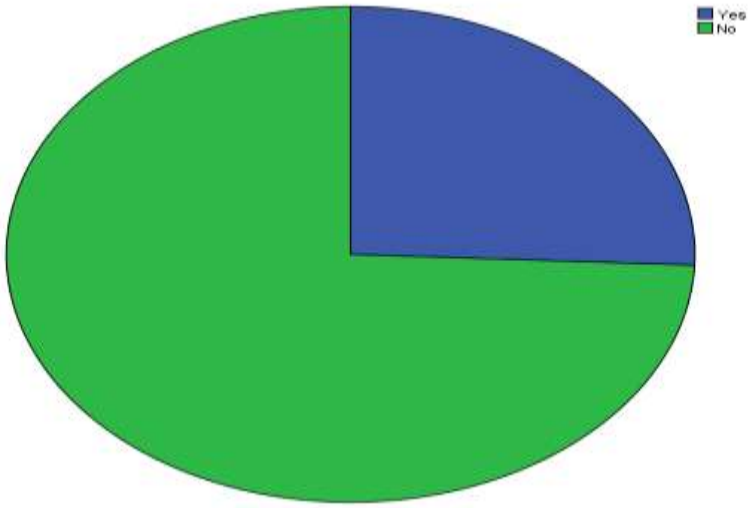


Practice

The survey aimed to assess the adoption of AI-based tools among dental professionals, with 545 respondents providing insights into their usage. Of these, 140 respondents (25.7%) reported integrating AI-based tools or software into their dental practices for tasks like diagnosis and treatment planning. A breakdown by gender reveals that 85 male respondents (27.8% of males surveyed) and 55 female respondents (23.3% of females surveyed) have adopted these tools. Conversely, a majority of 405 respondents (74.3%) indicated that they had not yet incorporated AI technology into their workflows. This data suggests that while a significant proportion of dental professionals are beginning to utilize AI tools, there remains a larger group who have not integrated them, possibly due to factors such as limited access, awareness, training opportunities, or varying perceptions of the necessity of AI in dental practice. The findings underscore both the potential and the current limitations in the adoption of AI technologies within the dental profession.

Adoption of AI-based Tools in Dental Practice (%)	Total Respondents	Male Respondents	Female Respondents
Adopted	25.7%	27.8%	23.3%
Not Adopted	74.3%	72.2%	76.7%

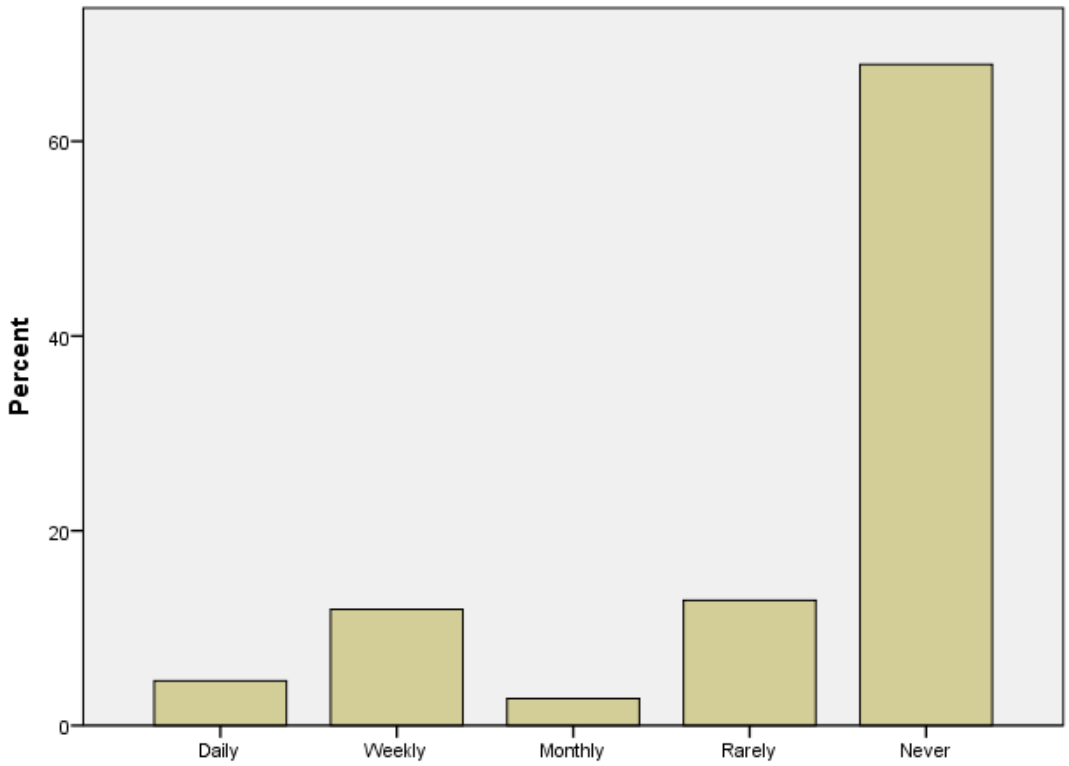
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The survey aimed to gauge the adoption of AI-based tools among dental practitioners, revealing a varied frequency of usage across 545 respondents. A significant majority, comprising 67.9% of respondents, reported never using AI-based tools in their practice. Of the remaining respondents, 12.8% use these tools rarely, while 11.9% integrate them weekly, indicating some regular adoption. Daily usage was reported by a smaller percentage, accounting for 4.6% of respondents, while 2.8% use AI tools on a monthly basis. Gender-specific analysis shows similar patterns across male and female respondents, with the majority in both groups not utilizing AI tools regularly. These findings highlight a widespread presence of AI technology in dental practices, yet also underscore significant variations in its adoption, potentially influenced by factors such as access to technology, training opportunities, and perceived benefits in clinical applications.

Adoption Frequency of AI-based Tools in Dental Practice (%)	Total Respondents	Male Respondents	Female Respondents
Never	67.9%	67.5%	68.5%
Rarely	12.8%	13.2%	12.4%
Weekly	11.9%	11.6%	12.2%
Daily	4.6%	4.8%	4.4%
Monthly	2.8%	3.0%	2.6%

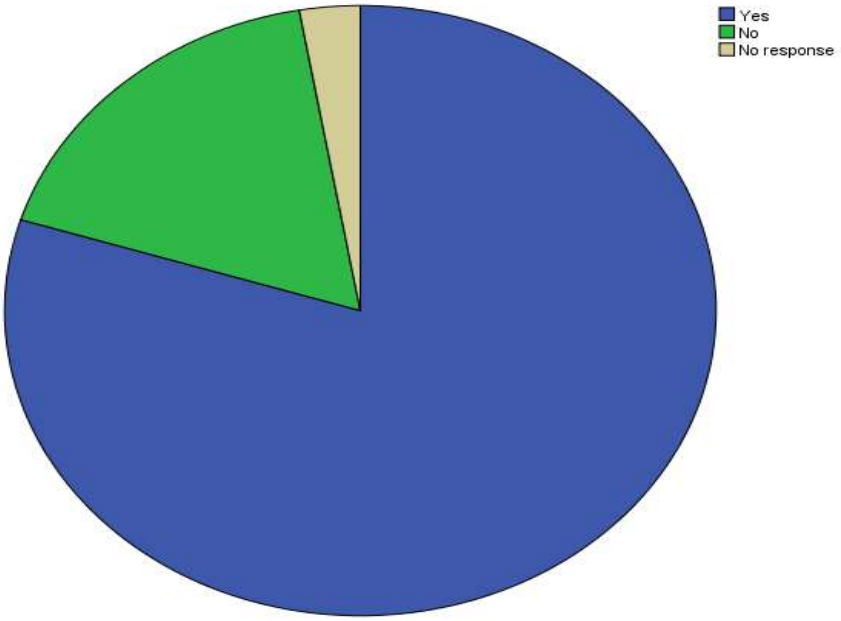
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This representation shows the gender-wise distribution of recommendations regarding the integration of AI-based modules into the dental curriculum. The majority of both male and female respondents support incorporating these advanced technologies, with approximately 79.8% of all respondents endorsing such integration. A smaller proportion, around 17.4%, expressed reservations or opposition, citing concerns that could range from practical challenges to skepticism about the educational benefits of AI in dentistry. About 2.8% of respondents did not provide a response, which may indicate a neutral stance or insufficient familiarity with the topic. Overall, these findings underscore a strong inclination towards embracing technological advancements in dental education among the surveyed professionals.

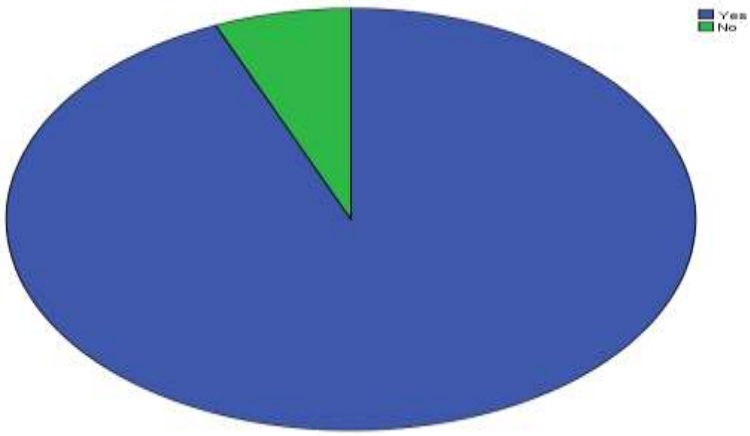
Recommendation for AI Integration in Dental Curriculum (%)	Total Respondents	Male Respondents	Female Respondents
Support	79.8%	79.7%	79.9%
Reservations/Opposition	17.4%	17.6%	17.2%
No Response	2.8%	2.7%	2.9%

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This representation illustrates the gender-wise distribution of beliefs regarding AI's potential contribution to dental research. The vast majority of both male and female respondents, comprising 93.6% of all surveyed, believe that AI can positively impact dental research. Specifically, 94.2% of male respondents and 93.0% of female respondents expressed this belief. In contrast, a smaller proportion, totaling 6.4% of respondents, indicated skepticism about AI's potential benefits in this context, with 5.8% of males and 7.0% of females holding this view. These findings highlight a strong consensus among dental professionals regarding the potential of AI to advance research in the field.

Belief in AI's Contribution to Dental Research (%)	Total Respondents	Male Respondents	Female Respondents
Positive	93.6%	94.2%	93.0%
Skeptical	6.4%	5.8%	7.0%



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DISCUSSION

This study aimed to assess the knowledge, attitudes, and practices (KAP) regarding artificial intelligence (AI) among dental undergraduates and postgraduates, with a focus on its integration into the dental academic curriculum. The findings provide valuable insights into the current state of AI awareness and application within the dental education community, highlighting significant areas for improvement and potential future directions.

The study revealed that knowledge levels about AI in dentistry varied significantly between dental undergraduates and postgraduates. While most participants were aware of AI and its general applications, detailed understanding, especially regarding its specific uses in dentistry, was limited. Postgraduates demonstrated a more in-depth knowledge compared to undergraduates, likely due to their advanced stage of education and greater exposure to emerging technologies. They were more familiar with AI applications such as diagnostic imaging, predictive analytics for patient care, and AI-driven dental practice management tools. This indicates a positive trend where more advanced dental education is associated with better knowledge of AI, yet it also underscores the need to introduce these concepts earlier in the curriculum.

Attitudinal differences towards AI integration in dental education were also evident. Both undergraduates and postgraduates generally expressed positive attitudes towards AI, recognizing its potential to enhance diagnostic accuracy, streamline administrative tasks, and improve patient outcomes. However, there were underlying concerns about the reliability of AI systems and the potential for reduced human oversight. Postgraduates, with their greater clinical experience, were more cautious, emphasizing the importance of maintaining a balance between AI use and human expertise. This cautious optimism suggests that while there is enthusiasm for AI, there is also a need for robust education on the limitations and ethical considerations of AI in dentistry.

The practical application of AI in daily academic and clinical activities was limited, especially among undergraduates. Few participants reported using AI tools regularly, reflecting a gap between theoretical knowledge and practical application. Postgraduates were slightly more likely to engage with AI-driven technologies, often in research settings or advanced clinical training programs. This disparity highlights the necessity of integrating hands-on AI training into the dental curriculum. Simulation exercises, AI-assisted diagnostic tools, and exposure to AI applications in clinical settings could bridge this gap, preparing students for future advancements in dental practice.

The findings from this study have several implications for dental education. Firstly, there is a clear need to incorporate comprehensive AI education into the dental curriculum. This should not only cover theoretical aspects but also provide practical training on AI tools and their applications in dentistry. Early exposure to AI concepts can help students develop a foundational understanding, which can be built upon in more advanced stages of their education.

Secondly, continuous professional development programs are essential for keeping dental educators and practitioners updated on the latest AI advancements. Workshops, seminars, and online courses focusing on AI applications in dentistry can ensure that both current students and practicing dentists are well-informed and competent in utilizing these technologies.

Thirdly, ethical considerations and the limitations of AI must be an integral part of the curriculum. Understanding the potential risks, biases, and ethical dilemmas associated with AI will help future dental professionals make informed decisions about its use in practice.

This study has several limitations, including its reliance on self-reported data, which may introduce bias. Additionally, the cross-sectional design captures a single point in time, and longitudinal studies are needed to understand how KAP regarding AI evolves throughout dental education. Future research should explore the impact of specific educational interventions on AI knowledge and practice among dental students and professionals.

In conclusion, while dental undergraduates and postgraduates show promising attitudes towards AI, there is a need for enhanced education and practical training to fully integrate AI into dental practice. By addressing these educational gaps, dental institutions can better prepare their students for a future where AI plays a pivotal role in healthcare.

CONCLUSION

In conclusion, this study highlights the positive attitudes but limited practical knowledge and application of AI among dental undergraduates and postgraduates, underscoring the need for comprehensive AI education within the dental curriculum. Integrating theoretical and hands-on AI training, along with emphasizing ethical considerations, can better prepare future dental professionals to effectively utilize AI technologies. Continuous professional development is essential to keep pace with rapid advancements in AI, ensuring that both current students and practicing dentists can leverage AI to enhance diagnostic accuracy, streamline administrative tasks, and improve patient outcomes in dental practice. Gender-wise, the survey reveals consistent support across male and female dental professionals for AI's potential in enhancing dental research, with minimal variation in beliefs. This unity underscores a shared optimism and readiness to embrace AI-driven advancements in the field, despite some minor differences in levels of skepticism.

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