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**Original Research Article**

# Assessment of knowledge, attitudes, perceptions, and utilization of artificial intelligence in medical education among medical students in a Nigerian university

**Chibuzor G. Muoka[1]*, Odochi Ewurum[2], Glory U. Godwin[1], Ikechukwu Nwoke-Udeka[1], Akparanta V. Nnedimma[1], Ijeoma Moneke[1]**

[1]Abia State University, College of Medicine and Health Sciences, Aba, Abia State, Nigeria
[2]Department of Pediatrics, Abia State University, College of Medicine and Health Sciences, Aba, Abia State, Nigeria

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***Correspondence:**
Dr. Chibuzor G. Muoka,
E-mail: muokac@yahoo.com



## ABSTRACT

**Background:** Artificial intelligence (AI) is increasingly being integrated into medical education and healthcare. However, there is limited data on medical students' knowledge, attitudes, perceptions, and utilization of AI in Nigeria. This study aims to assess these factors among medical students at a Nigerian university.
**Methods:** A descriptive cross-sectional study was conducted among 342 medical students at Abia State University using a multistage sampling technique. Data was collected via a structured, self-administered questionnaire covering socio-demographics, AI knowledge, attitudes, perceptions, and utilization. Statistical analysis was performed using SPSS version 23, with results presented in frequencies, percentages, and inferential statistics such as Chi-square and one-way ANOVA ($p \leq 0.05$ considered significant).
**Results:** AI awareness was high (94.4%), yet only 20.8% had received formal training. The mean knowledge score was 8.16±3.08, with 54.8% demonstrating moderate knowledge. While 92.7% believed AI could improve healthcare, 66.4% opposed the idea that AI would replace doctors. AI was most associated with radiology and surgery. The mean attitude score was 1.44±3.01, and 55.9% had a positive attitude. Gender significantly influenced AI perception ($p=0.024$), with males showing more positive perceptions. AI utilization was highest among clinical students ($p=0.013$) and correlated with knowledge levels ($p<0.001$).
**Conclusions:** Although awareness of AI is high, formal education on AI remains limited. Most students hold positive attitudes toward AI but express concerns about its impact on medical practice. Structured AI education and faculty engagement are essential for preparing future medical professionals for AI-driven healthcare.

**Keywords:** Artificial intelligence, Medical education, AI utilization, AI perception, AI attitudes, Medical students

## INTRODUCTION

Artificial intelligence (AI) is a branch of computer science focused on creating intelligent machines that perform tasks traditionally associated with human intelligence.[1,2] It has emerged as a transformative force across multiple industries, with its application in healthcare revolutionizing medical education, diagnostics, treatment planning, and research. AI, a concept that dates back to ancient myths and the mid-20th century with the contributions of Alan Turing and John McCarthy, has significantly evolved with the development of machine learning (ML) and deep learning (DL) models.[3,4] The widespread adoption of AI in healthcare has introduced new opportunities and challenges, raising concerns about how the medical student would embrace AI in their education and future clinical practice, and the possible

medical implications of such dynamic shifts in medical training.[5,6]

Medical education has witnessed an increasing integration of AI technologies, particularly in fields such as radiology, pathology, dermatology, and surgery. AI-driven applications, such as DL models for medical imaging, automated diagnosis, and robotic-assisted surgery, have demonstrated superior accuracy and efficiency in various medical specialties.[6-8] For instance, AI-based image recognition has been used to detect tumors in radiology and classify skin lesions in dermatology, often outperforming human experts.[9,10] Additionally, AI-powered chatbots and virtual assistants, such as ChatGPT, are now widely utilized for personalized learning and clinical case simulations in medical education.[11,12]

Despite these advancements, studies indicate a lack of structured AI education within medical curricula, particularly in developing countries. Research conducted in Nigeria, India, Lebanon, and Pakistan highlights significant gaps in medical students' understanding of AI and its practical applications in healthcare.[13-15] Many students acquire AI knowledge informally through media rather than through formal coursework, raising concerns about their preparedness to integrate AI-driven technologies into future clinical practice.[13] Furthermore, medical students' attitudes toward AI vary, with some viewing it as an assistive tool that enhances medical practice, while others express concerns about job displacement and ethical implications.[15]

The utilization of AI in medical education is also influenced by accessibility and familiarity with AI tools. Recent surveys indicate that a growing number of students are incorporating AI into their studies, with applications such as automated tutoring, academic writing assistance, and clinical training simulations becoming increasingly popular.[16] However, concerns remain regarding over-reliance on AI, which may hinder critical thinking and self-directed learning.[17] AI-powered chatbots, for example, despite their potential benefits, have limitations such as the potential for errors, ethical concerns, inherent biases, and knowledge gaps.[18,19] These issues have led to ongoing discussions and debates within the medical and public communities about the appropriate use of AI in medical practice and research.[18]

Given the rapid evolution of AI in healthcare, it is essential to assess medical students' knowledge, attitudes, perceptions, and utilization of AI. Understanding these factors will help bridge the knowledge gap, inform curriculum development, and ensure that future medical professionals are equipped to harness AI's potential while addressing its limitations and ethical considerations. This study aims to explore these aspects among medical students in a Nigerian university, contributing to the discourse on AI adoption in medical education and practice.

## METHODS

This is a descriptive cross-sectional study. The study was conducted at Abia State University, Uturu Campus, and Abia State University Teaching Hospital (ABSUTH), Aba, Abia State, Nigeria, where the preclinical and clinical medical students resides, respectively.

### *Study duration*

The study was conducted between January 2025 to March 2025.

### *Sample size*

The sample size is determined using Cochran's formula.

$$n = \frac{Z^2\, p(1-p)}{d^2}$$

Where:

Z=1.96 (95% confidence level)
p=0.52 (prevalence)
d=0.05 (margin of error)

$$n = \frac{(1.96)^2 * 0.52 * (1-0.52)}{(0.05)^2} = 384$$

Adjusting for finite population, (because sampling a large proportion of a small population affects the required sample size).

**Table 1: Distribution of medical students by academic level.**

| Level | Number in class | |
|---|---|---|
| **100 level** | 250 | Preclinicals [100-300 L] |
| **200 level** | 500 | |
| **300 level** | 210 | |
| **400 level** | 235 | Clinicals [400-600 L] |
| **500 level** | 222 | |
| **600 level** | 140 | |
| **Total** | 1557 | |

Now, applying the finite population correction for n=1557:

$$N_{adj} = \frac{384}{1 + \frac{384-1}{1557}} = 308$$

Adjusting for non-response (10%)

$$n_{final} = \frac{308}{1-0.10} = 342$$

Thus, the final sample size is 342 medical students.

A survey of at least 342 students of the total population of 1,557 is done to maintain a 95% confidence level and 5% margin of error.

***Sampling technique***

A multistage sampling technique was used to ensure adequate representation of medical students across different academic levels. In the first stage, stratified sampling was employed to divide the students into two groups based on their level of study: preclinical students (100-300 level) and clinical students (400-600 level). In the second stage, proportional allocation was applied to determine the number of students selected from each group, ensuring that the final sample size accurately reflected the distribution of students across academic levels. To maintain fairness and equal representation, simple random sampling was then conducted within each group to select participants.

***Inclusion criteria***

Registered medical students of the university and those who are willing to participate in the study were included.

***Exclusion criteria***

Participants who do not consent, non-medical responders and those who have incomplete responses in the questionnaire were excluded.

***Ethical approval***

Ethical approval of the study was obtained from the Abia State university hospital ethical and research committee (Dated: 13 March 2025. Ref: ABSUTH/MAC/117/ VOL.II/81). Informed consent was obtained from all participants, and confidentiality was maintained throughout the study.

***Data collection tool***

This study utilized a structured, self-administered questionnaire, which was adapted and developed after a thorough literature review.[5,13,15,20-22] Data collection was conducted after obtaining informed consent, using both online (Google forms) and paper-based methods. The questions were designed to be clear and easily understood.

The questionnaire was divided into five sections: Section A: Socio-demographic information, section B: Knowledge of AI, section C: Attitudes toward AI in medical education, section D: Perceptions of AI in medical education and section E: Utilization of AI in medical education.

Section A collected data on participants' socio-demographic characteristics, including age, gender, academic level, ethnicity, marital status, and religion. Section B explored participants' knowledge of AI through closed-ended questions. Sections C and D assessed perceptions and attitudes toward AI in medical education. By allowing participants to rate their responses on 4-point scale, ranging from strongly disagree to strongly agree, depending on statement. Section E examined utilization of AI, using structured questions primarily in a multiple-choice format, with some options for additional input.

***Data analysis***

Data analysis was performed using the statistical package for the social sciences (SPSS) program version 23 and excel. The analysis included simple descriptive statistics which were presented in frequency, percentages, and charts. Statistical tools such as Chi-square, and one way ANOVA were also employed. Comparisons were made to find relationships between socio demographic data and knowledge, attitude, perception, and utilization scores. As well as the relationship between knowledge of AI and utilization of AI. A $p \leq 0.05$ considered significant.

## RESULTS

Table 2 shows the socio-demographic characteristics of the medical students. The mean age was 22.33 years (±3.925). The majority of participants (56.4%) were aged 21-25 years. Females constituted 55.3% of the sample, while males made up 44.7%. Preclinical students (57.9%) outnumbered clinical students (42.1%). The mean knowledge score was 8.15±3.07 (out of 16), the mean attitude score was 1.44±3.01 (out of 8), the mean perception score was 2.01±4.52 (out of 12), and the mean utilization score was 8.67±1.95 (out of 16).

Table 5 shows that 94.4% of students are aware of AI in medicine, yet only 20.8% have received formal training. The majority self-rated their AI knowledge as "fair" (45.3%), while only 6.7% considered it "excellent." Confidence in explaining AI was generally low, and only 25.7% correctly identified AI as a branch of computer science. Social media was the primary source of AI knowledge, with diagnostic imaging, virtual health assistants, and robotic surgery being the most recognized applications. AI was most associated with radiology and surgery, while specialties like dermatology, pediatrics, and psychiatry received less recognition. Mean AI knowledge score was 8.16±3.08, with 54.8% demonstrating moderate knowledge, 25.2% good knowledge, and 20% poor knowledge. No significant associations found between AI knowledge and socio-demographic factors ($p>0.05$).

Table 6 shows that 92.7% of students believe AI can improve healthcare delivery, though only 23.6% think it will replace doctors, with 66.4% opposing this idea. 72.8% believe some specialties are more prone to AI replacement. While 41.5% feel comfortable receiving medical advice from AI, 58.5% remain skeptical.AI integration in medical education is widely supported, with 73.1% favoring its inclusion in the curriculum and 87.1% expressing interest in AI workshops. However, only 24.2% believe their teachers fully support AI. Preferences for AI-generated questions vs. traditional methods were nearly split (49.7% vs. 50.3%). Mean attitude score 1.44±3.01, with 55.9% of students holding positive attitudes, 24.3% neutral, and

19.8% negative. No significant associations were found between attitudes and socio-demographic factors (p>0.05).

Table 7 shows that 89.1% of students believe AI enhances physicians' access to information, while 82.5% think it facilitates patient education. 50.6% feel AI empowers patients, and 59.4% believe it increases confidence in medicine, though 34.5% disagree. The 66.9% say AI improves decision-making, yet 67.2% worry about confidentiality violations. Most students (72.5%) feel AI reduces the humanistic aspect of medicine, and 59.1% believe it damages patient trust. However, 69.6% think AI improves access to medical services, and 60.8% say it reduces errors. Only 34.2% feel AI devalues medicine, while 65.8% disagree. Regarding clinical skills assessment, 46.5% believe AI would ensure objective grading, but 53.5% disagree, and 59.7% prefer feedback from human standardized patients. Mean perception score was 2.01±4.52, with 61.2% holding positive perceptions, 23.9% negative, and 14.9% neutral. Gender was only significant factor (p=0.024), with males (67.3%) more likely to have positive perceptions than females (56.1%).

Table 8 shows that 86.5% of students have used AI-based tools, with 94.3% relying on AI chatbots like ChatGPT. Other tools, such as Google assistant/Siri/Alexa (27.7%), AI in research (12.2%), AI-powered medical apps (8.8%), and AI in image recognition (6.8%), are less commonly used. 56.1% of users engage with AI tools daily, primarily via smartphones (97.6%), while laptops/desktops (19.9%) and tablets (6.1%) are used less frequently. Students mainly use AI for research and writing (73.3%) and exam preparation (70.6%). The mean AI utilization score was 8.67±1.95, with 71.6% demonstrating moderate utilization, 7.3% low utilization, and 7% high utilization. Level of study was significantly associated with AI utilization (p=0.013), with clinical students (9.7%) exhibiting higher utilization than preclinical students (5.1%). Age group also showed significance (p=0.037), with the 26-30 age group having the highest proportion of high utilizers (15.4%). The ANOVA analysis also revealed that high AI utilizers had the highest mean knowledge score (1.542), with a statistically significant difference across utilization levels (p<0.001), indicating that higher AI usage correlates with greater AI knowledge.

**Table 2: Socio-demographic characteristics of the participants.**

| Variables | Frequency | Percent (%) |
|---|---|---|
| **Age group (in years)** | | |
| 16-20 | 114 | 33.3 |
| 21-25 | 193 | 56.4 |
| 26-30 | 26 | 7.6 |
| 31-40 | 6 | 1.8 |
| 41-50 | 3 | 0.9 |
| Total | 342 | 100.0 |
| Mean age: 22.33 years (±3.925) | | |
| **Gender** | | |
| Female | 189 | 55.3 |
| Male | 153 | 44.7 |
| Total | 342 | 100.0 |
| **Level** | | |
| Preclinical (100-300 L) | 198 | 57.9 |
| Clinical (400-600 L) | 144 | 42.1 |
| Total | 342 | 100.0 |
| **Tribe** | | |
| Igbo | 329 | 96.2 |
| Hausa | 7 | 2.0 |
| Yoruba | 5 | 1.5 |
| Others (e.g., Ijaw) | 1 | 0.3 |
| Total | 342 | 100.0 |
| **Marital status** | | |
| Single | 323 | 94.4 |
| Married | 19 | 5.6 |
| Total | 342 | 100.0 |
| **Religion** | | |
| Christianity | 333 | 97.4 |
| Islam | 8 | 2.3 |
| Traditional/African religions | 1 | 0.3 |
| Total | 342 | 100.0 |

**Table 3: Summary of knowledge, attitudes, perception, and utilization scores.**

| Variables | | Frequency | Percentage (%) |
|---|---|---|---|
| **Total knowledge score** | Poor knowledge | 69 | 20 |
| | Moderate knowledge | 216 | 54.8 |
| | Good knowledge | 57 | 25.2 |
| Total | | 342 | 100 |
| **Total attitude score** | Negative attitude | 68 | 19.8 |
| | Neutral attitude | 83 | 24.3 |
| | Positive attitude | 191 | 55.9 |
| Total | | 342 | 100 |
| **Total perception score** | Negative perception | 82 | 23.9 |
| | Neutral perception | 51 | 14.9 |
| | Positive perception | 209 | 61.2 |
| Total | | 342 | 100 |
| **Total utilization score** | None usage of AI | 48 | 14 |
| | Low utilization | 25 | 7.3 |
| | Moderate utilization | 245 | 71.6 |
| | High utilization | 24 | 7 |
| Total | | 342 | 100 |

**Table 4: Relationship between socio-demographic factors and perception/utilization of AI.**

| Variables | Perception of AI among medical students | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Positive perception | | Neutral perception | | Negative perception | | Total | Chi-square |
| **Gender** | **N** | **%** | **N** | **%** | **N** | **%** | | |
| Female | 106 | 56.1 | 27 | 14.3 | 56 | 29.6 | 189 | $X^2$=7.489, df=2, p=0.024 |
| Male | 103 | 67.3 | 24 | 15.7 | 26 | 17.0 | 153 | |
| | **Utilization of AI among medical students** | | | | | | | |
| | **Low utilization** | | **Moderate utilization** | | **High utilization** | | **Total** | **Chi-square** |
| **Age (in years)** | **N** | **%** | **N** | **%** | **N** | **%** | | |
| 16-20 | 9 | 7.9 | 85 | 74.6 | 8 | 7.0 | 102 | $X^2$=22.024, df=12, p=0.037 |
| 21-25 | 14 | 7.3 | 138 | 71.5 | 12 | 6.2 | 164 | |
| 26-30 | 1 | 3.8 | 19 | 73.1 | 4 | 15.4 | 24 | |
| 31-40 | 1 | 16.7 | 1 | 16.7 | 0 | 0.0 | 2 | |
| 41-50 | 0 | 0.0 | 2 | 66.7 | 0 | 0.0 | 2 | |
| **Level** | | | | | | | | |
| Clinical (400-600 L) | 5 | 3.5% | 110 | 76.4 | 14 | 9.7% | 129 | $X^2$=10.708, df=3,p=0.013 |
| Preclinical (100-300 L) | 10 | 5.1% | 135 | 68.2 | 10 | 5.1% | 155 | |

*P value≤0.05 is statistically significant.

**Table 5: Knowledge of AI.**

| Variables | Frequency | Percent (%) | Percent (%) of cases |
|---|---|---|---|
| **Have you heard of AI in medicine?** | | | |
| No | 19 | 5.6 | |
| Yes | 323 | 94.4 | |
| Total | 342 | 100.0 | |
| **Have you ever taken a technology course or training on AI?** | | | |
| No | 271 | 79.2 | |
| Yes | 71 | 20.8 | |
| Total | 342 | 100.0 | |
| **How would you rate your knowledge of AI in medicine?** | | | |
| Excellent | 23 | 6.7 | |
| Fair | 155 | 45.3 | |
| Good | 108 | 31.6 | |
| Poor | 56 | 16.4 | |
| Total | 342 | 100.0 | |

Continued.

| Variables | Frequency | Percent (%) | Percent (%) of cases |
|---|---|---|---|
| **How confident are you in explaining AI concepts to others?** | | | |
| Not confident at all | 52 | 15.2 | |
| Not very confident | 135 | 39.5 | |
| Somewhat confident | 113 | 33.0 | |
| Very confident | 42 | 12.3 | |
| Total | 342 | 100.0 | |
| **Which of the following best describes AI? (Select all that apply) *** | | | |
| Machines that can think and act like humans | 136 | 26.5 | 39.8 |
| Software programs that perform specific tasks without human intervention | 237 | 46.1 | 69.3 |
| A branch of computer science focused on creating intelligent machines | 88 | 17.1 | 25.7 |
| A type of robot | 46 | 8.9 | 13.5 |
| I don't know | 7 | 1.4 | 2.0 |
| Total | 514 | 100 | 150.3 |

*=Multiple responses present

**Table 6: Attitudes towards AI in medical education.**

| Variables | Frequency | Percent (%) |
|---|---|---|
| **Do you believe AI can improve healthcare delivery?** | | |
| Agree | 216 | 63.2 |
| Disagree | 17 | 5.0 |
| Strongly agree | 101 | 29.5 |
| Strongly disagree | 8 | 2.3 |
| Total | 342 | 100.0 |
| **Do you think AI will replace doctors in the future?** | | |
| Agree | 60 | 17.5 |
| Disagree | 151 | 44.2 |
| Strongly agree | 21 | 6.1 |
| Strongly disagree | 110 | 32.2 |
| Total | 342 | 100.0 |
| **Some specialties are more prone to be replaced by AI than others?** | | |
| Agree | 197 | 57.6 |
| Disagree | 66 | 19.3 |
| Strongly agree | 52 | 15.2 |
| Strongly disagree | 27 | 7.9 |
| Total | 342 | 100.0 |
| **Would you feel comfortable receiving medical advice from an AI system?** | | |
| Agree | 131 | 38.3 |
| Disagree | 134 | 39.2 |
| Strongly agree | 11 | 3.2 |
| Strongly disagree | 66 | 19.3 |
| Total | 342 | 100.0 |
| **Should AI be incorporated into the medical curriculum?** | | |
| Agree | 208 | 60.8 |
| Disagree | 64 | 18.7 |
| Strongly agree | 42 | 12.3 |
| Strongly disagree | 28 | 8.2 |
| Total | 342 | 100.0 |
| **Would you be interested in participating in further studies or workshops about AI in medicine?** | | |
| Agree | 198 | 57.9 |
| Disagree | 33 | 9.6 |
| Strongly agree | 100 | 29.2 |
| Strongly disagree | 11 | 3.2 |
| Total | 342 | 100.0 |

Continued.

| Variables | Frequency | Percent (%) |
|---|---|---|
| **My teachers are always in support of AI in medicine?** | | |
| Agree | 76 | 22.2 |
| Disagree | 195 | 57.0 |
| Strongly agree | 7 | 2.0 |
| Strongly disagree | 64 | 18.7 |
| Total | 342 | 100.0 |
| **Would you prefer learning from personalized AI generated questions as opposed to traditional questions (from textbooks, question banks etc…)?** | | |
| Agree | 134 | 39.2 |
| Disagree | 123 | 36.0 |
| Strongly agree | 36 | 10.5 |
| Strongly disagree | 49 | 14.3 |
| Total | 342 | 100.0 |

**Table 7: Perception of AI in medical education.**

| Variables | Frequency | Percent (%) |
|---|---|---|
| **AI facilitates physicians access to information** | | |
| Agree | 232 | 67.8 |
| Disagree | 22 | 6.4 |
| Strongly agree | 73 | 21.3 |
| Strongly disagree | 15 | 4.4 |
| Total | 342 | 100.0 |
| **AI facilitates patients education** | | |
| Agree | 228 | 66.7 |
| Disagree | 49 | 14.3 |
| Strongly agree | 54 | 15.8 |
| Strongly disagree | 11 | 3.2 |
| Total | 342 | 100.0 |
| **AI allows the patient to increase their control over own health** | | |
| Agree | 173 | 50.6 |
| Disagree | 105 | 30.7 |
| Strongly agree | 34 | 9.9 |
| Strongly disagree | 30 | 8.8 |
| Total | 342 | 100.0 |
| **AI increases patients' confidence in medicine** | | |
| Agree | 176 | 51.5 |
| Disagree | 118 | 34.5 |
| Strongly agree | 24 | 7.0 |
| Strongly disagree | 24 | 7.0 |
| Total | 342 | 100.0 |
| **AI enables the physician to make more accurate decisions** | | |
| Agree | 193 | 56.4 |
| Disagree | 94 | 27.5 |
| Strongly agree | 36 | 10.5 |
| Strongly disagree | 19 | 5.6 |
| Total | 342 | 100.0 |
| **In using AI, violations of professional confidentiality may occur more** | | |
| Agree | 181 | 52.9 |
| Disagree | 96 | 28.1 |
| Strongly agree | 49 | 14.3 |
| Strongly disagree | 16 | 4.7 |
| Total | 342 | 100.0 |
| **AI reduces the humanistic aspect of the medical profession** | | |
| Agree | 174 | 50.9 |
| Disagree | 73 | 21.3 |
| Strongly agree | 74 | 21.6 |
| Strongly disagree | 21 | 6.1 |
| Total | 342 | 100.0 |

Continued.

| Variables | Frequency | Percent (%) |
|---|---|---|
| **AI damages the trust which is the basis of the patient-physician relationship** | | |
| Agree | 145 | 42.4 |
| Disagree | 116 | 33.9 |
| Strongly agree | 57 | 16.7 |
| Strongly disagree | 24 | 7.0 |
| Total | 342 | 100.0 |
| **AI facilitates patients' access to the service** | | |
| Agree | 207 | 60.5 |
| Disagree | 90 | 26.3 |
| Strongly agree | 31 | 9.1 |
| Strongly disagree | 14 | 4.1 |
| Total | 342 | 100.0 |
| **AI devalues the medical profession** | | |
| Agree | 90 | 26.3 |
| Disagree | 163 | 47.7 |
| Strongly agree | 27 | 7.9 |
| Strongly disagree | 62 | 18.1 |
| Total | 342 | 100.0 |
| **AI reduces errors in medical practice** | | |
| Agree | 182 | 53.2 |
| Disagree | 111 | 32.5 |
| Strongly agree | 26 | 7.6 |
| Strongly disagree | 23 | 6.7 |
| Total | 342 | 100.0 |
| **AI negatively affects the relationship of the physician with the patient** | | |
| Agree | 145 | 42.4 |
| Disagree | 127 | 37.1 |
| Strongly agree | 41 | 12.0 |
| Strongly disagree | 29 | 8.5 |
| Total | 342 | 100.0 |
| **Would you feel more objectively assessed and graded if an AI system graded you during the clinical skills exam instead of the usual standardized preceptor?** | | |
| Agree | 135 | 39.5 |
| Disagree | 129 | 37.7 |
| Strongly agree | 24 | 7.0 |
| Strongly disagree | 54 | 15.8 |
| Total | 342 | 100.0 |
| **If you were to be assessed by an AI system during your clinical skills exam, do you feel that you would receive more personalized feedback than with a human standardized patient?** | | |
| Agree | 114 | 33.3 |
| Disagree | 138 | 40.4 |
| Strongly agree | 24 | 7.0 |
| Strongly disagree | 66 | 19.3 |
| Total | 342 | 100.0 |

**Table 8: Utilization of AI in medical education.**

| Variables | Frequency | Percent (%) | Percent (%) of cases |
|---|---|---|---|
| **Have you ever used AI-based tools or software in your medical studies?** | | | |
| No | 46 | 13.5 | |
| Yes | 296 | 86.5 | |
| Total | 342 | 100.0 | |
| **If yes, which AI tools or software have you used? (Select all that apply)*** | | | |
| AI chatbots | 279 | 63.0 | 94.3 |
| Google assistant or Siri or Alexa | 82 | 18.5 | 27.7 |
| AI in research | 36 | 8.1 | 12.2 |
| AI powered medical apps | 26 | 5.9 | 8.8 |
| AI in image recognition | 20 | 4.5 | 6.8 |
| Total | 443 | 100 | 149.7 |

Continued.

| Variables | Frequency | Percent (%) | Percent (%) of cases |
|---|---|---|---|
| **How often do you use AI tools in your studies?** | | | |
| Daily | 192 | 56.1 | |
| Weekly | 54 | 15.8 | |
| Monthly | 10 | 2.9 | |
| Rarely | 40 | 11.7 | |
| Total | 296 | 86.7 | |
| **What device do you use most frequently to access AI tools? (Select all that apply)*** | | | |
| Smartphone | 289 | 79.0 | 97.6 |
| Laptop/Desktop | 59 | 16.1 | 19.9 |
| Tablet | 18 | 4.9 | 6.1 |
| Total | 366 | 100 | 123.6 |
| **Where do you apply AI tools the most in your academic or clinical activities? (Select all that apply) *** | | | |
| Research and writing | 217 | 44.7 | 73.3 |
| Studying for exams | 209 | 43.0 | 70.6 |
| Clinical decision-making | 32 | 6.6 | 10.8 |
| Patient diagnosis and management simulations | 28 | 5.8 | 9.5 |
| Total | 486 | 100 | 164.2 |

* = Multiple responses present

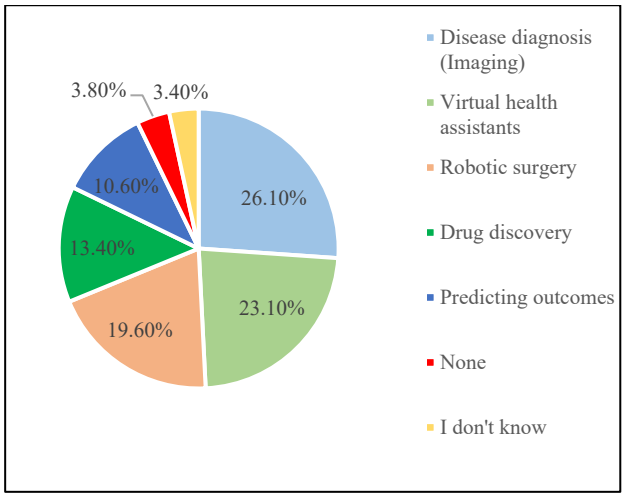


**Figure 1: AI application awareness in healthcare**

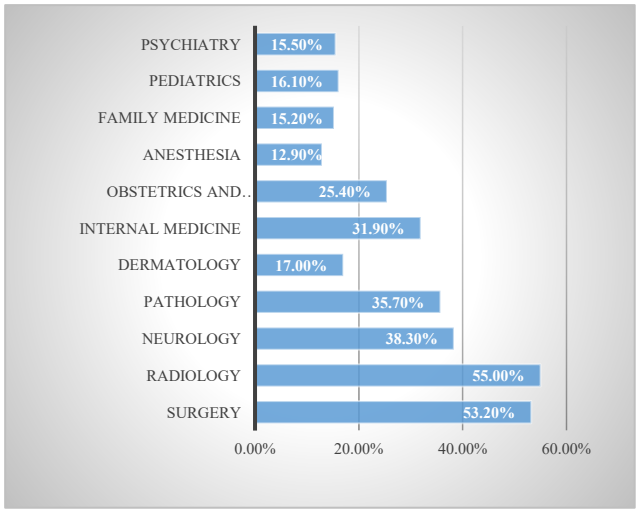


**Figure 2: Specialties with most application of AI.**

## DISCUSSION

AI technologies are increasingly integrated into healthcare, including diagnostics, treatment planning, robotic surgery, medical imaging, and patient management.[5,6,8,28] While widely adopted in developed countries, AI implementation in research and education remains limited in Africa.[13,29] A majority (56.4%) of participants were aged 21-25, similar to studies in, Saudi Arabia, and Ekiti, Nigeria.[22,24] Younger students may be more adaptable to emerging technologies.[23] The slight female predominance (55.3%) aligns with global trends in medical school enrollments.[22,24] However, previous studies suggest females generally have less exposure to AI and more negative attitudes toward technology, which may explain gender differences in AI perception.[25]

Despite 94.4% AI awareness, only 20.8% had received formal AI training, with 6.7% rating their knowledge as "excellent" and 45.3% as "fair." Confidence in AI concepts was low, as 39.5% reported being "not very confident." These findings align with studies conducted at the University of Ilorin (UNILORIN), Nigeria (98.8% aware of AI, 9.3% AI training), India (73.9% aware of AI, 80% without formal AI education), and Pakistan (68.8% aware of AI, only 19.4% aware of AI's medical applications).[13,14,21] Even in technologically advanced countries like Canada, over half of medical students (51.08%) misunderstood AI concepts.[26] The knowledge gap highlights the urgent need for structured AI education. Students primarily learned about AI through social media (68.7%), while formal education contributed only 13.9%, mirroring trends in UNILORIN, where 90.4% relied on media for AI knowledge.[13] Over-reliance on informal sources may lead to misconceptions and fragmented understanding. Regarding AI applications in medicine, students most frequently associated AI with radiology

(55%) and surgery (53.2%), followed by pathology (35.7%). However, specialties like pediatrics (16.1%), psychiatry (15.5%), family medicine (15.2%), and anesthesia (12.9%) were underrecognized. This trend is consistent with studies in Lebanon and Pakistan, where radiology and pathology were most identified as AI-driven fields.[14,15] Overall, 54.8% of students demonstrated moderate AI knowledge, 25.2% good, and 20% poor, emphasizing the need for improved AI literacy in medical curricula.

Most students (92.7%) believe AI can improve healthcare delivery, consistent with studies in Nigeria (63%) and Lebanon (95.6%).[13,15] However, 66.4% reject the idea that AI will replace doctors, aligning with Nigerian studies but contrasting with Lebanese students, where 55.8% expected AI to replace physicians.[13,15] Concerns about AI replacing certain specialties were evident, with 72.8% believing some fields are more prone to AI integration-similar to Lebanese findings (90.3%).[15] In Saudi Arabia, 85% of students feared AI-driven job losses, while in the U.S., 66% saw radiology as the most AI-vulnerable field, with 44% discouraged from pursuing it.[20,22] A majority (87.1%) expressed interest in AI workshops, and 73.1% supported AI's integration into the curriculum, aligning with studies in UNILORIN (87.1%) and Pakistan (76.7%).[13,14] However, only 24.2% believed their teachers fully supported AI, indicating a potential barrier to AI education. Overall, 55.9% of students held positive attitudes toward AI, 24.3% were neutral, and 19.8% negative, mirroring Syrian findings, where most students expressed positive attitudes toward AI's necessity in medicine, and senior students were nearly three times more likely to support AI in medicine.[27]

A majority (61.2%) had a positive perception of AI in medical education, while 23.9% were negative, and 14.9% neutral. Males (67.3%) were more likely than females (56.1%) to have a positive AI perception (p=0.024), possibly due to differences in technology exposure and career aspirations, with males generally being more tech-savvy.[25] Students acknowledged AI's benefits, with 89.1% believing AI enhances physician access to information, and 82.5% agreeing it improves patient education, consistent with Indian (80% and 56.7%) and Saudi Arabian (70.8%) studies.[21,22] Most students (60.8%) believed AI reduces medical errors, supporting studies conducted in Kerala and Karnataka India (72.3%, 71.1%) and Saudi Arabia (65.2%).[5,21,22] However, concerns about AI's impact on medical practice remain. A significant 72.5% feared AI reduces the humanistic aspect of medicine, contrasting with Indian findings (45.6%).[21] Additionally, 67.2% worried about confidentiality violations, and 59.1% believed AI damages physician-patient trust, aligning with Indian findings (61.1%).[21] Regarding AI's role in clinical assessments, 53.5% opposed AI grading, and 59.7% preferred human feedback over AI evaluations, paralleling results from Lebanon (42.3% and 65.7%).[15] This skepticism suggests that students value human oversight in clinical evaluations.

Majority (86.5%) of students reported using AI-based tools, with chatbots (94.3%) being the most used tools, followed by Google Assistant/Siri/Alexa (27.7%). However, clinical AI applications, such as patient diagnosis (10.8%) and decision-making (9.5%), were minimally used, indicating AI is primarily leveraged for academic purposes. The dominance of smartphone-based AI use (97.6%) aligns with findings from Port Harcourt, Nigeria, where AI use was largely mobile-dependent.[31] Most students (71.6%) exhibited moderate AI utilization, while 7.3% had low and 7% high utilization. Importantly, clinical students (400-600 L) showed significantly higher AI utilization (9.7%) than preclinical students (5.1%) (p=0.013), likely due to greater exposure to real-world applications. Similarly, age was a significant factor in AI utilization (p=0.037), with students aged 26-30 having the highest AI usage (15.4%). ANOVA results further confirmed that higher AI utilization was associated with greater AI knowledge (p<0.001).

### *Limitations*

This study has some limitations that must be acknowledged and addressed to ensure the credibility and validity of these findings. Firstly, the single-center design limits generalizability, as AI exposure may differ across institutions. Additionally, reliance on self-reported data introduces potential biases, such as social desirability and recall bias, affecting the accuracy of responses. While students perceived low teachers support for AI, the study did not explore the teacher's perspectives, which could have provided a more balanced view. Being cross-sectional, the study captures AI engagement at a single point in time, preventing assessment of trends over time. It also excludes other healthcare students, limiting insights into AI adoption across medical disciplines. Finally, the demographic distribution may not be fully representative, as the majority of participants were younger (21-25 years) and Igbo (96.2%), potentially underrepresenting diverse perspectives. To overcome these limitations, future research should include multiple institutions, faculty perspectives, and a broader sample across healthcare professions, ideally using a longitudinal approach to track AI adoption over time. The acknowledgment of these limitations will aid in the interpretation of the study's findings and guide future research in addressing these gaps.

## CONCLUSION

This study highlights the growing awareness of AI in medical education among Nigerian medical students, with the majority recognizing its potential to improve healthcare delivery. However, despite high awareness, there remains a significant gap in formal AI training and comprehension, as evidenced by the moderate knowledge levels (54.8%) and low confidence in explaining AI concepts. The reliance on informal learning sources, particularly social media, further underscores the need for structured AI education within medical curricula.

While most students hold positive attitudes toward AI, concerns persist regarding its impact on job security, the humanistic aspect of medicine, and patient confidentiality. The belief that AI could compromise physician-patient trust and depersonalize healthcare suggests a cautious approach to AI adoption in clinical practice. Notably, the low recognition of AI's role in non-procedural specialties, such as psychiatry, family medicine, and anesthesiology, indicates a limited understanding of AI's diverse applications beyond radiology and surgery. AI utilization among students is primarily academic rather than clinical, with chatbots and AI-powered research tools being the most commonly used applications. The significant association between AI utilization and both level of study and knowledge scores suggests that increased exposure to clinical environments enhances AI adoption. However, low utilization rates in clinical decision-making highlight the need for AI integration into practical medical training.

To address these challenges, medical schools should incorporate structured AI education into their curricula, ensuring students receive formal training on AI applications, ethical considerations, and real-world case studies. Faculty engagement is also critical, as only 24.2% of students felt their teachers fully supported AI in medicine. Educator training programs should be implemented to equip faculty with the knowledge and skills needed to teach AI effectively. Furthermore, efforts should be made to bridge gender disparities in AI perception and utilization, encouraging greater female participation in AI-related learning and research. AI workshops, interdisciplinary collaborations, and hands-on simulations should be introduced to enhance students' familiarity with AI-driven tools in clinical settings. By addressing these gaps, medical institutions can better prepare future healthcare professionals for an AI-driven era, ensuring that AI enhances rather than disrupts medical practice while maintaining the essential human touch in patient care.

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