بسم الله الرحمن الرحيم

كلية نبتة
NAPATA COLLEGE

NAPATA COLLEGE

FACULTY OF MEDICINE

DEPARTMENT OF RESEARCH METHYDOLOGY

Assessment of the Medical Students' Perceptions Towards Artificial Intelligence Integration in Medicine at Napata Collage, 2025

A Dissertation Submitted in Partial Fulfillment of the Requirements for MBBS Degree

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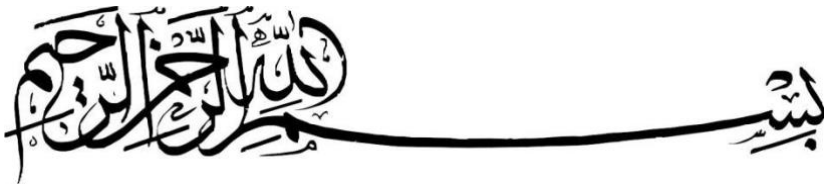

قال تعالى:

(وَفوْقَ كُلِّ ذِّي عِّلْم عَلِّيم)

"صدق الله العظيم"

Dedication

We dedicate this research to our parents, for their unconditional love, unwavering support and constant encouragement throughout our academic and personal journey.

They have been our role models, instilling in us the values of hard work, perseverance, and dedication. Their guidance and sacrifices have been instrumental in shaping our characters and helping us achieve our goals.

Thank you for being the light that guides us through the challenges of life.

To our siblings, for being our constant source of motivation and inspiration.

To our backbones and our friends, for their love and support and for always being there for us, no matter what. We could not have made it this far without you.

Acknowledgment

First, all thanks to Allah, for this incredible opportunity and for all the blessings that he has bestowed upon us.

We would like to express our deepest gratitude to our supervisor, **Dr. Hadeel Ahmed**, for her invaluable guidance, support, and encouragement throughout this research project. Her expertise and insights were instrumental in shaping the direction of this study and in helping us to navigate the various challenges that arose along the way.

Her dedication and commitment to our academic success have been a source of inspiration and motivation for us. Her willingness to share her knowledge and experience with us has been a privilege. We are grateful for her patience and understanding, especially during the challenging periods of our research.

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Abstract

Background:

Artificial Intelligence (AI) has made a strong entrance into different fields such as healthcare, but currently, medical degree curricula are not adapted to the changes that adopting these types of tools entitles. Furthermore, concerns about the accuracy, reliability, and proper use of these tools persist. Understanding medical students' perceptions of Artificial Intelligence (AI) is crucial for optimizing its use in educational settings. It is also important to understand the future needs of students to provide the most comprehensive education possible Therefore, the aim of this study was to assess the perception level of medical students at Napata Collage towards Artificial Intelligence integration in Medicine in Sudan, 2025.

Method:

An observational descriptive cross-sectional facility – based study was conducted on February 2025. A total of 350 medical students participated in this study from Napata College, Sudan. Data was collected using online self-administered questionnaires using Google forms. The data was entered and analyzed using SPSS version 27.

Results:

A total of 350 medical students participated in this study, of which females (54.3%) were more than males (45.7%), and the most common age group was found to be 20-23 years (78.9%), followed by 24-26 years (15.4%). The commonest academic level was third year (40.3%), followed by fourth year (38.6%). The majority of students (72.3%) have used Artificial Intelligence (AI) before to obtain medical information. Almost half of students (46%) are somehow familiar with the current artificial intelligence tools applied to medicine, such as AI-assisted diagnosis or therapeutic recommendations, and the majority (62.9%) stated that they have basic understanding of AI technologies. The overall positive perception of students towards Artificial Intelligence (AI) in Medicine was found to be 50.1%, while 49.9%% had negative perception. A significant association was found between the perception towards Artificial Intelligence (AI) in Medicine of students and their use of AI to obtain medical information, familiarity with the current artificial intelligence tools applied to medicine, and basic understanding and interest of AI technologies (P-value = 0.00001, 0.00003, and 0.001, respectively).

Conclusion:

As overall, this study demonstrated that students of Napata College are increasingly familiar with and utilize AI in medicine and have a balanced view regarding its advantages and disadvantages. Although a majority of students perceive the future of AI in medical education and health care with optimism, fear from the ethical aspects and faith is present. In spite of frequent exposure, education on the topic is insufficient, as with the global pattern. Acing systematic AI training within medical school programs can prepare students to be more confident and ready to practice in an AI-oriented healthcare setting. Coming to terms with ethical concerns and encouraging practical implementations of AI will be the most significant considerations in achieving its proper utilization in medicine.

ملخص الدراسة

الخلفية:

شهد الذكاء الاصطناعي (AI) دخولا قويا في مجالات مختلفة، مثل الرعاية الصحية، إلا أن مناهج الدراسات الطبية لا تتكيف حالي مع التغييرات التي يفرضها اعتماد هذه الأدوات. علاوة على ذلك، لا تزال هناك مخاوف بشأن دقة هذه الأدوات وموثوقيتها وسلامتها. يعد فهم تصورات طلاب الطب للذكاء الاصطناعي أمر بالغ الأهمية لتحسين استخدامه في البيئات التعليمية. ومن المهم أيضا ا فهم الاحتياجات المستقبلية للطلاب لتوفير تعليم شامل قدر الإمكان. لذلك، هدفت هذه الدراسة إلى تقييم مستوى تصور طلاب الطب في كلية نبتة لدمج الذكاء الاصطناعي في الطب في السودان، 2025.

المنهجية:

أجُريت دراسة وصفية رصدية مقطعية في فبراير 2025، شملت 350 طالب طب من كلية نبتة بالسودان. جُمعت البيانات باستخدام استبيانات ذاتية الإدارة عبر الإنترنت باستخدام نماذج جوجل. تم إدخال البيانات وتحليلها باستخدام برنامج SPSS الإصدار 27.

النتائج:

شارك في هذه الدراسة 350 طالب طب، شكلت الإناث منهم نسبة أعلى.(54.3 %) من الذكور (45.7%) وكانت الفئة العمرية الأكثر شيوعا هي 20-23 عاما (78.9%) تليها 24-26 عاما (15.4%.) أما المستوى الأكاديمي الأكثر شيوعا فكان السنة الثالثة (40.3%)، تليها السنة الرابعة (38.6%) وقد استخدم غالبية الطلاب (72.3%) الذكاء الاصطناعي سابقا للحصول على معلومات طبية. ويمتلك ما يقارب من نصف الطلاب (46%) إلماما بأدوات الذكاء الاصطناعي الحالية المطبقة في الطب، مثل التشخيص بمساعدة الذكاء الاصطناعي أو التوصيات العلاجية، بينما أفاد الغالبية (62.9%) بأن لديهم فهما أساسيا لتقنيات الذكاء الاصطناعي. بلغ التصور الإيجابي للطلاب تجاه الذكاء الاصطناعي في الطب 50.1%، بينما كان لدى 49.9% تصور سلبي. تم العثور على ارتباط مهم بين تصور الطلاب للذكاء الاصطناعي في الطب واستخدامهم للذكاء الاصطناعي للحصول على المعلومات الطبية، والتعرف على أدوات الذكاء الاصطناعي الحالية المطبقة على الطب، والفهم الأساسي والاهتمام بتقنيات الذكاء الاصطناعي (القيمة الاحتمالية = 0.00001، 0.00003، و 0.001، على التوالي).

الخلاصة:

بشكل عام، أظهرت هذه الدراسة أن طلاب كلية نبتة أصبحوا أكثر دراية ا بالذكاء الاصطناعي واستخدامه في الطب، ولديهم نظرة متوازنة تجاه مزاياه وعيوبه. على الرغم من أن غالبية الطلاب ينظرون إلى مستقبل الذكاء الاصطناعي في التعليم الطبي والرعاية الصحية بتفاؤل، إلا أن هناك مخاوف من الجوانب الأخلاقية والإيمانية. ورغم كثرة التعرض له، فإن التثقيف حوله غير كاف كما هو الحال في النمط العالمي. إن إتقان التدريب المنهجي على الذكاء الاصطناعي ضمن برامج كلية الطب يمُكن أن يهُيئ الطلاب ليكونوا أكثر ثقة واستعداد للممارسة في بيئة رعاية صحية قائمة على الذكاء الاصطناعي. وسيكون تقبل المخاوف الأخلاقية وتشجيع التطبيقات العملية للذكاء الاصطناعي من أهم الاعتبارات لتحقيق الاستخدام الأمثل له في الطب.

Chapter One: Introduction

1.1 Background:

The recent COVID-19 pandemic forced an abrupt leap into the virtual learning environment, expediting the widespread use of technology-enhanced learning. Concomitantly, the pandemic contributed to increased awareness of social and health disparities, spurring the implementation of diversity initiatives and social determinants of health curricula in medical schools and residency programs worldwide. We are currently on the precipice of another transformational shift in health care and medical education. Artificial intelligence (AI) and AI-based large language models (LLMs), such as Chat GPT , have the potential to revolutionize the way medicine is learned, taught, and practiced. [1]

Artificial Intelligence (AI) simply means making machines capable of simulating intelligence by giving the computer human-like capabilities, such as understanding, reasoning and problem-solving. AI interprets external data, learns from it, and uses this learning to achieve specific goals and tasks. While in medicine, Artificial intelligence (AI) refers to using computers and advanced technology, such as machine learning algorithms, to assemble and process data input from experts and analyze it, producing critical thinking comparable to that of a human being. AI has been primarily employed for tasks involving visual imagery, where it can analyze images and detect any abnormal phenotypic characteristics in them to formulate a hypothesis regarding the patient's underlying condition [2, 3]

A range of AI-based applications, such as clinical and genomic diagnostics, chronic disease management, block chain technology and sophisticated surgical robots have deeply reshaped medical practice in the 21st century. As an emerging field, AI will only continue to transform the way medical science advances and become an integral part of medicine in the future. [4]

For example, the CheXNeXt algorithm for chest radiograph diagnosis was found to perform at a level similar to radiologists. AI algorithms can also predict future adverse medical events much better than traditional methods. One example is predicting aneurysms. Even in the realm of psychiatry, AI algorithms can help detect subtle, yet key information about patients, such as speech patterns, that can predict subsequent psychosis onset. For medical research applications, AI has been able to recognize complex patterns in large amounts of data (eg, gene expression and gut microbiota) to classify clinical conditions, such as cardiomyopathies, inflammatory bowel disease, and cardiovascular diseases. [5, 6]

Artificial intelligence (AI) is anticipated to fundamentally change the educational and professional landscape for the next generation of physicians, but its successful integration depends on the global perspectives of all stakeholders. [6]

Although it has been pointed out that AI will be one of the main elements of medical education in the upcoming decade, research is lacking perceptions of medical students towards AI and their intentions to adopt AI technologies. Therefore, empirical studies on medical students' perception of AI are needed.

Being said, this study was conducted with the aim of assessing the perceptions of medical students at Napata Collage towards Artificial Intelligence integration in Medicine. As to the best of our knowledge, no such local study had been conducted regarding this topic in Sudan, and the results of this study would provide new perspectives on this topic, that can benefit both medical schools and medical students.

1.2 Problem statement:

Artificial Intelligence (AI) has made a strong entrance into different fields such as healthcare, but currently, medical degree curricula are not adapted to the changes that adopting these types of tools entitles. Furthermore, concerns about the accuracy, reliability, and proper use of these tools persist. Understanding medical students' perceptions of Artificial Intelligence (AI) is crucial for optimizing its use in educational settings. It is also important to understand the future needs of students to provide the most comprehensive education possible. [5, 7]

1.3 Justification:

Artificial Intelligence (AI) means making machines capable of stimulating intelligence by giving the computer human like capabilities such as understanding, reasoning & problem solving. AI systems can provide multi-sensory stimulating environment, feedback about learners' performance, opportunity to engage in problem-based learning, opportunity to observe medical cases on a model in a variety of grades & introducing different interventions in a safe environment. Implementing technological reform in medical education requires students' readiness & awareness regarding importance of adopting the latest technologies in order to equip themselves with knowledge& skills require for future medical practice. [6, 7]

1.4 Research question:

- What is the perception level of medical students at Napata College towards Artificial Intelligence integration in Medicine?

1.5 Research Hypothesis:

- **Null Hypothesis:** Medical students of Napata College were anticipated to have negative perceptions towards Artificial Intelligence integration in Medicine.
- **Alternative Hypothesis:** Medical students of Napata College were anticipated to have positive perceptions towards Artificial Intelligence integration in Medicine.

1.6 Objectives:

1.6.1 General objectives:

- To assess the perception level of medical students at Napata Collage towards Artificial Intelligence integration in Medicine in Sudan, 2025.

1.6.2 Specific Objectives:

- To explore the socio-demographic characteristics of students.
- To determine the factors related to the use of Artificial Intelligence (AI) in Medicine among students.
- To evaluate the perception level of medical students towards Artificial Intelligence integration in Medicine.
- To find out the association between students' perception towards Artificial Intelligence (AI) in Medicine and related factors.

Chapter Two: Literature Review

The future of medical education and practice is being reshaped by the integration of artificial intelligence (AI) across healthcare. AI-enabled technologies such as natural language processing, machine learning, computer vision, and robotics all made impressive entrances in clinical domains such as personalized care planning, predictive analytics, pathology, and imaging diagnostics. [8] As these technologies become increasingly integrated within the healthcare system, they can potentially increase diagnostic performance, outcomes in patients, cost-effectiveness' of care, and reduce the bureaucratic load on practitioners. [9] Successful adoption of AI into clinical practice also depends significantly on the attitudes and preparedness of future healthcare professionals, particularly future medical students who will pave the way with this technology revolution. [10].

Although AI has been applied in many aspects of medicine, medical education has been slower to catch up. The majority of medical curricula globally still lack formal AI education, and the students are thus not prepared for their future working environment. [11] Attitudes of medical students range in surveys from optimism to apprehension regarding the integration of AI. While some of the students embrace the potential positive role of AI in the form of improved diagnostic accuracy and decision support, others are worried about replacement of human physicians, ethical issues, and confidentiality of patient data. [12] Some other students are also worried that overreliance on AI would compromise some of the most critical clinical skills and physicianpatient relationships, given the need to strike a balance in AI use in health care. [13]

The literature suggests that medical students' perceptions of AI are influenced by a variety of factors, including prior experience with technology, understanding of AI concepts, perceived self efficacy with digital technologies, and future specialty interest. For example, students interested in radiology, pathology, or surgery are more familiar and open to AI since AI is more prominent in these specialties. [14] On the other hand, students learning specialties that are viewed as more

interpersonal interaction-dependent, i.e., family medicine or psychiatry, may be more skeptical about AI utilization. [15] In addition, geographical and institutional contexts also play a role, with students at institutions that offer courses on AI being more inclined to have a positive attitude and self-efficacy in using AI systems in their future practice. [16]

Several studies have talked of the imperatives of incorporating AI education in undergraduate medical education. Curricula that introduce students to AI at an early point and provide them with experience in using AI tools can reaffirm good attitudes and position students to use AI in an effective and responsible way. [17] Educational interventions were shown to significantly improve students' understanding of AI weaknesses and strengths, debunking replacement anxiety, and enhancing their critical assessment of AI outputs. [18] Furthermore, the integration of ethical, legal, and social implications of AI into medical education is needed to equip future physicians with the skills necessary to handle difficult questions of bias, accountability, and patient consent in an AI-augmented healthcare system. [19]

Medical students' perceptions to accept and work with AI is not just an educational, but also a broader professional issue. Their attitudes can influence future adoption of AI in clinical practice, which will dictate how quickly and effectively new technologies are adopted. [20]

Students who view AI as a collaborative tool will be more accepting of technological change and more conducive to rightful utilization of AI. Negative attitudes can lead to resistance, delayed adoption, and reduced use of otherwise beneficial innovations. [21] The attitudes of students are therefore valuable to curriculum developers, policymakers, and healthcare executives who desire seamless AI integration in medicine.

Furthermore, the COVID-19 pandemic also accelerated digitalization in healthcare, which further emphasized the role of AI in telemedicine, remote monitoring, and resource allocation. [22] This

sudden shift has shown weaknesses in the digital competencies of physicians in practice and students, which have underlined the need to bring medical education into line with the prevailing technology requirements. Post-pandemic and pandemic-related research has demonstrated that there is more interest among students in gaining digital health competencies, including AI literacy, with an eye to more appreciation of the relevance of AI in future clinical practice. [23]

Despite increasing awareness, there are difficulties. There are no generic pedagogic models under which AI is being taught in medical schools, and therefore diversity exists in knowledge and confidence in students among schools. Also driving these challenges are misconceptions regarding the abilities of AI, partly driven by sensationalized media coverage and lack of firsthand experience with the real-world application of AI in healthcare. [24] Solving these issues will not only involve curriculum change but also mentorship, interprofessional education, and access to experiential use of AI technology during clinical training. [25]

In conclusion, the integration of AI in medicine is both a future possibility and a difficult conundrum for the future health professional. The attitudes of medical students towards AI will be what finally shapes how technology is adopted in practice and in patient care. A detailed understanding of such attitudes is crucial to the direction of education reforms, the promotion of responsible use of AI, and the empowering of future physicians to unlock the potential of AI without undermining the ethics of medicine. [26] A study of medical students' attitudes towards AI is therefore opportune and of utmost significance in ascertaining the mechanisms available to empower healthcare systems for an AI-assisted future.

Various global studies were found in the literature on this topic, however, to the best of our knowledge, no local studies were found in Sudan. Therefore, this study can provide valuable information that can help both universities and medical students in Sudan.

For example, a study was carried out by Gualda-Gea et al. in Spain in the year 2025 to describe the knowledge, attitudes, and perspectives of medical students regarding the application of AI and chatbots with patients, also considering their ethical perceptions. Out of the 61 students enrolled in the subject, 34 (56%) attended the seminar, of whom 29 (85%) completed the questionnaire correctly. Of those completing the questionnaire, 20 (69%) had never used chatbots for medical information, 19 (66%) expressed a strong interest in the practical applications of AI in medicine, 14 (48%) indicated elevated concern about the ethical aspects, 17 (59%) acknowledged potential biases in these tools, and 17 (59%) expressed at least moderate confidence in chatbot-provided information. Notably, 24 (83%) agreed that acquiring AI-related knowledge will be essential to effectively perform their future professional roles. [27]

Another study was conducted by Rjoop et al. in Jordan in 2025 to assess and compare medical AI-related attitudes among medical students in general medicine and in one of the visually oriented fields (pathology), along with illuminating their anticipated role of AI in the rapidly evolving landscape of AI-enhanced health care. A total of 394 respondents participated (328 medical students and 66 pathology residents). The majority of respondents (272/394, 69%) were already aware of AI and deep learning in medicine, mainly relying on websites for information on AI, while only 14% (56/394) were aware of AI through medical schools. There was a statistically significant difference in awareness among respondents who consider themselves tech experts compared with those who do not (P=.03). More than half of the respondents believed that AI could be used to diagnose diseases automatically (213/394, 54.1% agreement), with medical students agreeing more than pathology residents (P=.04). However, more than one-third expressed fear about recent AI developments (167/394, 42.4% agreed). Two-thirds of respondents disagreed that their medical schools had educated them about AI and its potential use (261/394, 66.2% disagreed), while 46.2% (182/394) expressed interest in learning about AI in medicine. In terms of pathology-specific questions, 75.4% (297/394) agreed that AI could be used to identify

pathologies in slide examinations automatically. There was a significant difference between medical students and pathology residents in their agreement (*P*=.001). Overall, medical students and pathology trainees had similar responses. [28]

In Nigeria, Wobo et al. performed a study in the year 2025 to assess medical students' awareness, perception and usage of AI in learning. 64 (46%) of the respondents are aware of AI. 57 (44%) of respondents applied AI during their clinical training. The most commonly used AI tool is Chatbots. 57(100%). The major limitations to AI use were unreliable internet connectivity (62%) and the high cost of AI hardware and software (53%). Most respondents (68%) expressed ethical concerns about the use of AI. There was a statistically significant relationship between awareness of AI and the use of AI in learning (p=0.0001). [29]

Meanwhile, in Jordan, Abu Hammour et al. participated in a study in the year 2024 to evaluate how medical students perceive ChatGPT for educational purposes and to assess its perceived advantages and disadvantages. Nearly two-thirds (N = 136, 61.5%) claimed to have knowledge of AI but not in clinical settings. Most participants (88.5%, N = 216) were aware of ChatGPT, with 86.9% (N = 212) agreeing that 'Medical students can benefit from using ChatGPT.' Additionally, 83.2% (N = 203) felt that 'ChatGPT helps students quickly and easily summarize complex information.' Conversely, 78.3% (N = 191) expressed concerns about ChatGPT's potential inaccuracies, with accuracy and reliability cited as primary concerns. Multiple logistic regression showed that younger students (OR = 0.902, P = 0.025) and those with lower proficiency (OR = 0.487, P = 0.007) used ChatGPT more frequently than others. [30]

Furthermore, a study was done in India by Raja in the year 2024 to assess the knowledge, perception, and acceptance of AI in healthcare among recent medical graduates, including medical interns, junior residents, senior residents, and fellowship candidates. A total of 254

interested candidates (57% females) responded to the survey. The median knowledge score of the participants was slightly higher in male respondents than female respondents (Image 1). A majority of the respondents stated that AI would be capable of analyzing patient information to interpret diagnostic imaging, diagnoses, and prognoses, as well as conducting population health surveillance. Additionally, 53% of the participants indicated that AI has already or will impact their choice of specialty selection. Moreover, 66% of them feel that current medical education inadequately prepares them to work alongside AI, while a striking 81% of them believe in incorporating AI competencies into medical training. [31]

A study was also carried out by Obiekwe et al. in Nigeria in the year 2024 to assess the knowledge, perspectives, and readiness perceived by medical students at Nnamdi Azikiwe University. The vast majority of the respondents (99.4%) had heard of AI, but only 3.2% were very familiar with its real-world applications. Most participants (96.8%) lacked formal education or training in AI, and few (7.4%) regularly followed AI-related news. Concerns about AI integration included data privacy (39.4%) and the potential loss of human touch in patient care (70.9%). Job displacement (72.1%) and misuse of AI (55.9%) were common fears. Despite these concerns, more than half of the respondents (55.6%) were interested in AI research, and many expressed openness to collaborating with AI systems (34.1%) and acquiring additional AI-related skills (67.9%). [32] Lastly, a study was conducted by Hawezy et al. in Iraq in the year 2024 to explore the perceptions and expectations of medical students in the Kurdistan region, Iraq, regarding AI integration in medical education. In total, 224 medical students responded to the online survey. The majority of them were female (n=129; 57.6%), while 95 were male (42.4%). Additionally, most of the participants were in stage 4 (54 (24.1%); stage 1, 48 (21.4%); and stage 2, 43 (19.2%). In terms of measuring students' perceptions of AI integration in medical education, 186 (83%) of the students wanted to use smartphones and tablets, and 38 (17%) of them reported wanting hard copies. In addition, 112 (50%) of the medical students considered themselves experts in using AI

and 98 (43.8%) did not know exactly what AI was used; however, only a few of them (6.3%) did not use AI. Few patients reported using Manikins instead of real patients (42 (18.8%)), while 140 (62.5%) reported that they could be used but not an alternative. [33]

Chapter Three:

Materials and Methods

3.1 Study Design:

The study was conducted as a descriptive, cross-sectional, facility-based study.

3.2 Study Area:

Data was collected from Napata College. Napata University College is one of the private higher education institutions in Sudan. It was founded by Professor Al-Zubair Bashir Taha, accompanied by Professor Babakir Al-Hajj Musa, Dr. Abdul-Rahman Ibrahim Al-Khalifa, and Professor Muhammad Al-Amin Ahmed, in 2014. Student admission and training began in the academic year 2015-2016. It was named after the city of Napata, the center of the historic ancient Nubian kingdom in northern Sudan. The college is located in two complexes: Riyadh Complex which includes pharmacy, computer science, and information technology programs, and is located in the Riyadh area in the capital, Khartoum, at the intersection of Al-Mashtal Street and Obaid Khatam Street, Square 10, Building No. 151, (2) Kafouri Collection, which includes programs in medicine and surgery, dental medicine and surgery, medical laboratory sciences, nursing, administrative and financial sciences, and is located in the Khartoum Bahri area - Kafouri, North of Qantara, Square 11, Building No. 117, and Kafouri Complex (B): This building was added to accommodate students of the new programs, and includes a dental clinic, a student activity space, study halls, and administrative offices. [34]

3.3 Study Population:

The study population for this study consisted of medical students of Napata College.

3.3.1 Inclusive Criteria:

Medical students at third, fourth, and fifth-year, in addition to higher degrees students, who accepted to participate in the study.

3.3.2 Exclusive Criteria:

First and second-year medical students, and those who refused to participate in this study.

3.4 Variables:

3.4.1 Dependent variables:

Perceptions of Artificial Intelligence integration in Medicine.

3.4.2 Independent variables:

Sociodemographic characteristics (Gender, Age, Academic Level).

3.5 Period of Study:

February 2025.

3.6 Sampling Technique and sample size:

Simple random sampling technique was used in this study.

The following equation was used to calculate the sample size:

$N=z2\ pq/d2$ Where:

N= sample size.

Z= level of confidence (1.96)

P= represent estimated number of third, fourth, fifth-year medical students, and higher degrees students. q= represent (1-P) d= degree of precision (0.05%)

N= 315

The original sample size of 315 students was estimated, however, to get more accurate results and avoid bias, 350 students were enrolled in this study.

3.7 Data collection:

The data was collected using structured self-administered questionnaires based on sociodemographic information. The questionnaire consisted of closed-ended questions to collect quantitative and qualitative data, respectively. It was modified from previously done studies [7, 27, 28] to capture information relevant to the specific objectives and variables of interest. Some questions assessed sociodemographic characteristics of participants such as gender, age, and academic level. Other questions evaluated the perceptions of medical students towards Artificial Intelligence integration in Medicine.

3.8 Plan for data analysis:

The collected data which retrieved from the questionnaires was exported into Microsoft Excel and then imported into the Statistical Package for Social Sciences (SPSS) version 27. Descriptive percentage was calculated by (Frequency*100/Sample size) & was presented in tables & figures. Chi-square test was used to assess associations.

3.9 Ethical consideration:

Permission and approval were sought from the University's committee. Informed consent was taken before data collection. The participants had the right to privacy and confidentiality. Investigation results were classified. The data collection process did not cause any interruption to the participants.

Chapter Four:

Results & Discussion

4.1 Results:

A total of 350 medical students participated in this study, of which females (54.3%) were more than males (45.7%), and the most common age group was found to be 20-23 years (78.9%), followed by 24-26 years (15.4%). The commonest academic level was third year (40.3%), followed by fourth year (38.6%). The majority of students (72.3%) have used Artificial Intelligence (AI) before to obtain medical information. Almost half of students (46%) are somehow familiar with the current artificial intelligence tools applied to medicine, such as AIassisted diagnosis or therapeutic recommendations, and the majority (62.9%) stated that they have basic understanding of AI technologies. The overall positive perception of students towards Artificial Intelligence (AI) in Medicine was found to be 50.1%, while 49.9%% had negative perception. A significant association was found between the perception towards Artificial Intelligence (AI) in Medicine of students and their use of AI to obtain medical information, familiarity with the current artificial intelligence tools applied to medicine, and basic understanding and interest of AI technologies (P-value = 0.00001, 0.00003, and 0.001, respectively).

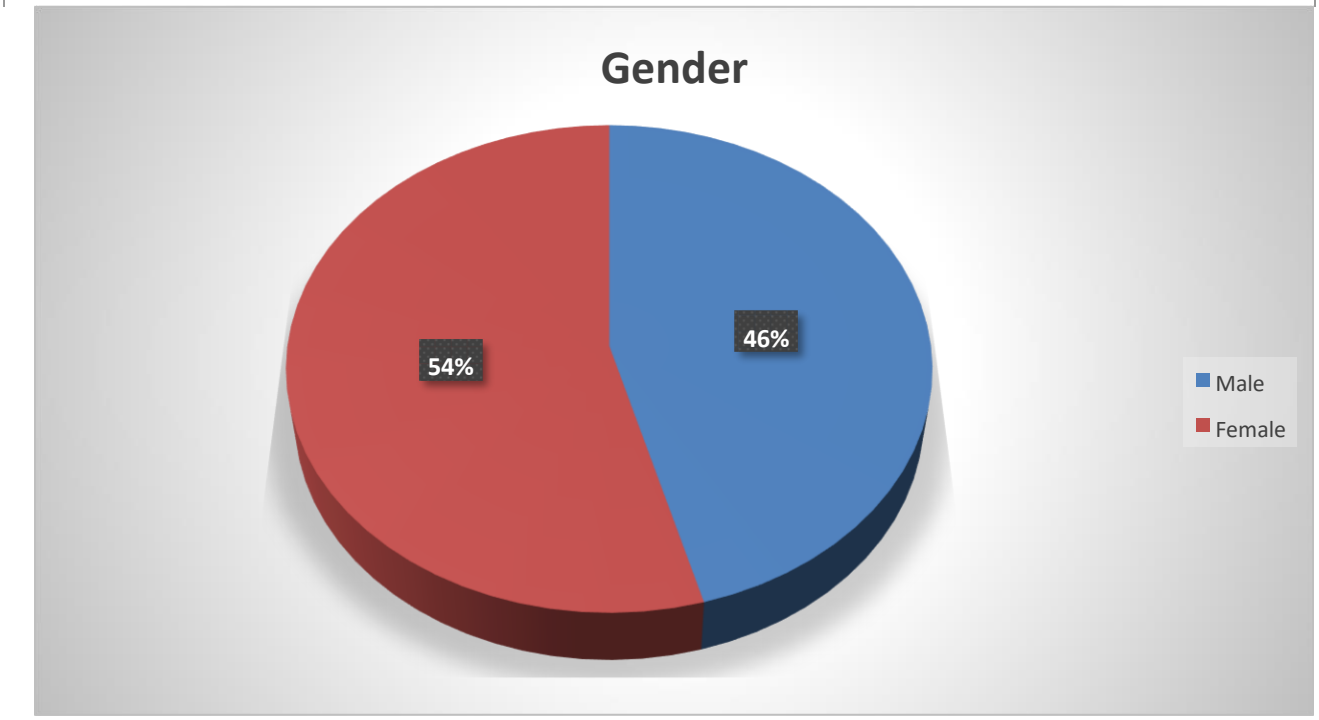

Figure (1): Gender distribution of students.

Females (54.3%) were more than males (45.7%).

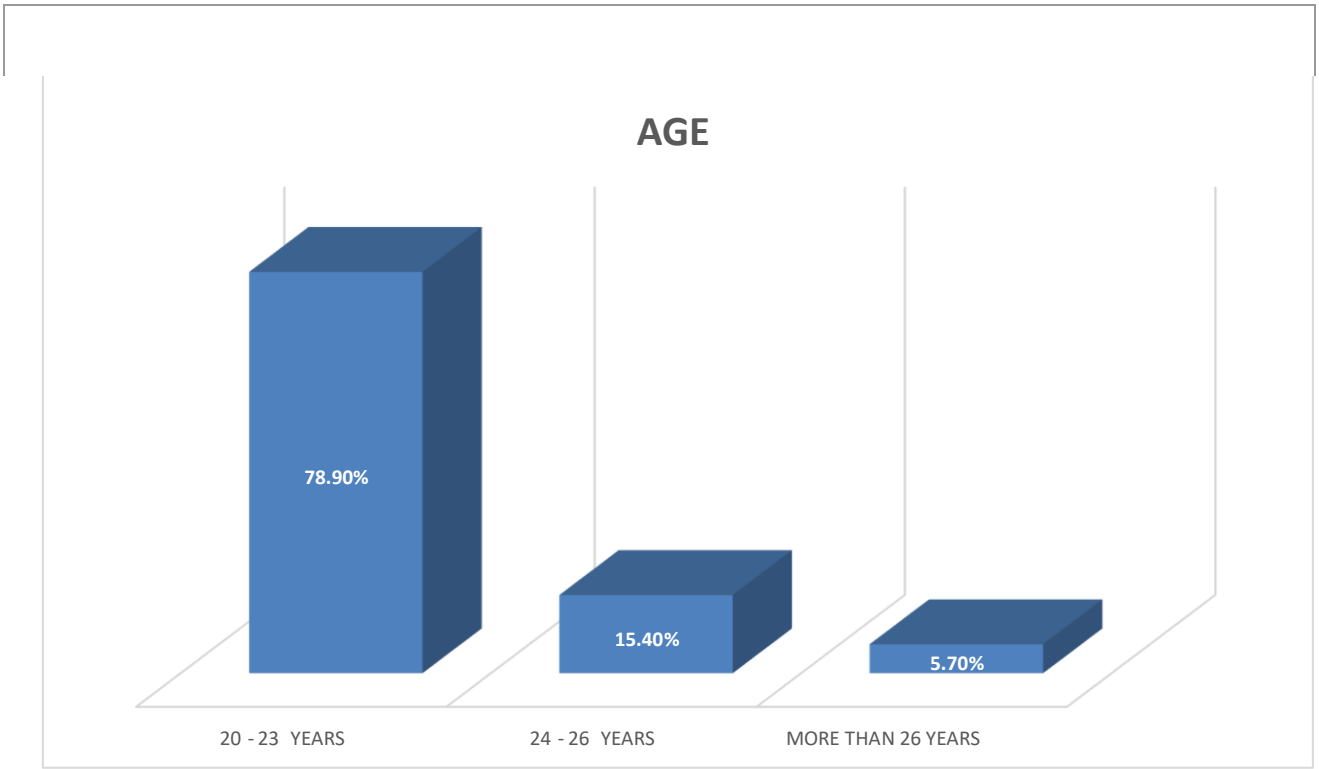

Figure (2): Age distribution of students.

The most common age group was found to be 20-23 years (78.9%), followed by 24-26 years (15.4%).

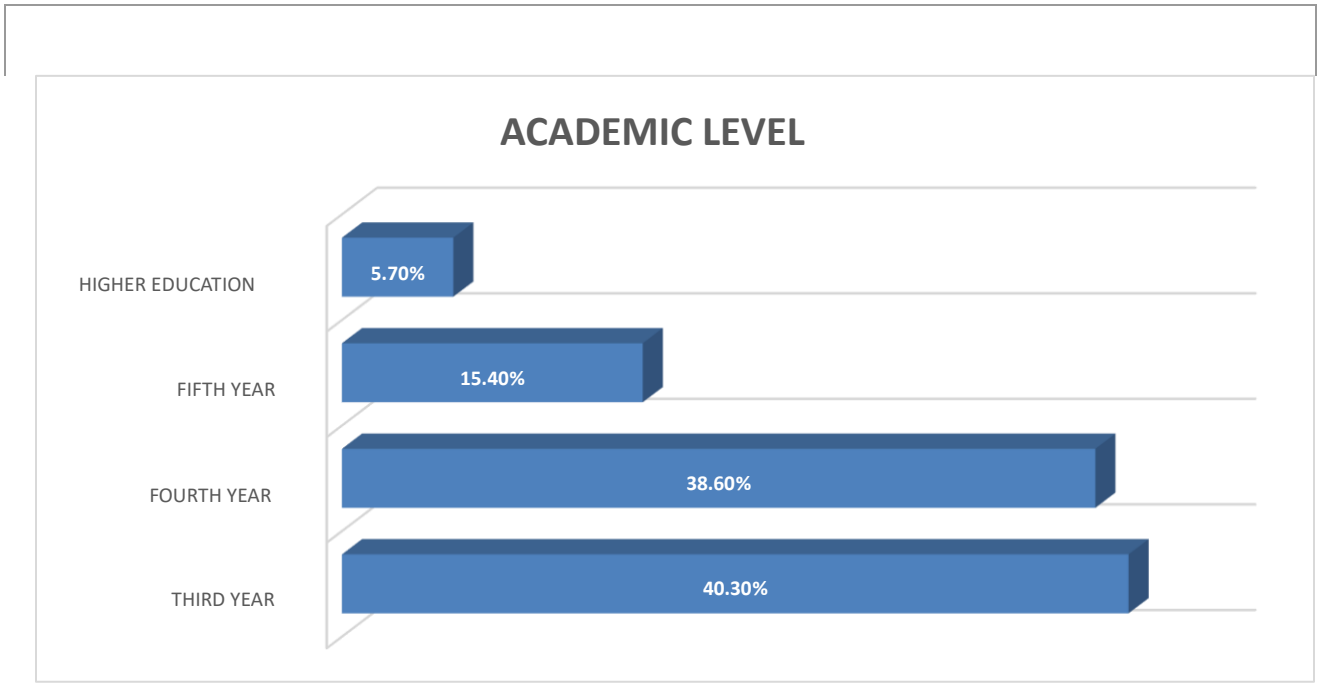

Figure (3): Academic level of students.

The commonest academic level was third year (40.3%), followed by fourth year (38.6%).

Table (1): Factors related to the use of Artificial Intelligence (AI) in Medicine.

Variables	Category	Count	Percentage
If students had any courses related to Artificial Intelligence (AI).	Yes	74	21.1%
	No	276	78.9%
If students have ever used Artificial Intelligence (AI) to obtain medical information.	Yes	253	72.3%
	No	97	27.7%
Degree of familiarity with the current artificial intelligence tools applied to medicine, such as AI-assisted diagnosis or therapeutic recommendations.	Very familiar	24	6.9%
	Somehow familiar	161	46%
	Neutral	100	28.6%
	Not familiar	53	15.1%
	Not familiar at all	12	3.4%
Basic understanding and interest of AI technologies.	Yes	220	62.9%
	No	90	25.7%
	Not sure	40	11.4%
Total		**350**	**100%**

According to Table *1*, The majority of students (72.3%) have used Artificial Intelligence (AI) before to obtain medical information. Almost half of students (46%) are somehow familiar with the current artificial intelligence tools applied to medicine, such as AI-assisted diagnosis or

therapeutic recommendations, and the majority (62.9%) stated that they have basic understanding of AI technologies.

Table (2): Perception of students towards Artificial Intelligence (AI) in Medicine.

Variables	Category	Count	Percentage
Artificial intelligence (AI) system would have positive impact on medical education.	Strongly agree	106	30.3%
	Agree	120	34.3%
	Neutral	68	19.4%
	Disagree	37	10.6%
	Strongly disagree	19	5.4%
AI play important role in health care.	Strongly agree	99	28.3%
	Agree	116	33.1%
	Neutral	82	23.4%
	Disagree	32	9.1%
	Strongly disagree	21	6%
Using AI system in medical education would prepare students for real clinical practice.	Strongly agree	100	28.6%
	Agree	123	35.1%
	Neutral	75	21.4%
	Disagree	34	9.7%
	Strongly disagree	18	5.1%
AI algorithms can analyze vast amount of medical data quickly and accurately.	Strongly agree	95	27.1%
	Agree	130	37.1%

	Neutral	80	22.9%
	Disagree	28	8%

	Strongly disagree	17	4.9%
AI raises ethical concerns related to data privacy, consent and potential biases.	Strongly agree	101	28.9%
	Agree	129	36.9%
	Neutral	75	21.4%
	Disagree	31	8.9%
	Strongly disagree	14	4%
AI aids medical students in research, literature review and understanding complex medical terminologies.	Strongly agree	108	30.9%
	Agree	119	34%
	Neutral	73	20.9%
	Disagree	32	9.1%
	Strongly disagree	18	5.1%
If students are interested in the practical aspects of AI in medicine.	Strongly agree	102	29.1%
	Agree	112	32%
	Neutral	86	24.6%
	Disagree	33	9.4%
	Strongly disagree	17	4.9%
Level of confidence in the information provided by	Very confident	47	13.4%

chatbots on medical topics.	Somehow confident	138	39.4%
	Neutral	92	26.3%
	Not very confident	55	15.7%
	Not confident at all	18	5.1%
The use of AI in healthcare can positively change medicine.	Strongly agree	99	28.3%
	Agree	112	32%
	Neutral	84	24%
	Disagree	30	8.6%
	Strongly disagree	25	7.1%
The use of AI can negatively affect the doctor-patient relationship.	Strongly agree	92	26.3%
	Agree	116	33.1%
	Neutral	90	25.7%
	Disagree	31	8.9%
	Strongly disagree	21	6%
Doctors will need to know about AI-based tools to perform their jobs in the near future.	Strongly agree	109	31.1%
	Agree	113	32.3%
	Neutral	76	21.7%
	Disagree	34	9.7%
	Strongly disagree	18	5.1%

AI should be part of medical education.	Strongly agree	104	29.7%
	Agree	119	34%
	Neutral	72	20.6%
	Disagree	36	10.3%
	Strongly disagree	19	5.4%

Practical content on the use of AI-based tools in medicine should be introduced in medical degree programs.	Strongly agree	93	26.6%
	Agree	124	35.4%
	Neutral	72	20.6%
	Disagree	37	10.6%
	Strongly disagree	24	6.9%
The use of such tools will lead to a dehumanization of medicine.	Strongly agree	94	26.9%
	Agree	116	33.1%
	Neutral	81	23.1%
	Disagree	34	9.7%
	Strongly disagree	25	7.1%
The use of such tools will create dependency among medical staff.	Strongly agree	105	30%
	Agree	109	31.1%
	Neutral	85	24.3%
	Disagree	28	8%

	Strongly disagree	23	6.6%
The imposition of these new technologies may influence the choice of specialization for medical personnel.	Strongly agree	97	27.8%
	Agree	113	32.3%
	Neutral	86	24.6%
	Disagree	40	11.4%
	Strongly disagree	14	4%
Total		**350**	**100%**

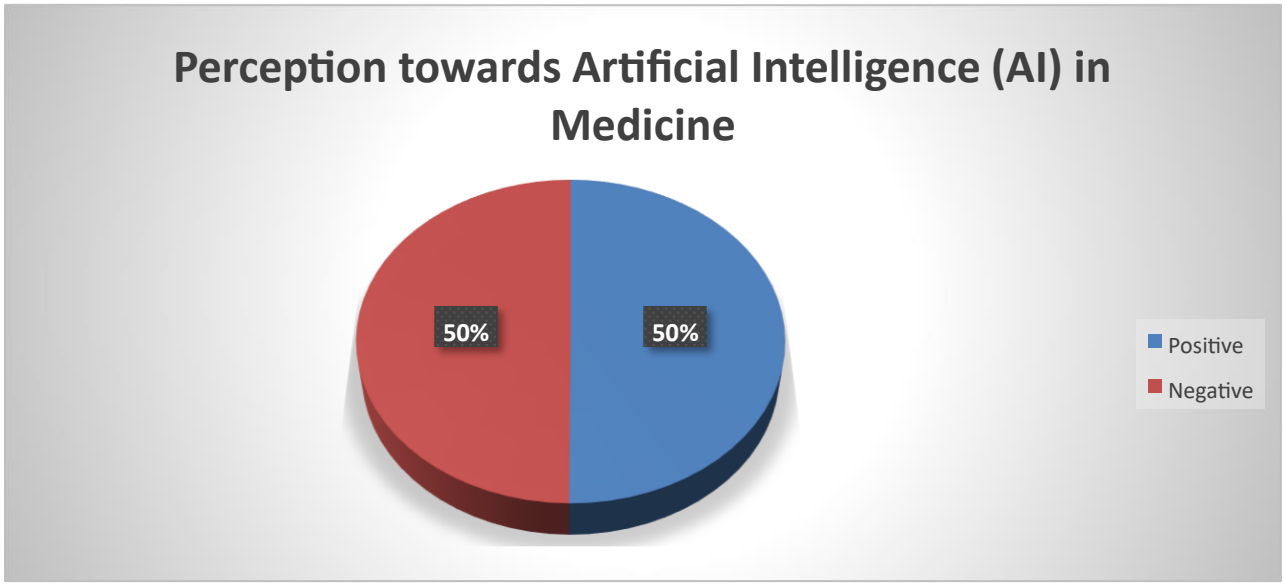

Figure (4): Overall perception of students towards Artificial Intelligence (AI) in Medicine.

According to Figure 4, The overall positive perception of students towards Artificial Intelligence (AI) in Medicine was found to be 50.1%, while 49.9%% had negative perception.

Table (3): The correlation between students' perception towards Artificial Intelligence (AI) in Medicine and their sociodemographic characteristics.

		Perception		
Variables	**Category**	**Positive**	**Negative**	**P-value**
Gender	Male	84.1	75.9	0.4
	Female	91.2	98.8	
Age	20-23 years	137.6	138.4	0.8
	24-26 years	28.7	25.3	
	More than 26 years	9	11	
Academic level	Third year	69.1	71.9	0.9
	Fourth year	68.5	66.5	
	Fifth year	28.7	25.3	
	Higher degrees	9	11	
If students had any courses related to Artificial Intelligence (AI).	Yes	57	17	1.8
	No	118.3	157.7	
If students have ever used Artificial Intelligence (AI) to obtain medical information.	Yes	145	108	**0.00001***
	No	30.3	66.7	

Familiarity with the current artificial intelligence tools applied to medicine, such as AI-assisted diagnosis or therapeutic recommendations.	Very familiar	16.5	7.5	**0.00003***
	Somehow familiar	99	62	
	Neutral	38.6	61.4	
	Not familiar	18.9	34.1	
	Not familiar at all	2.3	9.7	
Basic understanding and interest of AI technologies.	Yes	118.5	101.5	**0.001***
	No	30.8	59.2	
	Not sure	26	14	

Chi square test was performed, p-value is significant (< 0.05)

According to Table *3*, A significant association was found between the perception towards Artificial Intelligence (AI) in Medicine of students and their use of AI to obtain medical information, familiarity with the current artificial intelligence tools applied to medicine, and basic understanding and interest of AI technologies (P-value = 0.00001, 0.00003, and 0.001, respectively).

4.2 Discussion:

This study aimed to assess Napata College Sudan medical students regarding their perceptions towards the application of Artificial Intelligence (AI) in Medicine. The results of this study represent their opinions about the use of AI in healthcare, and that in medical school as well. Comparing the findings of the present study with others that were previously done globally further contextualize the perceptions of Napata College students within a global framework.

The study had shown that most of the participants were between the ages of 20-23 years (78.9%), and third- and fourth-year students were the most-represented (40.3% and 38.6%, respectively). This was congruent with the study of Hawezy et al. (2024) in Iraq, which found that the majority of medical students were from early academic years. [33] The data also indicate that 54.3% of the sample were females, a ratio which is in line with other research, such as the study of Hawezy et al.'s in Iraq, where 57.6% of the respondents were female. [33]

With respect to the use of AI, 72.3% of the students indicated that they used AI to obtain medical information, which is significantly higher compared to the rate indicated in the study of GualdaGea et al. (2025) in Spain, where only 31% had used chatbots for healthcare reasons. [27] Such disparity suggests that use of AI by medical students may not be growing at the same level in some areas of Europe. Also, in the study of Wobo et al., (2025) in Nigeria, only (46%) of the students had awareness of AI, whereas awareness was significantly higher in the present study, where Napata College students were exposed more to AI tools. [29]

Almost half of the students (46%) in the current study were at least "somewhat familiar" with AI application in medicine. This is lower than the percentage found in the study of Rjoop et al., (2025) in Jordan, in which 69% of the students were aware of AI in medicine. [28] There is, however, a critical lack of AI training. In the current study, 62.9% indicated they had some fundamental knowledge regarding AI technologies, whereas just 14% of the Jordanian students (Rjoop et al., 2025) had learned AI from their medical schools. [28] The study in Nigeria (Obiekwe et al., 2024) also reported that 96.8% of the medical students were not formally trained in AI, which is a long-standing problem worldwide regarding the inclusion of AI in curricula. [32]

Regarding perceptions, the positive perceptions towards AI in Medicine among Napata College students reached 50.1%, while 49.9% had negative attitudes. This balance perspective is in line with Jordanian research (Rjoop et al., 2025), where more than one-third (42.4%) of the students were worried about AI development. [28] Ethical concerns were also prevalent in this study, in line with that of Nigeria (Wobo et al., 2025), where 68% of the students had posed ethical concerns. [29] On the other hand, the study of Spain (Gualda-Gea et al., 2025) had a mere 48% of students who were concerned about AI ethics, which showed the presence of regional disparities in ethical issues. [27]

Regarding trust assessment of AI systems, the students at Napata College were split, with most having moderate confidence in chatbot medical facts. The same holds true in the study of Spain (Gualda-Gea et al., 2025), where 59% of the students had at least moderate confidence in AI chatbots. [27] Accuracy and reliability issues for AI were also experienced in Jordan (Abu Hammour et al., 2024), where 78.3% of the students were worried about AI errors. [30] The need

for AI training in medical curriculums was greatly supported by the students in this study. This concurs with the study of India (Raja, 2024), where 81% of the graduates supported the inclusion of AI in medical education. [31] While (66.2%) of the students in Jordan (Rjoop et al., 2025) felt that their medical schools did not properly educate them concerning AI. [28] The growing need for training on AI implies that medical schools have to keep up with changing technological developments.

Interestingly, among the students at Napata College, a significant association was found between the perception towards Artificial Intelligence (AI) in Medicine of students and their use of AI to obtain medical information, familiarity with the current artificial intelligence tools applied to medicine, and basic understanding and interest of AI technologies (P-value = 0.00001, 0.00003, and 0.001, respectively). This is different from what was reported by the study in Jordan (Abu Hammour et al., 2024), where younger students were much more likely to use AI (P=0.025). [30] In the same context, in India (Raja, 2024), male students scored marginally higher on AI knowledge compared to females, while gender was not significant in this study. [31] Professionally, 53% of the Indian students (Raja, 2024) expected AI to influence their preferred specialty. [31] In this study, though, no serious proposition went towards the realization that AI impacted specialization possibilities among Napata College students. This could be an indication that AI as a determinant in professional choices is an up-growing phenomenon in Sudan compared to other regions.

As summary, the findings from Napata College highlights that medical students have a very good degree of awareness and utilization of AI in comparison with the studies in Spain, Nigeria, and Jordan. However, there remains a gap in formal education regarding AI in accordance with the

advancement of the world in Jordan, Nigeria, and India. Ethical concerns and trust in AI systems remain the significant determinants for the attitudes of the students

Chapter Five:

Conclusion & Recommendations

5.1 Conclusion:

As overall, this study demonstrated that students of Napata College are increasingly familiar with and utilize AI in medicine and have a balanced view regarding its advantages and disadvantages. Although a majority of students perceive the future of AI in medical education and health care with optimism, fear from the ethical aspects and faith is present. In spite of frequent exposure, education on the topic is insufficient, as with the global pattern. Acing systematic AI training within medical school programs can prepare students to be more confident and ready to practice in an AI-oriented healthcare setting. Coming to terms with ethical concerns and encouraging practical implementations of AI will be the most significant considerations in achieving its proper utilization in medicine.

5.2 Recommendations:

- AI-specific curricula should be developed in Sudanese medical schools.
- Practical training in AI should incorporated in order to increase familiarity and reduce ethical concerns.
- Enhancing awareness about the uses of AI in medicine should be done through regular seminars, webinars, and online sources.
- Universities and medical schools should provide medical students with access to AI-powered medical applications, chatbots, and diagnostic tools to facilitate their learning and clinical decision-making.
- More studies on this topic should be conducted in order to assess and strengthen the found evidence.

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Annex:

Questionnaire:

Informed consent:

I have read and I understand the provided information and have had the opportunity to ask questions.

I understand what the aim of this research and I understand the benefits of this research, and I understand that this information may be published and I agree with that, and I know there's will not be any material return of my participation.

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost.

Participant's signature _____ Date_____

Investigator's signature _____ Date_____

Dear Participant,

Your Consent on answering this questionnaire is very appreciated. All the information collected is anonymous and confidential.

Do you consent to participate in this study? *

Yes

No

Section (1): Sociodemographic characteristics:

Gender:

Male

Female

Age:

Less than 20 years

20-23 years

24-26 years

More than 26 years

Academic level:

Third year

Fourth year

Fifth year

Higher degrees

Section (2): Factors related to the use of Artificial Intelligence (AI) in Medicine:

Have you had any courses related to Artificial Intelligence (AI)?

Yes

No

Have you ever used Artificial Intelligence (AI) to obtain medical information?

Yes

No

How familiar are you with the current artificial intelligence tools applied to medicine, such as AI-assisted diagnosis or therapeutic recommendations?

Very familiar

Familiar

Neutral

Not familiar

Not familiar at all

Do you have a basic understanding or interest in the technologies used in these topics?

Yes

No

Not sure

Section (3): Perceptions towards Artificial Intelligence (AI) in Medicine:

Artificial intelligence (AI) system would have positive impact on medical education.

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

AI play important role in Health care.

Strongly agree Agree

Neutral

Disagree

Strongly disagree

Using AI system in medical education would prepare you for real clinical practice.

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

AI Algorithms can analyze vast amount of medical data quickly and accurately.

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

AI Raises ethical concern related to data privacy, consent and potential biases.

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

AI aids medical students in research, literature review and understanding complex medical terminologies. Strongly agree

Agree

Neutral

Disagree

Strongly disagree

I am interested in the practical aspects of AI in medicine.

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

How much trust do you have in the information provided by chatbots on medical topics?

Very confident

Confident

Neutral

Not that confident

Not confident at all

The use of AI in healthcare can positively change medicine.

Strongly agree

Agree Neutral

Disagree

Strongly disagree

The use of AI can negatively affect the doctor-patient relationship.

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

Doctors will need to know about AI-based tools to perform their jobs in the near future.

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

AI should be part of medical education.

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

Practical content on the use of AI-based tools in medicine should be introduced in medical degree programs.

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

The use of such tools will lead to a dehumanization of medicine.

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

The use of such tools will create dependency among medical staff.

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

The imposition of these new technologies may influence the choice of specialization for medical personnel.

Strongly agree

Agree

Neutral

Disagree

Strongly disagree

Thank you!