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Research Paper

The Readiness of Guilan University Medical Students Regarding the Use of Artificial Intelligence in Medicine

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ABSTRACT

Background: With the rapid advancement of artificial intelligence (AI) in medicine, the readiness of students to use this technology significantly impacts their acceptance and effective use of AI.

Objectives: This study investigated the preparedness level of medical students of Guilan University of Medical Sciences (GUMS) for applying AI in medical practice.

Materials & Methods: This study was conducted in 2024 on medical students at GUMS. The Persian version of the standard medical artificial intelligence readiness scale for medical students (MAIRS-MS) was used as the data collection tool, which assessed the readiness of students in four domains: Cognitive, ability, attitude, and ethics. Descriptive statistics, t-tests, and Spearman correlation coefficients were used for data analysis.

Results: The average score of total readiness to use for AI was 51.66 out of 110, indicating an average level of readiness. The cognitive and ethics domains had the lowest and highest scores, respectively. The readiness score was related to the educational level, with the physiopathology course having the highest score. Moreover, men obtained higher scores overall and in the ability and attitude domains (P<0.001). Cognitive scores increased with age (P=0.037), but younger students scored higher in the ethics domain (P=0.009).

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Conclusion: The readiness of GUMS medical students to use AI was in the medium range, and significant differences were observed based on academic level, gender, and age. It is essential to design structured training courses to improve the abilities of students for the effective use of AI in medical practice.

Keywords: Artificial intelligence (AI), Medical students, Medical education

Highlights

- The average total AI readiness use score among the studied medical students was lower than that in some other similar studies.
- The highest and lowest scores were achieved in the ethics and cognition domains, respectively.
- Boys significantly achieved higher scores in the ability and attitude domains and in the total AI readiness use than girls.
- Physiopathology students scored the highest in total AI readiness use score.

Introduction

Artificial intelligence (AI) is a computer-dependent system that uses data sources to make independent decisions or assist humans in making decisions, and attempts to simulate human intelligence [1].

It is a broad term encompassing machine learning, deep learning, and representation learning. As a subset of computer science, AI focuses on processing and analyzing large volumes of data, with applications spanning diverse domains, such as medicine, psychology, linguistics, and statistics [2].

Machine learning has been widely applied in various medical fields, such as diabetes, cancer, cardiovascular disease, mental health, and radiology [3]. It has significantly contributed to the treatment of several diseases and has helped minimize errors in diagnosis and follow-up [4, 5].

Wealthy nations have allocated significant financial resources to AI research, especially in the medical sector. In contrast, low-income and developing nations face a lack of concrete strategies for AI adoption and limited research efforts in this domain. According to the World Health Organization (WHO), a worldwide shortage of approximately 12.9 million healthcare professionals is anticipated by 2035 [6].

Over the past six decades, AI has made remarkable progress, yet the implementation of machine learning in developing and resource-constrained countries remains comparatively limited [7, 8].

The futuصorithms designed for medical use, build a thorough understanding of AI, and become skilled, knowledgeable users [13].

As the use of AI continues to expand across various medical fields, it is essential to evaluate students' preparedness in the area of AI before they enter the medical profession. This assessment will enable the implementation of suitable planning, considering the current and future applications of AI in medicine [14].

Therefore, measuring the preparedness of medical students for medical AI is crucial in informing the design of educational programs and various development processes, including curriculum development, instructional design, and needs analysis.

Materials and Methods

This descriptive cross-sectional study was performed in early 2025 at the Faculty of Medicine, Guilan University of Medical Sciences (GUMS) in northern Iran, after receiving the ethics code from the Research Ethics Committee of GUMS. Sampling was performed using a stratified method based on the academic level (basic sciences, physiopathology, externship, and internship). The required sample size was calculated with 95% confidence and a 5% error based on a previous study by Xuan et al. [15]. Considering potential dropout, the final sample size was determined to be 129 and was distributed among each academic level in proportion to the number of students at each level. At that time, the Faculty of Medicine had a total of 1,145 medical students, with 350, 252, 286, and 257 in basic sciences, physiopa-

thology, externship, and internship, respectively. A total of 129 medical students (40 basic science students, 28 physiopathology students, 32 stagers, and 29 interns) participated in the study.

The inclusion criterion was enrollment in the general medicine program at the Faculty of Medicine of GUMS, while the exclusion criteria included unwillingness to complete the questionnaire and incomplete or distorted questionnaires (less than 80% of the questionnaire completed). Sampling continued until the determined sample size was reached.

After providing complete information about the aims and method of conducting the research and ensuring confidentiality of the information, printed questionnaires, including the demographic checklist and the Persian version of the medical AI readiness scale (P-MAIRS-MS), were provided to the students. The questionnaire was given to the students manually (in person), and they were asked to complete it, and if they needed guidance, they were given adequate explanations.

Instrument and data gathering

The P-MAIRS-MS, a Persian translation of the "MAIRS-MS", was utilized to collect the collected data.

The instrument, initially designed in 2021 by Karaca et al. [16], began with 27 items and was refined into a 22-item scale with a four-factor structure: Cognition, ability, vision, and ethics. This structure accounted for 50.9% of the cumulative variance, as determined by exploratory factor analysis (EFA). The reliability of the scale was supported by a Cronbach's α coefficient of 0.87. Confirmatory factor analysis (CFA) demonstrated a good fit for the four-factor model (χ^2/df=3.81, root mean square error of approximation (RMSEA)=0.094, standardized root mean squared residual (SRMR)=0.057, Comparative fit index (CFI)=0.938, and non-normed fit index (NNFI)/Tucker-Lewis index (TLI)=0.928), indicating strong construct validity. The questionnaire employs a 5-point Likert scale for its 22 items, ranging from 1 (strongly disagree) to 5 (strongly agree). It assesses four distinct domains: Cognition (items 1–8), ability (items 9–16), attitude (items 17–19), and ethics (items 20–22). The total score for the questionnaire ranges from 22 to 110, with domain-specific score ranges as follows: Cognition (8–40), ability (8–40), attitude (8–15), and ethics (3–15) [16].

The P-MAIRS-MS was psychometrically validated in 2025 by Khajeali et al. In the face and content validity study, all items had an impact score >1.5, and the content validity index (CVI) and content validity ratio (CVR) was ≥0.8. Confirmatory factor analysis also confirmed the four-factor model (χ^2/df=1.963, RMSEA=0.063, CFI=0.939, goodness of fit index (GFI)=0.901). Also, the convergent validity of the instrument was appropriate (average variance extracted (AVE)>0.5, composite reliability (CR)>0.7), and the reliability indices were also reported at the desired level (Cronbach's α = 0.938, McDonald's omega=0.938, intraclass correlation coefficient (ICC)=0.992) [17].

Data analysis

Data analysis was conducted using SPSS software version 26. The Shapiro-Wilk test indicated that the readiness score for using AI and its four domains did not follow a normal distribution. Consequently, non-parametric tests, including the Mann-Whitney U test and Kruskal-Wallis test, were employed to compare the scores of questionnaires across different groups. Additionally, the Spearman correlation coefficient was utilized to assess the relationship between age, the total score, and the domains of the questionnaire. A significance level of P<0.05 was applied to all statistical tests.

Results

In this study, 129 medical students participated, consisting of 40 basic science students, 28 physiopathology students, 32 stagers, and 29 interns. The mean age of the participants was 22.7±2.9 years. Of the participants, 56.94% were female and 43.06% were male. The mean total score of the participants on the MAIRS-MS was 66.51±15.53 out of a maximum of 110. The highest mean score among the four assessed domains was in the ethics domain, with a score of 10.29±2.95, while the lowest score was achieved in the cognitive domain, with a score of 22.10±6.25 (Table 1 and Figure 1).

The number of questions in the domains of the P-MAIRS-MS varies. To compare domain scores in the studied samples, we initially normalized the scores by dividing each domain's score by the number of questions in that domain (which ranged from 1 to 5), and subsequently compared the domain scores using the Friedman test. The findings showed that the students achieved the highest and lowest scores in the ethics and cognitive domains, respectively. The results of the Friedman test showed a statistically significant difference between the scores of the four domains (P<0.001). Pairwise compar-

Table 1. Mean scores of P-MAIRS-MS across dimensions among the studied medical students (n=129)

Domains	Mean±SD	Min	Max
Cognition	22.10±6.25	8.00	40.00
Ability	25.36±6.25	8.00	40.00
Attitude	8.77±2.85	3.00	15.00
Ethics	10.29±2.95	3.00	15.00
Total	66.51±15.53	22.00	107.00

P-MAIRS-MS: The Persian version of the medical artificial intelligence readiness scale.

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isons showed no difference between "ability and ethics scores" and "cognition and attitude scores", in contrast to other pairwise comparisons, which were significant.

Comparative analyses showed that boys achieved significantly higher scores in the ability (26.29±6.27 vs. 24.65±6.15; P=0.015) and attitude (9.17±2.72 vs. 8.46±2.92; P=0.033) domains, as well as in the total AI readiness use (P-MAIRS-MS) (68.26±15.67 vs. 65.18±15.34; P=0.047) compared to girls. The difference in the cognition and ethics domains was not statistically significant.

In terms of educational level, the highest total readiness score was observed in pathophysiology students (70.56±13.34), and the lowest score was observed in basic science students (63.56±16.93). A significant difference was observed between educational levels in the cognition (P=0.032) and ability (P=0.026) domains, favoring the physiopathology group (Table 2).

Correlation analysis demonstrated a positive and significant correlation between age and cognitive domain scores; as age increased, the cognitive domain score also increased (P=0.037, r=0.125). In contrast, an inverse and significant correlation was observed between age and the moral domain score (P=0.009, r=-0.156). There was no correlation between age and the ability domain (P=0.068, r=0.109) or the attitude domain (P=0.808, r=0.015). There was a direct correlation between age and the P-MAIRS-MS score, but it was not significant (P=0.206, r=0.076) (Table 3 and Figure 2).

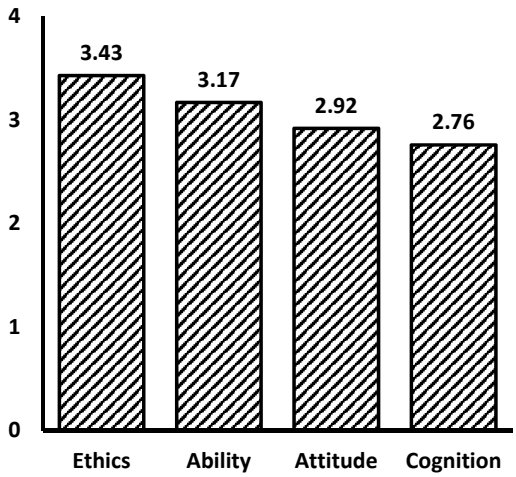

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Figure 1. Scores of P-MAIRS-MS across four domains among medical students at Guilan University of Medical Sciences

P-MAIRS-MS: The Persian version of the medical AI readiness scale.

Table 2. Comparing the mean scores of P-MAIRS-MS based on gender and educational level

Variables		Cognition	Ability	Attitude	Ethics	Total
Gender	Female	21.58±6.32	24.65±6.15	8.46±2.92	10.49±2.95	65.18±15.34
	Male	22.78±6.11	26.29±6.27	9.17±2.72	10.03±2.94	68.26±15.67
	Z statistic	-1.75	-2.44	-2.13	-1.74	-1.98
	P*	0.081	0.015	0.033	0.081	0.047
Levels of education	Basic science	20.76±6.18	23.93±6.84	8.41±3.19	10.46±3.45	63.56±16.93
	Physiopathology	23.41±6.1	27.02±5.01	9.45±2.45	10.69±2.16	70.56±13.34
	Stagers	22.36±5.96	26.07±5.07	8.80±2.43	9.99±2.64	67.22±13.12
	Interns	23.15±6.67	25.33±7.45	8.58±3.04	9.73±3.05	66.78±17.48
	H statistic	8.82	9.23	3.98	7	7.81
	P†	0.032	0.026	0.264	0.072	0.050

P-MAIRS-MS: The Persian version of the medical artificial intelligence readiness scale.

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*Mann-Whitney U test; †Kruskal-Wallis test.

Discussion

Rapid advancements in new technologies, particularly AI, have significantly impacted the future of medicine. AI can streamline diagnostic, therapeutic, and health data management processes, thereby enhancing the accuracy and speed of clinical decision-making. Consequently, medical students' readiness to effectively utilize this technology is one of the crucial factors ensuring the future success of healthcare systems and the delivery of advanced medical services. According to the MAIRS-MS, student readiness is categorized into four key areas: Cognition, attitude, ability, and ethics [16].

The average total score of AI readiness of medical students at GUMS in this study was 5.66±5.15 out of a possible 110 points. The results showed that the average total score, compared to some other similar studies, reflects an average level of readiness among medical students at GUMS.

In a study in Kazakhstan, the overall mean score of medical students on the MAIRS-MS was 72.4, surpassing the score found in this investigation. This discrepancy may stem from varying levels of access to technology-based training and student engagement with AI tools [18]. In contrast, research in Malaysia showed that the average total scores of medical students fell between 64 and 68, a

Table 3. Spearman correlation coefficients of scores on P-MAIRS-MS across four domains and based on age among the studied medical students

Variables	Age	Cognition	Ability	Attitude	Ethics	Total
Age	1.000	0.125*	0.109	0.015	-0.156**	0.076
Cognition		1.000	0.640†	0.624†	0.276†	0.858†
Ability			1.000	0.654†	0.466†	0.895†
Attitude				1.000	0.420†	0.792†
Ethics					1.000	0.541†
Total						1.000

P-MAIRS-MS: The Persian version of the medical artificial intelligence readiness scale.

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*P<0.05; **P<0.01; †P<0.001.

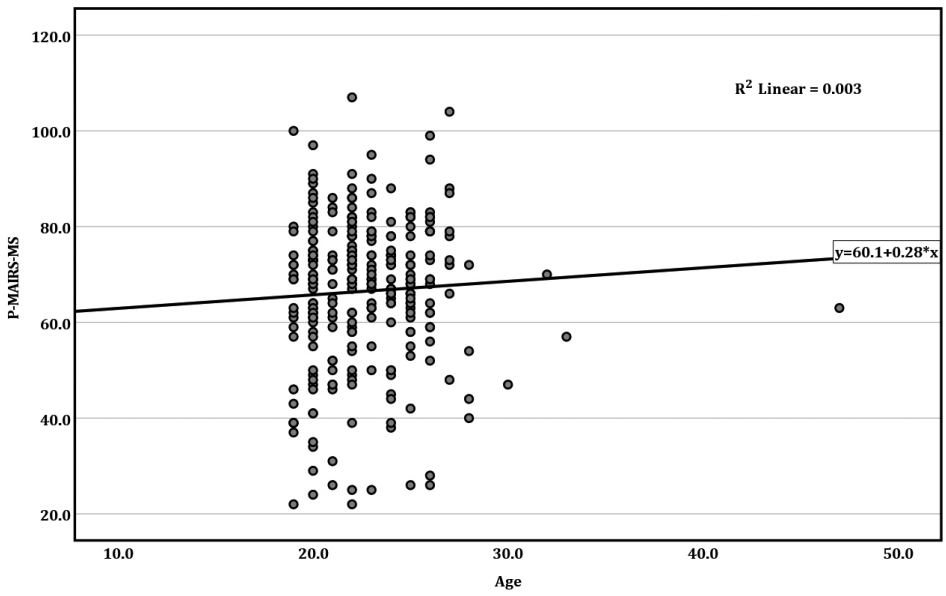

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Figure 2. Relationship between the scores of P-MAIRS-MS and age among medical students at Guilan University of Medical Sciences (Spearman's rho).

P-MAIRS-MS: The Persian version of the medical AI readiness scale.

finding that mirrors those of our study [15]. This suggests that the restricted access to practical AI training in these countries could be attributed to inadequate infrastructure or insufficient specialized training programs. A study in Saudi Arabia found a mean total score of 70.1, slightly higher than that of this study. Recent growth of AI-based education programs in Saudi universities has been observed, resulting in higher scores in this field [19].

High levels of anxiety can also hinder the adoption of new technologies. Lugito et al. discovered that students were reluctant to employ technology in practice owing to apprehensions about social repercussions and privacy, which can decrease overall readiness ratings [20].

In numerous universities, particularly those in Iran, students typically have highly limited practical experience working with AI tools. A comparable study conducted in Iran discovered that students who participated in hands-on workshops achieved higher overall results on the MAIRS-MS [21].

The study also examined the preparedness of the samples to use AI in the cognition, ability, attitude, and ethics domains. On average, the samples achieved the lowest score in the cognition domain and the highest score in the ethics domain. The low scores in the cognition domain indicate that medical students have not yet acquired a sufficient understanding of the fundamental concepts and their practical applications in AI.

This outcome aligns with the results of other research, which indicates that limited cognitive knowledge stems from insufficient structured training in AI. In a study, medical students participating in clinical phases outperformed basic science students in the cognitive domain [16].

Research conducted in Indonesia found that students who participated in hands-on workshops performed better in the cognition domain, achieving higher results [20]. However, substantial cognition scores are largely attributed to the insufficient structured training in AI provided during early medical education. The lack of knowledge about AI is particularly concerning, given its potential to revolutionize diagnosis, treatment planning, and patient care [19, 22, 23].

To fill this gap, it is essential for medical educators to focus on teaching AI in their curricula. By integrating AI concepts, applications, and ethical issues into medical education, future healthcare students can be better prepared to harness the benefits of AI in clinical settings. A higher score in the ethics domain than in the cognition domain suggests that students have a heightened awareness of the ethical concerns associated with AI. According to Moodi Ghalibaf et al., students comprehend the potential implications of AI on medical ethics in depth, particularly concerning patient privacy and fair decision-making processes [21].

Students' higher ethics score and lower cognition score suggest a positive attitude toward AI, but also indicate a potential gap in the necessary skills and infrastructure for its effective use among future doctors, primarily due to insufficient knowledge of AI. The results indicated that the average overall readiness to use AI was most pronounced in the physiopathology course, whereas it was lowest in the basic science course. Furthermore, in terms of both ability and cognition, the scores of the basic sciences course were substantially lower than those of the physiopathology course. Meanwhile, the score in the basic science group was also lower than those of other groups. These disparities may be attributed to several factors, including lower clinical experience in the basic science course and less practical training in lower-level qualifications.

A comparable study demonstrated that one of the primary factors contributing to higher readiness scores in pathophysiology and internships courses compared to basic sciences course is that students are exposed to hands-on and real-world examples in clinical environments. During these stages, students gain more practical skills in the application of medical technologies, encompassing AI [21].

The result demonstrated that boys achieved a higher total score than girls in readiness to use AI. Also, there was a notable discrepancy between boys and girls in the two areas of ability and attitude, with boys achieving higher average scores than girls in both domains.

Research suggests that historically, men have shown a greater tendency to pursue fields associated with technology and AI. Research conducted in India discovered that Indian men generally exhibit a stronger inclination toward acquiring technology-related knowledge, largely due to the prevalent cultural attitudes that encourage involvement in technical and technological activities [22].

In addition, a study that specifically examined the validity and reliability of the MAIRS-MS showed that self-confidence in assessing technological abilities led to higher scores in the "ability" domain. Men tend to be more confident in this area compared to women due to different social and educational environments [16].

Based on the results, a substantial and direct correlation was found between age and cognitive abilities. Scores in the cognition domain increased with age. There was also a significant inverse relationship between age and the ethics domain, with younger individuals having higher scores in the ethics domain.

A factor influencing the improvement of cognitive readiness for the use of AI in medicine with increasing age could be the greater educational experience of students. Older students are usually involved in more advanced courses of study and have more educational experiences. A comparable investigation demonstrated that pupils at higher levels of education attained better cognitive ratings on the MAIRS-MS due to their superior comprehension of scientific processes and medical technologies [21].

The higher scores in the ethics domain among younger individuals can be explained by a growing focus on ethical issues in recent years. Over the past few years, numerous universities have given more consideration to the instruction of ethical concerns in technology, and younger students are deriving more benefit from this education. According to Grimaud et al., new educational content on the ethics of AI can lead to higher scores in this area [23]. Younger students also tend to hold higher standards for ethical issues because of their more idealistic perspectives on technology and the world. This idealistic approach can lead to greater sensitivity to ethical concerns [20].

Conclusion

This study investigated the level of preparedness of medical students at GUMS to utilize AI, and the results revealed that their overall level of preparedness was average.

This study investigated the level of preparedness of medical students at GUMS to utilize AI, and the results revealed that their overall level of preparedness was average. This readiness was influenced by several factors, including academic level and practical experience, and demonstrated substantial improvement as academic progress advanced, particularly in higher levels like physiopathology. Emphasis is placed on the value of hands-on training and experience with medical technologies in enhancing students' skills.

The results also showed considerable disparities in various areas of preparedness, with pupils achieving lower scores in the cognition domain and higher scores in the ethics domain. It is essential to enhance theoretical education at an early stage and promote a positive ethical outlook to improve acceptance of new technologies.

To enhance student preparation, it is recommended to develop comprehensive training programs that encompass theoretical instruction, practical workshops, and ethics-related discussions. These measures can boost

students' cognitive and practical abilities and equip them with the skills necessary for the effective application of AI in their future professions.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Research Ethic Committee of Guilan University of Medical Sciences, Rasht, Iran (Code: IR.GUMS.REC.1403.448).

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Authors contributions

Conceptualization: Alia Saberi; Methodology: Abtin Heidarzadeh, Sajjad Rezaei, and Shadman Nemati; Formal analysis: Mohammadali Yazdanipour; Supervision: Mahdokht Taheri, Abtin Heidarzadeh, Sajjad Rezaei, and Shadman Nemati; Investigation and writing the original draft: Amirmohamad Norouzy; Review, editing, and final approval: All authors.

Conflict of interest

The authors declared no conflict of interests.

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