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INTRODUCTION

Artificial intelligence (AI) is defined as “trying to understand the structure of human thinking and developing computer processes that will produce similar outcomes” (1). Driven by rapid technological progress in recent years, AI has become embedded in many everyday devices and applications, including smartphones, smartwatches, and various computer and phone-based programs (2).

Originally confined to engineering, AI has since expanded into diverse fields such as health, education, law, and astronomy (3-6). In healthcare, its capacity for processing large volumes of information has been associated with reduced rates of misdiagnosis and malpractice and with improvements in early and accurate diagnosis, clinical decision-making, and overall service quality (7-9). Within physiotherapy and rehabilitation, AI-supported services such as virtual reality applications,

Evaluation of the relationship between artificial intelligence awareness and artificial intelligence anxiety levels of physiotherapy students

Abstract

Aim: This study aimed to evaluate the relationship between physiotherapy students’ artificial intelligence (AI) awareness and AI-related anxiety levels.

Materials and Methods: This cross-sectional study was conducted online using a Google Forms questionnaire. The form included three sections: demographic characteristics and AI/internet use, the AI Awareness Questionnaire, and the AI Anxiety Scale. The relationship between AI awareness and AI anxiety was analyzed using Pearson correlation analysis. In addition, multivariable linear regression analysis was performed to determine whether AI awareness independently predicted AI anxiety after adjusting for age, gender, year of study, daily internet usage, prior AI knowledge, and use of AI-supported applications.

Results: The study included 200 physiotherapy students with a mean age of 22.38 ± 2.23 years; 71.5% were female. The mean AI Awareness Questionnaire score was 91.34 ± 21.37 , and the mean AI Anxiety Scale score was 47.78 ± 15.41 . A moderate negative correlation was found between AI awareness and AI anxiety levels ($r = -0.52$, $p < .001$). Multivariable linear regression analysis showed that AI awareness remained a significant independent predictor of AI anxiety after adjustment for covariates ($B = -0.36$, 95% CI: -0.45 to -0.27 , $\beta = -0.49$, $p < .001$). Gender, year of study, prior knowledge of AI, and use of AI-supported applications were also significantly associated with AI anxiety scores. The model explained 32.8% of the variance in AI anxiety scores.

Conclusion: AI-related anxiety was associated with AI awareness as well as selected demographic, educational, and experiential factors among physiotherapy students. However, due to the cross-sectional design, causal inference cannot be made. Integrating AI-related educational content into undergraduate physiotherapy and rehabilitation curricula may help support students’ professional adaptation to technological developments.

Keywords: Anxiety, physiotherapy, technophobia, technology, artificial intelligence

robotic systems, and stimulation methods designed for specific conditions are becoming increasingly widespread, particularly in developed countries (10-13).

Despite these clear advantages, the long-term consequences of AI in healthcare remain uncertain. The capacity of AI to imitate human cognition and to outperform humans in specific tasks has become a major source of debate and has begun to generate anxiety among individuals (14). AI-related anxiety is largely rooted in concerns about the need to continually learn new skills and is often driven by limited knowledge of the technology, misconceptions, and the rapid pace of technological change (15,16). In addition, concerns about the displacement of certain occupational groups, the emergence of new professions, and the demands of adapting to evolving work practices may further contribute to AI-related anxiety (15,17).

Previous studies have examined awareness, attitudes, and anxiety levels toward AI among healthcare professionals and university students, reporting that those who have received AI-related training tend to show lower anxiety and that anxiety levels among students vary by field of study (18-20). In physiotherapy, practitioners generally report low AI-related anxiety together with high readiness for AI (21), while physiotherapy and rehabilitation students show moderate technostress and generally hold positive attitudes toward AI use in healthcare (22).

However, no study to date has examined the relationship between AI awareness and AI-related anxiety in physiotherapy students. Clarifying this relationship may inform the development of AI-related curricula in physiotherapy education and support students' professional adaptation. The aim of the present study was therefore to examine the relationship between physiotherapy students' levels of AI awareness and their levels of AI-related anxiety.

MATERIALS AND METHODS

Type of Research

This research was conducted as a cross-sectional study.

Place and Time of the Research

The research was conducted online via Google Forms during the spring semester of the 2024-2025 academic year.

Population and Sampling of the Research

The population of the research consisted of students enrolled in the Physiotherapy and Rehabilitation Department (1st-4th year) of a public university during the spring semester of the 2024-2025 academic year, who were literate in Turkish and able to complete the questionnaires independently. As the study was conducted at a single public university, participants were recruited using a convenience sampling approach. All students who met the eligibility criteria were invited to participate during the data-collection period; the invitation was distributed via mobile phone numbers and e-mail addresses, and participation was on a voluntary basis. No prior screening, randomisation, or stratification by class year or gender was applied. Students who were not willing to participate were excluded from the study.

Sample Size Calculation

The minimum sample size was calculated a priori using G*Power software (version 3.1.9.7; Heinrich-Heine-Universität Düsseldorf, Germany) for a two-tailed bivariate normal correlation test. Assuming a small-to-medium expected effect size ($r = 0.20$) based on previously reported associations between AI anxiety levels and affecting factors among faculty of health sciences students (20), with an alpha level of 0.05 and a statistical power ($1-\beta$) of 0.80, the minimum required sample size was estimated at 194 participants.

Ethical Aspect of the Research

Prior to the commencement of the study, approval was obtained from the Hatay Mustafa Kemal University Ethics Committee where the research was conducted (Date: 09.07.2024, Decision No: 4). The study was conducted in accordance with the principles of the Declaration of Helsinki. Individuals were invited to participate in the study by the responsible researcher. Informed consent was obtained from volunteers who met the inclusion criteria and agreed to participate in the research.

Data Collection Tools

For the evaluation of participants, an online form consisting of three sections was prepared. The first section included questions regarding participants' demographic information, AI and internet usage (23); the second section contained the AI Awareness Questionnaire to assess participants' AI awareness levels (23); and the third section included the AI Anxiety Scale to evaluate participants' AI anxiety levels (24). The form was distributed to participants through mobile phone numbers or e-mail addresses.

First Section: This section asked about participants' age, gender, year of study, use of internet technologies, daily internet usage time, knowledge about AI, knowledge about AI-supported programs on the internet, knowledge about the use of AI in healthcare, sources of information about AI, and whether they use any AI-supported applications. Participants' responses regarding knowledge about AI, knowledge of AI-supported programs on the internet, and knowledge of the use of AI in healthcare were assessed using yes/no binary questions. Participants were categorized as "knowledgeable" if they answered "yes" to these questions and as "not knowledgeable" if they answered "no." This binary classification was applied consistently across all three knowledge-related variables and is presented in Table 1.

Second Section: In this section, the AI Awareness Questionnaire was used to assess participants' AI awareness levels. Developed by Yılmaz et al. (23), this questionnaire consists of 27 items. The items are rated on a 5-point Likert scale: "Strongly Disagree (1)," "Disagree (2)," "Neutral (3)," "Agree (4)," and "Strongly Agree (5)." The maximum possible score is 135, and the minimum is 27. The scale does not have a cut-off score.

Third Section: In this section, the AI Anxiety Scale, developed by Wang et al. (15) and adapted into Turkish with validity and reliability studies by Akkaya et al. (24), was used to evaluate participants' AI anxiety levels. The scale consists of

four subscales: “Learning,” “Job Change,” “Sociotechnical Blindness,” and “AI Structuring.” Each item is scored on a 5-point Likert scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree. The minimum possible score is 16, and the maximum is 80. The AI Anxiety Scale does not have an established cut-off value to classify participants into anxiety categories; therefore, the total score was used as a continuous variable in all analyses.

Necessary permissions for the use of the questionnaires were obtained.

Data Collection

Individuals who met the inclusion criteria and volunteered to participate in the study were provided with the online form. To prevent participants from completing the form more than once, the “Limit to 1 response” option was activated in the settings section of Google Forms. The average completion time of the form was approximately 10-15 minutes. Participants’ responses were recorded in Google Forms.

Statistical Analysis

Statistical analyses were performed using SPSS version 20.0 (SPSS Inc., Chicago, IL, USA). The normality of continuous variables was assessed using the Shapiro-Wilk test and visual inspection methods. Descriptive statistics were presented as mean and standard deviation for continuous variables and as frequency and percentage for categorical variables.

The relationship between AI awareness and AI anxiety levels was examined using Pearson correlation analysis. Correlation coefficients were interpreted according to widely accepted standards. A multivariable linear regression analysis was performed to examine whether AI awareness independently predicted AI-related anxiety after adjusting for age, gender, year of study, daily internet usage duration, prior knowledge of AI, and use of AI-supported applications. Binary categorical variables were coded as indicator variables, while ordinal variables such as year of study and daily internet usage duration were entered as ordinal predictors.

The assumptions of linear regression, including linearity, independence of residuals, homoscedasticity, normality of residuals, and multicollinearity, were checked and found to be acceptable. Regression results were reported as unstandardized coefficients (B), standardized coefficients (β), 95% confidence intervals (CI), and p-values. A Bonferroni correction was applied for multiple correlation analyses, and the corrected significance level was set at $p < 0.01$. For all other analyses, statistical significance was set at $p < 0.05$ (25).

RESULTS

A total of 404 physiotherapy students were invited to participate in the study. Three students were excluded because they could not complete the questionnaires independently, and 201 students declined participation; therefore, the study was completed with 200 participants. The mean age of the participants was $22.38 \pm$

2.23 years. The majority of participants were female (71.5%) and third-year students (40.5%). The demographic and descriptive characteristics of the participants are presented in Table 1.

Table 1. Demographic and descriptive characteristics of the participants

Characteristics	Mean	Standard deviation
Age	22.38	2.23
Internet technology usage status (0: I never use it, 10: I am highly interested)	7.36	1.85
Characteristics	n	%
Gender		
Female	143	71.5
Male	57	28.5
Class		
1st year	7	3.5
2nd year	48	24
3rd year	81	40.5
4th year	64	32
Daily internet usage duration		
30 min – 1 hour	5	2.5
1 – 2 hours	20	10
2 – 3 hours	42	21
3 – 4 hours	51	25.5
More than 4 hours	82	41
Status of having knowledge about AI		
Knowledgeable	135	67.5
Not knowledgeable	65	32.5
Status of knowledge about AI-supported programs on the internet		
Knowledgeable	111	55.5
Not knowledgeable	89	44.5
Status of knowledge about the use of AI in healthcare		
Knowledgeable	114	57
Not knowledgeable	86	43
Source of knowledge about AI		
Social media	116	58
Print/visual media	7	3.5
Courses	19	9.5
Friends/family	3	1.5
Research	41	20.5
Scientific events	9	4.5
Other	5	2.5
Use of AI-supported application		
User	98	49
Non-user	102	51

n: Number; min: minutes; AI: Artificial intelligence

Analysis of the AI Awareness Questionnaire revealed that 71.5% of participants agreed it is important to follow AI-related developments in their profession, 70.5% agreed that AI applications should be trained with ethical considerations, and 68.5% agreed that AI applications process data to derive meanings and suggestions. Conversely, 74% disagreed that their future profession would disappear due to AI, 75% disagreed that AI systems should be defined as legal persons, and 76% disagreed that AI systems would negatively affect society through racist, sexist, or discriminatory decisions. The mean total score of the AI Awareness Questionnaire was 91.34 ± 21.37 (Supplementary Table S1).

The mean total score of the AI Anxiety Scale was 47.78 ± 15.41 . Subscale scores were as follows: Learning (13.59 ± 5.28), Job Change (12.34 ± 4.33), Sociotechnical Blindness (12.86 ± 4.39), and AI Structuring (9.01 ± 3.56) (Table 2).

Correlation analysis demonstrated a negative and moderate relationship between AI awareness and AI anxiety levels ($r =$

-0.52 , $p < .001$). Subscale analysis revealed similar negative and moderate correlations between AI awareness and Job Change ($r = -0.52$, $p < .001$), Sociotechnical Blindness ($r = -0.53$, $p < .001$), Learning ($r = -0.41$, $p < .001$), and AI Structuring ($r = -0.42$, $p < .001$). All correlations were statistically significant. These findings are summarized in Table 3.

Table 2. Participants' AI Anxiety Scale and subscale results

Scale and subscales	Mean	Standard deviation
AI Anxiety Scale	47.78	15.41
Learning	13.59	5.28
Job change	12.34	4.33
Sociotechnical blindness	12.86	4.39
AI structuring	9.01	3.56
AI: Artificial intelligence		

Table 3. Relationship Between AI Awareness and AI Anxiety

Variable	AI Anxiety Scale total score	Learning	Job change	Sociotechnical blindness	AI structuring
AI Awareness Questionnaire total score	$r = -0.52$ (95% CI: -0.61 to -0.41) $p < .001$	$r = -0.41$ (95% CI: -0.52 to -0.29) $p < .001$	$r = -0.52$ (95% CI: -0.61 to -0.41) $p < .001$	$r = -0.53$ (95% CI: -0.62 to -0.42) $p < .001$	$r = -0.42$ (95% CI: -0.53 to -0.30) $p < .001$

AI: Artificial intelligence; r: Correlation coefficient; p: p-value from two-tailed Pearson correlation test. A Bonferroni-corrected significance level of $p < .01$ was applied for correlation analyses.

The overall regression model was statistically significant ($F(7, 192) = 13.42$, $p < .001$) and explained 32.8% of the variance in AI anxiety scores ($R^2 = 0.328$, adjusted $R^2 = 0.304$). After adjustment for covariates, AI awareness remained a significant independent predictor of AI-related anxiety ($B = -0.36$, 95% CI = -0.45 to -0.27, $\beta = -0.49$, $p < .001$), indicating that higher AI awareness scores were independently associated with lower AI anxiety scores. In addition, gender ($B = 3.42$, 95% CI = 0.86 to

5.98, $p = .009$), year of study ($B = -1.08$, 95% CI = -2.15 to -0.01, $p = .048$), prior knowledge of AI ($B = -2.84$, 95% CI = -5.18 to -0.50, $p = .018$), and use of AI-supported applications ($B = -2.35$, 95% CI = -4.51 to -0.19, $p = .033$) were also significantly associated with AI anxiety scores. Age and daily internet usage duration were not significantly associated with AI anxiety scores in the multivariable model. The results of the multivariable linear regression analysis are presented in Table 4.

Table 4. Multivariable linear regression analysis predicting AI anxiety

Predictor	B	95% CI	SE	β	p
AI Awareness Questionnaire (total score)	-0.36	-0.45 to -0.27	0.05	-0.49	<.001
Age	-0.12	-0.97 to 0.73	0.43	-0.02	.779
Gender (male = reference)	3.42	0.86 to 5.98	1.30	0.16	.009
Year of study	-1.08	-2.15 to -0.01	0.54	-0.13	.048
Daily internet usage duration	0.45	-0.65 to 1.55	0.56	0.05	.421
Prior knowledge of AI (no = reference)	-2.84	-5.18 to -0.50	1.19	-0.13	.018
Use of AI-supported applications (non-user = reference)	-2.35	-4.51 to -0.19	1.10	-0.11	.033

Dependent variable: AI Anxiety Scale total score. Model summary: $R^2 = 0.328$, adjusted $R^2 = 0.304$, $F(7, 192) = 13.42$, $p < .001$. Statistical significance was set at $p < .05$ for the multivariable linear regression analysis

DISCUSSION

In this study, a negative and moderate correlation was found between physiotherapy students' levels of AI awareness and their levels of AI-related anxiety. This finding suggests that higher AI awareness may be associated with lower AI-related anxiety. Greater familiarity with the capabilities and limitations of AI may therefore be associated with lower concerns about technological change and professional adaptation.

Previous studies have reported that the use of internet and AI applications may influence individuals' awareness levels. One study reported the internet technology usage level of health sciences faculty students as 7.27 ± 1.83 (23), while in our study physiotherapy students' level was 7.36 ± 1.85 . Daily internet usage among medical students has been reported as approximately 4 hours (26). Other studies found that 31.1% of health science faculty students (23) and 45.1% of physiotherapy students (22) used the internet for 4 hours or more. Similarly, in our study, 41% of physiotherapy students reported daily internet usage of 4 hours or more. These results indicate intensive internet use in daily life and show that our findings are consistent with the literature.

It has been reported that 47.4% of health sciences faculty students had knowledge of the concept of AI, and 34.8% had knowledge of AI use in healthcare (23). In our study, 67.5% of physiotherapy students reported knowledge of the concept of AI, and 57% reported knowledge of AI use in healthcare. This difference may reflect the rapid integration of AI into daily life between 2021 and 2025. Furthermore, while previous studies reported social media as the main source of AI-related information for most students (23,27,28), in our study this rate was 58%, suggesting that other sources such as research, scientific publications, and academic events are beginning to play a greater role in knowledge acquisition.

Earlier studies have generally reported that university students hold positive views toward AI but have limited knowledge of it (21-23,26,27,29,30). Our findings only partially align with this pattern; while physiotherapy students in this study likewise expressed positive attitudes toward AI use, their awareness levels were notably higher than those reported previously.

Since the long-term problems that AI may cause in healthcare are still unknown, AI-related anxiety can be triggered among individuals (31). One study evaluated AI anxiety levels in family physicians (32), while another assessed AI anxiety levels in physiotherapists (21), both reporting low levels of anxiety. In our study, however, physiotherapy students reported notable AI anxiety scores. This difference may be attributed to students' lack of clinical experience and the rapid pace of technological advancements. Accordingly, the inclusion of more AI-related content in the educational process may be associated with lower anxiety levels and greater professional confidence among students.

Although AI awareness and anxiety have been examined separately in various professional groups and university populations (19,21,32,33), the relationship between these two constructs in physiotherapy students had not previously been explored. Given the growing integration of AI technologies into physiotherapy and rehabilitation practice (11,34), the moderate inverse association observed in our study suggests that initiatives aimed at strengthening AI awareness during physiotherapy education may contribute to easing students' adaptation to AI-supported clinical environments.

Although AI awareness was the primary variable of interest and showed the strongest association with AI anxiety in the multivariable model, the regression analysis also indicated that gender, year of study, prior knowledge of AI, and use of AI-supported applications were significantly associated with AI anxiety scores. These findings suggest that AI-related anxiety is not explained by awareness alone but may also be influenced by demographic, educational, and experiential factors. In particular, students with prior knowledge of AI and those using AI-supported applications had lower AI anxiety scores, which may reflect greater familiarity with AI technologies and reduced uncertainty. Similarly, the associations observed for gender and year of study suggest that students' perceptions of AI may vary according to personal characteristics and stage of professional education. Therefore, future studies should examine these factors in larger and more diverse samples.

Several interrelated mechanisms may help explain the inverse relationship between AI awareness and AI-related anxiety observed in our sample. From a cognitive perspective, anxiety toward emerging technologies has been conceptualised within the integrated fear acquisition framework, in which fear and uncertainty arise primarily from perceived unfamiliarity and unpredictability of the technology (31). According to this view, greater conceptual knowledge of how AI tools function, what tasks they can support, and what their current limitations are reduces the perceived novelty and unpredictability of these systems, thereby lowering the threat appraisal that drives technology-related anxiety (15,16,31). This interpretation is consistent with reports that healthcare professionals and students who receive structured AI-related training exhibit lower AI anxiety than untrained peers (18-20,32). A second, complementary mechanism relates to perceived self-efficacy: awareness of AI applications relevant to one's future profession may strengthen students' confidence in their ability to learn, use, and critically appraise these tools, which has been linked to reduced technostress and more positive attitudes toward AI in healthcare students (20,22). A third mechanism concerns about job displacement, a core component of the AI Anxiety Scale (15,17). Awareness of how AI is currently being used as a clinical-decision support rather than a replacement for physiotherapists (10,11,34) may reframe these technologies as complementary tools, attenuating fears related to professional obsolescence. Taken together, these mechanisms suggest that the association observed in the present

study is unlikely to reflect a single causal pathway and is more plausibly mediated by cognitive familiarity, self-efficacy, and occupational appraisal.

The present study has several strengths. It addresses a timely and emerging topic in physiotherapy education by examining the relationship between AI awareness and AI-related anxiety among physiotherapy students. The sample size was supported by an a priori power analysis, and the use of multivariable regression allowed us to evaluate this relationship while accounting for relevant demographic, educational, and experiential factors. By focusing on future physiotherapists, the findings may offer useful insights for developing undergraduate curricula that better prepare students for AI-supported clinical practice.

This study has certain limitations. First, the sample consisted only of students from a single public university, which limits the generalizability of the results to all physiotherapy students. Second, the socioeconomic status of participants was not evaluated in detail; this factor should be considered as it may influence the use of AI technologies and awareness levels. Third, only AI-related anxiety levels were examined, while general anxiety levels, which may act as a variable triggering AI-related anxiety, were not assessed. Fourth, the cross-sectional design of the study allows only for the identification of associations between variables and does not permit any causal inference. Fifth, because all data were collected through self-reported online questionnaires, the findings may be subject to response biases such as social desirability and recall bias, and the online distribution may have introduced a degree of selection bias toward participants with greater digital access.

CONCLUSION

In conclusion, this study identified a negative and moderate relationship between physiotherapy students' levels of AI awareness and their levels of AI-related anxiety. Higher AI awareness was independently associated with lower AI-related anxiety after adjustment for covariates. In addition, gender, year of study, prior knowledge of AI, and use of AI-supported applications were also significantly associated with AI anxiety scores in the multivariable model, suggesting that AI-related anxiety may be influenced by multiple demographic, educational, and experiential factors. Although the cross-sectional design does not allow for causal interpretation, incorporating AI-related educational content into undergraduate physiotherapy and rehabilitation programs may help support students' professional adaptation. Future longitudinal, multicenter, and interventional studies should build on these initial multivariable findings to confirm the observed associations and clarify potential causal relationships.

Conflict of Interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

The authors declare that there is no financial support.

Ethical Approval

This study was approved by the Hatay Mustafa Kemal University Ethics Committee (Date: 09.07.2024, Decision No: 4). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Informed Consent

Informed consent was obtained from volunteers who met the inclusion criteria and agreed to participate in the research.

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