



Research Article

Anxiety Levels and Anxiety States of Nurses and Nursing Students towards Artificial Intelligence

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Abstract

Objective: The aim of this study was to determine the anxiety of nurses working in the hospital and nursing students studying at the university against artificial intelligence.

Method: The study was a cross-sectional study and the data were collected between November 2022 and February 2023. “Descriptive Data Form” and ‘Artificial Intelligence Anxiety Scale’ were used for the study. A total of 321 people, including 160 nurses working in the hospital and 161 nursing students, participated in the study.

Results: A total of 321 people participated in the research, and 43.9% of the working nurses stated that breaking down artificial intelligence would reduce application errors in the healthcare field, and 57.3% stated that it would increase more than once by operating artificial intelligence. Significant differences were found in learning anxiety, job change anxiety, artificial intelligence structuring anxiety, and total artificial intelligence anxiety scores between nursing students and working nurses ($p<0.05$). Nursing students had higher anxiety levels than working nurses.

Conclusion: A significant difference was found in the anxiety levels of nursing students. It was determined that working nurses had higher knowledge of artificial intelligence and lower anxiety levels. Organizing training and events related to artificial intelligence for nursing students is recommended.

Keywords: Anxiety, artificial intelligence, nurse, nursing student

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1 INTRODUCTION

Today, rapid technological development and transformation continue to shape many sectors. Artificial intelligence is one of the most prominent innovations and

is defined as “the ability of computer-based machines to mimic human behaviors”^[1]. Artificial intelligence contributes to many areas of human life, including health, education, and the economy. Since the 1970s, artificial

intelligence has increasingly entered the healthcare field^[2]. In healthcare institutions, artificial intelligence applications can be broadly categorized as medical and managerial^[3]. Artificial intelligence technologies can be used in healthcare institutions for various administrative functions, including document management, human resources, finance, emergency management, and strategic decision-making. In healthcare services, the use of artificial intelligence has led to important advances in the diagnosis, treatment, monitoring, and care of diseases. These developments are considered important for the future of nursing. However, the use of artificial intelligence in nursing may lead to anxiety among nurses. This anxiety may be related to insufficient knowledge in this field among nurses^[4]. Artificial intelligence and robot technologies are utilized to reduce the workload in nursing. Artificial intelligence is used in many areas such as the creation of medications and treatment plans, especially to facilitate routines^[5].

Despite the conveniences provided by artificial intelligence, nurses and nursing students may experience anxiety regarding its use in healthcare services for various reasons. The main causes of this anxiety include concerns that professional roles may change or that certain tasks may be replaced through automation, uncertainties related to job security, insufficient technological knowledge and skills, and difficulties adapting to digital systems^[6,7]. In addition, lack of trust in artificial intelligence systems, uncertainties regarding ethical responsibilities, concerns about data security, and the belief that human interaction in patient care may be reduced can also increase anxiety^[7].

Particularly among nursing students, limited artificial intelligence literacy, insufficient digital competence, and low perceived technological self-efficacy may contribute to higher levels of anxiety related to artificial intelligence^[8]. Among working nurses, the obligation to adapt to new technologies in addition to existing workloads, the need for in-service training, and pressure to adjust to changing clinical care processes are considered important sources of stress^[6]. Nevertheless, it has been reported that anxiety levels may be reduced through increased knowledge about artificial intelligence, the provision of appropriate educational programs, and the active involvement of nurses in technology development processes^[6,8]. Therefore, it is important to develop artificial intelligence-based educational programs for both nursing students and working nurses and to strengthen digital literacy. It has been stated that there is a need for studies that can evaluate the perspectives, thoughts and perceptions of health professionals about artificial intelligence^[9]. For this reason, this study was prepared to provide an overview of the studies to be conducted on the use of artificial intelligence with working nurses and nursing students.

In the very near future, a process is being entered in which artificial intelligence is predicted to rise to a decision-making

position in businesses^[10]. It is thought that health institutions should enter this process with adequate technological infrastructure, trained human resources, inclusive and up-to-date legislation, a functional organizational structure and management by completing the necessary preparations without wasting time. It is predicted that service quality will increase if nurses' experience, knowledge and critical thinking skills are combined^[8]. It is necessary to consider ethical concerns and the safety of the individual during the use of artificial intelligence and robot technologies^[11].

Nurses, as the largest group of healthcare professionals, are expected to use artificial intelligence technologies more frequently than other members of the healthcare team. However, it has been reported that the level of artificial intelligence use among nurses and their scientific contribution to this field remain limited^[12]. Therefore, it is important to enhance the knowledge, awareness, and readiness of nursing students, who represent the future nursing workforce, regarding artificial intelligence before entering clinical practice. At the same time, identifying the knowledge levels, attitudes, and anxiety of working nurses toward artificial intelligence is essential for the effective integration of technology into clinical practice. Accordingly, the aim of this study was to comparatively examine the anxiety levels and perspectives of working nurses and nursing students regarding artificial intelligence.

2 MATERIALS AND METHODS

2.1 Type of Research

This is a cross-sectional study conducted with nurses and nursing students working in the hospital.

2.2 Research Place and Time

In the study, data collection tools were sent to the participants who accepted to participate in the study and met the inclusion criteria via the "google.docs" program and online link. The research was conducted online between November 2022 and February 2023. It was used after obtaining ethics committee permission.

2.3 Population and Sample of the Study

The study population consisted of working nurses and nursing students who met the inclusion criteria, agreed to participate, and had access to the online questionnaires. A snowball sampling method was used for participant recruitment. To determine the required sample size, a power analysis was conducted using G*Power version 3.1.9.4. Based on an independent samples t-test, with a Type I error rate of 5%, an effect size of 0.20, and a statistical power of 80%, the minimum required sample size was calculated as 102 participants, with 51 participants in each group. However, the final sample comprised 321 participants, including working nurses and nursing students. Inclusion criteria were being a working nurse or nursing student, being aged 18 years or older, speaking Turkish, owning

a smartphone, and voluntarily agreeing to participate in the study. Because participants were recruited through voluntary online participation, selection bias may have occurred, particularly among individuals with limited internet access or lower interest in artificial intelligence.

2.4 Setting and Data Collection Procedure

The questionnaire was created using Google Forms and distributed online through WhatsApp groups and institutional university email lists using a snowball sampling approach. Data were collected between November 2022 and February 2023. All questionnaire items were set as mandatory; therefore, incomplete submissions could not be formally submitted through the system. After data screening, a total of 321 complete responses were included in the final analysis. No missing data were identified in the analyzed dataset.

2.5 Data Collection Tools

Descriptive Data Form: It was prepared by the researchers in line with the literature^[1,13,14]. It consists of two sections evaluating participants' sociodemographic characteristics and perspectives regarding artificial intelligence. The first section included 8 questions on demographic characteristics. The second section included 14 items assessing participants' views regarding artificial intelligence in healthcare. These 14 perspective items were researcher-developed exploratory questions based on previous literature. They were not intended as a standardized psychometric scale and were analyzed descriptively.

Artificial Intelligence Anxiety Scale: Artificial intelligence anxiety was assessed using the Artificial Intelligence Anxiety Scale developed by Wang and Wang (2019), which was originally designed to evaluate individuals' anxiety toward artificial intelligence and its relationship with motivated learning behavior^[15]. The original scale consists of 21 items across four factors. The Turkish validity and reliability study conducted by Akkaya, Özkan, and Özkan resulted in a 16-item version with four subdimensions^[16]. In the Turkish adaptation study, the overall internal consistency coefficient was reported as $\alpha=0.937$. Subscale reliability coefficients were $\alpha=0.948$ for Learning, $\alpha=0.895$ for Job Switching, $\alpha=0.875$ for Sociotechnical Blindness, and $\alpha=0.950$ for Artificial Intelligence Structuring^[16]. In the current study, Cronbach's alpha coefficients were 0.88 for Learning Anxiety, 0.88 for Job Change Anxiety, 0.89 for Sociotechnical Blindness Anxiety, 0.90 for Artificial Intelligence Structuring Anxiety, and 0.94 for the total scale score.

2.6 Ethical Principles

Ethics committee permission was obtained from the Istanbul Kültür University Ethics Committee (14.10.2022, Decision No: 2022/141). The research was conducted by human ethics, with participant approval and in accordance

with the principles of the Declaration of Helsinki. Informed voluntary consent forms were obtained from the participants. It was stated that it was completely voluntary and that the study could be withdrawn at any stage. No funding source was used.

2.7 Data Analysis

SPSS Statistics version 24.0 was used for data analysis. Descriptive statistics were presented as frequencies, percentages, means, and standard deviations. The normality of continuous variables was assessed using skewness and kurtosis values, and values within ± 1.5 were accepted as indicating normal distribution^[17]. Independent samples t-test was used to compare two-group variables, and one-way analysis of variance (ANOVA) was used for comparisons involving three or more groups. The Chi-square test of independence was used to examine associations between categorical variables. Statistical significance was set at $p<0.05$.

3 RESULTS

It was determined that 77.9% of the 321 participants were female, 22.1% were male; 56.7% were 18-24 years old, 30.2% were 25-34 years old, 10.6% were 35-44 years old, 2.5% were 45 years and older; 49.2% were nursing students, 49.5% were working nurses, and 1.2% were both nursing students and working nurses (Table 1).

Of the 162 nursing students, 42.6% were 1st grade, 20.4% 2nd grade, 19.1% 3rd grade, 17.9% 4th grade students. Of the 163 working nurses, 47.9% had worked 0-5 years, 34.4% 6-11 years, 11.0% 12-17 years, 6.7% 18 years or more.

Participants' knowledge about artificial intelligence; "Willing to receive training on artificial intelligence" 64.5%, "The use of artificial intelligence, the state of reducing the workload" 70.1%, "The state of increasing the number of unemployment with the increase in the use of artificial intelligence" 57.3%. When the knowledge levels of the individuals participating in the study ($n=321$) were examined; those who are interested in artificial intelligence were found to be 48.9%, the desire to receive training with artificial intelligence was 64.5%, the state of reducing mistakes in the healthcare field was 43.9%, the state of reducing the workload was 70.1%, the state of increasing self-reliance was 41.1%, the belief that it will isolate working nurses was 47.7%, and the state of increasing the unemployment rate was found to be high with a rate of 57.3%. Participants' knowledge about artificial intelligence; "Willing to receive training on artificial intelligence" 64.5%, "The use of artificial intelligence, the state of reducing the workload" 70.1%, "The state of increasing the number of unemployment with the increase in the use of artificial intelligence" 57.3% (Table 2).

Significant differences were found in learning anxiety, job change anxiety, sociotechnical blindness anxiety,

Table 1. Demographic Information (n=321)

		<i>n</i>	%
Gender	Female	250	77.9
	Male	71	22.1
	Total	321	100.0
Age	18-24 Years	182	56.7
	25-34 Years	97	30.2
	35-44 Years	34	10.6
	45 Years and older	8	2.5
	Total	321	100.0
Profession/Occupation	Nursing Student	158	49.2
	Working Nurse	159	49.5
	Both	4	1.2
	Total	321	100.0
Grade Level of Nursing Student	1. Grade	69	42.6
	2. Grade	33	20.4
	3. Grade	31	19.1
	4. Grade	29	17.9
	Total	162	100.0
Working Period of Working Nurse (Years)	0-5 Years	78	47.9
	6-11 Years	56	34.4
	12-17 Years	18	11.0
	18 Years ve older	11	6.7
	Total	163	100.0

Table 2. Participants' Knowledge about Artificial Intelligence (n=321)

	Yes		No		Partly	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
State of Being Interested in Artificial Intelligence	157	48.9	51	15.9	113	35.2
The Will to Receive Training with Artificial Intelligence	207	64.5	45	14.0	69	21.5
State of Artificial Intelligence Usage in Reducing Mistakes in Healthcare Field	141	43.9	43	13.4	137	42.7
State of Artificial Intelligence Usage in Reducing Workload	225	70.1	21	6.5	75	23.4
State of Artificial Intelligence Usage in Increasing Self Reliance	132	41.1	93	29.0	96	29.9
State of Artificial Intelligence Usage in Becoming of Working NursesIsolated	153	47.7	73	22.7	95	29.6
State of Artificial Intelligence Usage in Increasing the Number of Unemployment	184	57.3	46	14.3	91	28.3

artificial intelligence structuring anxiety, and total artificial intelligence anxiety scores according to willingness to receive training on artificial intelligence ($p<0.05$). In pairwise comparisons, participants who were willing to receive training on artificial intelligence had lower scores than those who were unwilling or partially willing to receive training. (Table 3).

There was a significant difference between the learning anxiety, job change anxiety, sociotechnical blindness anxiety, artificial intelligence structuring anxiety and artificial intelligence anxiety scores of nursing students and working nurses ($p<0.05$), and nursing students had higher learning anxiety, job change anxiety, sociotechnical blindness anxiety, artificial intelligence structuring anxiety and artificial

intelligence anxiety than working nurses (Table 4).

4 DISCUSSION

The increasing prevalence of artificial intelligence technology in nursing care practices^[3] is an area that needs to be learned and integrated by nurses. However, the use of artificial intelligence in the field of nursing may cause anxiety among nurses. The reason for this anxiety is thought to be that nurses do not have sufficient knowledge in this field^[4]. When the literature is reviewed, it is seen that studies evaluating the anxiety^[13] and knowledge levels^[13,14] of healthcare professionals about artificial intelligence have been conducted, but no studies evaluating only nurses' knowledge and anxiety in this field have been found to our knowledge. Accordingly, the aim of this study was

Table 3. Comparison of Artificial Intelligence Anxiety Scale and Subscale Scores according to Will to Receive Education on Artificial Intelligence (N=321)

Willing to Receive Education on Artificial Intelligence		Ave.	S. Deviation	F	p	Diff.
Learning	a. Yes	207	9.51	9.760	0.00*	b, c>a
	b. No	45	11.89			
	c. Partly	69	11.16			
Job Change	a. Yes	207	9.90	6.600	0.00*	c>a
	b. No	45	10.89			
	c. Partly	69	12.04			
Sociotechnical Blindness	a. Yes	207	10.30	8.823	0.00*	c>a
	b. No	45	11.84			
	c. Partly	69	12.83			
Artificial Intelligence Structuring	a. Yes	207	6.74	7.956	0.00*	c>a
	b. No	45	7.82			
	c. Partly	69	8.43			
Artificial Intelligence Anxiety	a. Yes	207	36.46	11.008	0.00*	b, c>a
	b. No	45	42.44			
	c. Partly	69	44.46			

Notes: F: One-Way Analysis of Variance (Anova), *Significant at Level $p<0.05$.

Table 4. Comparison of Artificial Intelligence Anxiety Scale and Subscale Scores by Profession/Occupation (n=321)

Profession/Occupation		n	Ave.	S. Deviation	T	p
Learning	Nursing Student	158	10.73	3.90	2.402	0.02*
	Working Nurse/Both	163	9.68	3.96		
Job Change	Nursing Student	158	11.99	4.27	6.336	0.00*
	Working Nurse/Both	163	9.06	4.00		
Sociotechnical Blindness	Nursing Student	158	12.83	4.33	7.248	0.00*
	Working Nurse/Both	163	9.35	4.27		
Artificial Intelligence Structuring	Nursing Student	158	8.06	3.18	4.446	0.00*
	Working Nurse/Both	163	6.48	3.21		
Artificial Intelligence Anxiety	Nursing Student	158	43.61	12.62	6.222	0.00*
	Working Nurse/Both	163	34.57	13.39		

Notes: T: Independent Sample T Test, *Significant at Level $p<0.05$.

to compare the anxiety levels and perspectives regarding artificial intelligence between working nurses and nursing students.

The study group consisted of a total of 321 nursing students and working nurses. 77.9% of the participants were women. Among all participants, approximately half were nursing students and the other half were working nurses. Notably, more than half reported having only partial knowledge of artificial intelligence, with social media as their primary source of information. Similarly, a previous study found that university students primarily obtained their knowledge of artificial intelligence from social media^[18]. Previous studies have also reported that many students had partial knowledge regarding the concept of artificial intelligence and that social media was the primary source of information about artificial intelligence-

supported programs^[4]. Previous research involving health professionals reported that most participants had previously heard of artificial intelligence, while fewer had received formal education or training on the subject, and a limited proportion reported knowledge regarding its use in medicine and healthcare services^[9].

When evaluated according to professional status, statistically significant differences were found between nursing students and working nurses in learning anxiety, job change anxiety, artificial intelligence structuring anxiety, and total artificial intelligence anxiety scores ($p<0.05$). The higher anxiety levels observed among nursing students may be associated with lower levels of digital proficiency, artificial intelligence literacy, and limited readiness for emerging technologies. Similar findings were reported by Abou Hashish and Alnajjar, who emphasized the

importance of AI-related knowledge, attitudes, and skills among university nursing students^[8]. The higher scores of nursing students across all subdimensions and the total anxiety score compared with working nurses appear to be consistent with previous research reporting lack of knowledge and concerns regarding the use of artificial intelligence in healthcare among students^[9].

A significant difference was observed in job change anxiety scores according to nursing students' grade level. First-year nursing students had higher job change anxiety scores than third- and fourth-year students. This finding may suggest that increased educational exposure over time is associated with lower anxiety levels.

Nurses with knowledge about artificial intelligence had lower learning anxiety, job change anxiety, sociotechnical blindness anxiety, artificial intelligence structuring anxiety, and total artificial intelligence anxiety scores compared with those who had no or partial knowledge. Similarly, nurses who believed that artificial intelligence should be integrated into healthcare had lower anxiety scores across all subdimensions than those who did not hold this view. Previous studies have reported that medical students were willing to use artificial intelligence in their future careers and believed that artificial intelligence applications in healthcare would facilitate professional practice^[19].

Nurses who were interested in artificial intelligence had lower learning anxiety, job change anxiety, sociotechnical blindness anxiety, artificial intelligence structuring anxiety, and total artificial intelligence anxiety scores compared with those who were partially interested or not interested. Similarly, nurses who were willing to receive training on artificial intelligence had lower learning anxiety and total artificial intelligence anxiety scores than those who were partially willing or unwilling to receive training. In addition, nurses who believed that the use of artificial intelligence would reduce application errors in healthcare had lower anxiety scores across all subdimensions compared with those who believed it would only partially reduce errors. Previous studies have also reported that medical students were willing to use artificial intelligence in their future careers and believed that artificial intelligence applications in healthcare would facilitate professional practice^[19]. Nurses who thought that the use of artificial intelligence would reduce their workload had lower learning anxiety compared to nurses who did not think that it would reduce their workload. Filiz et al., it was considered as an advantage that artificial intelligence reduces the workload and medical errors of healthcare professionals and saves time, money and labor^[13].

Artificial intelligence is generally categorized as applications designed to reduce the workload of healthcare professionals and robotic systems. Previous studies have

emphasized the potential role of artificial intelligence particularly in preventing medical errors and supporting clinical processes^[4]. This suggests that artificial intelligence may be perceived as both an opportunity and a source of concern in healthcare services.

In the present study, 34.2% of nursing students and 47.9% of working nurses believed that the use of artificial intelligence would increase self-reliance. In addition, 62.0% of students and 52.8% of working nurses believed that increasing use of artificial intelligence would lead to higher unemployment rates. The higher level of unemployment concern among students may be associated with uncertainty regarding future professional roles and job security. Concerns about job loss due to robotic systems and automation have been identified as common anxieties related to artificial intelligence technologies. Previous studies have also suggested that the expansion of robotic systems in the workplace and increasing automation may replace certain human tasks^[7]. Therefore, it is important to position artificial intelligence as a supportive tool within the nursing profession and to promote awareness that it is intended to complement, rather than replace, human care.

These findings highlight the importance of reviewing existing curricula to better prepare health sciences students for future artificial intelligence applications and their use in healthcare^[20]. Integrating artificial intelligence-related content into nursing and health sciences education may help improve awareness, knowledge, and readiness for emerging technologies. In addition, virtual care has been reported to enhance information transfer and health outcomes between patients and healthcare teams, as well as among team members themselves^[21]. Another important consideration is that the effective delivery of AI-oriented course content requires adequately prepared educators. Therefore, further studies are needed to evaluate educators' awareness, readiness, and perceived competence regarding artificial intelligence and its applications in healthcare^[4].

5 CONCLUSION

In this study, nursing students demonstrated higher levels of artificial intelligence anxiety than working nurses, whereas working nurses reported greater knowledge regarding artificial intelligence. These findings suggest that limited knowledge and preparedness may be associated with higher anxiety levels among future nurses. From a practical perspective, integrating artificial intelligence-related content into nursing curricula and providing seminars, courses, and applied training programs may help improve knowledge, readiness, and confidence while reducing anxiety toward emerging technologies. Integrating artificial intelligence content into undergraduate nursing curricula may improve students' confidence and readiness, as suggested by Abou Hashish and Alnajjar^[8]. Moreover, the growing use of virtual care systems in healthcare

settings further supports the need for technology-oriented nursing education. Babaei et al. reported that virtual care may enhance communication, continuity of care, and health outcomes. These findings suggest that integrating artificial intelligence and digital health competencies into nursing education may reduce anxiety and improve professional readiness^[19]. Future multicenter longitudinal studies with randomized sampling methods are recommended to improve generalizability and reduce sampling bias.

5.1 Limitations of the Study

The study is limited to the online introduction information form and artificial intelligence anxiety measurement tools. Since the study was conducted using online snowball sampling and included a specific sample of nurses and nursing students in Türkiye, the findings cannot be generalized to all nurses or nursing students. Participants were recruited through voluntary online participation, which may have introduced selection bias by excluding individuals with limited internet access or lower interest in artificial intelligence.

5.2 Relevance For Clinical Practice

The technology used in the health field is rapidly advancing today, including artificial intelligence. It is important for nurses, who make up the majority of healthcare personnel, to improve themselves and work in this regard to move the profession forward. These developments also bring anxiety. Determining the concerns of active and student nurses in the clinic will be the first step in supporting the clinic in using artificial intelligence.

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Ethical Statement

Ethical approval for this study was obtained from the Istanbul Kültür University Ethics Committee. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Informed consent was obtained from all participants prior to data collection, and participation was entirely voluntary. Participants were informed of their right to withdraw from the study at any stage without penalty.

Conflicts of Interest

The authors declared no conflict of interest.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Author Contribution

Conceptualization, methodology, investigation, and statistical analysis were performed by Meral Madenoğlu Kıvanç and Ayfer Kaya. Data curation, writing of the original draft, and review and editing were carried out by Ülkü Yılmaz. Ülkü Yılmaz also completed the translation process and read and approved the final version of the manuscript.

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