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INTRODUCTION

Artificial intelligence (AI) is expected to have a transformative impact on many settings of the nursing profession, including clinical care, nursing management, nursing education and researches (1). Concurrent with the development of AI in the settings of nursing, it is anticipated that nurses will enhance patient care through the utilization of this technology (2). However, there is a conspicuous absence of comprehension regarding the fundamental principles underpinning this novel technology. A substantial proportion of nurses acknowledge the advantages of AI. Nevertheless, apprehensions regarding its potential deleterious effects, particularly in the context of its extensive implementation in clinical practice, persist. Additionally, elevated anxiety levels regarding this technology may influence nurses' acceptance of it. Indeed, AI anxiety has been identified as

Nurses' opinions and anxiety levels regarding artificial intelligence technologies

Abstract

Aim: Artificial intelligence (AI) anxiety is a contemporary issue that may hinder the adoption, use, and acceptance of AI technology in nursing care. This study aims to assess nurses' opinions and anxiety levels regarding AI.

Materials and Methods: This cross-sectional and descriptive study utilized self-report questionnaires distributed to 263 nurses between January and June 2023. Data were collected using the "nurses information form" and "artificial intelligence anxiety scale (AIAS)".

Results: The findings indicated that while 83.7% of nurses reported being informed about AI, only 4.9% had received formal training, and 9.1% had used AI technology in nursing care. The total mean AIAS score was 61.79 ± 27.70 , with sub-dimensions scores of 22.21 ± 11.96 for "learning," 16.12 ± 8.37 for "job replacement," 13.99 ± 7.05 for "sociotechnical blindness," and 9.46 ± 5.77 for "AI configuration."

Conclusion: Although nurses exhibited low levels of AI-related anxiety generally held positive views regarding AI, their use of AI in nursing practice remained minimal. Continuous education programs should be implemented to enhance AI utilization in healthcare, facilitate adaptation, improve nurses' technological skills, and mitigate AI-related anxiety.

Keywords: Artificial intelligence, anxiety, opinions, nursing

a factor that can impede the adoption, utilization, or acceptance of this technology, thereby hindering the realization of its benefits (3). For this reason, ascertaining nurses' perspectives and levels of anxiety concerning AI is imperative for elucidating impediments to its adoption and utilization by nurses, in addition to formulating efficacious solutions. However, the manner in which nurses will adapt to this process, the anxiety levels of nurses, and the manner in which these anxiety levels will affect the process are yet to be elucidated.

AI-related anxiety has recently emerged as a topic of study in the literature, with varying findings regarding anxiety levels among healthcare professionals. Cobanoglu and Oguzhan (2023) reported that nurses exhibited low levels of anxiety concerning AI (4). Similarly, Seren Intepeler et al. (2022) found that nurses had low levels of AI-related anxiety but expressed concerns about

potential ethical and legal issues (5). In contrast, Othman et al. (2021) reported that 28.5% of nurses working in medical units experienced high anxiety levels, while 43.7% of those in critical care units exhibited moderate anxiety levels (6). Additionally, studies conducted by Filiz et al. (2022) and Menekli & Senturk (2022) indicated that healthcare professionals had moderate concerns regarding the use of AI in healthcare settings (7,8).

This study was aimed to assess nurses' opinions and anxiety levels regarding AI.

Research questions;

1. What are the opinions of nurses' regarding AI?
2. What is the level of anxiety of nurses' regarding AI?

MATERIALS AND METHODS

Research Design

This study employed a cross-sectional and descriptive design using self-report questionnaires.

Setting

This study was conducted between January and June 2023 in a state hospital located in western Türkiye.

Population and Sample

The study population consisted of 377 nurses working in a state hospital in western Turkey. Using the Epi InfoTM Statcalc tool, the required sample size was determined to be 241 nurses. The final study sample included 263 voluntary nurses employed at the hospital. Nurses who had never used AI-based technology in their personal or professional lives were excluded. The confidence interval for the sample was set at 99%.

Instruments

The "nurses information form" and the "artificial intelligence anxiety scale (AIAS)" were used to collect data for this study.

Nurses information form: It was developed by the researchers based on relevant literature to assess nurses' demographic characteristics and opinions on AI (9-11). The instrument consisted of two sections. The first section collected demographic information, including age, marital status, educational level, clinical department, professional status and work experience. The second section contained 24 questions evaluating nurses' views on AI technologies, included its use in nursing care, training on AI, and perceptions of its reliability and ethical implications.

AIAS: It was developed by Wang and Wang (2019) to measure individuals' anxiety levels related to AI (12). The Turkish validity and reliability study of the scale was conducted by Terzi in 2020 (13). The AIAS consists of 21 items distributed across four sub-dimensions: Learning, Job Replacement, Sociotechnical Blindness, and AI Configuration. Responses are recorded on a 7-point Likert-scale (1=never to 7=completely), with total scores ranging from 21 to 147. Higher scores indicate greater AI-related anxiety. The Cronbach's Alpha

reliability coefficient for the full scale was reported as 0.96, with sub-dimension coefficients as follows: Learning (0.89), Job Replacement (0.95), Sociotechnical Blindness (0.89), and AI Configuration (0.95) (13). In this study, Cronbach's alpha coefficient for the total scale was 0.95, while the coefficients for the Learning, Job Replacement and AI configuration, and Sociotechnical Blindness sub-dimensions were 0.94, 0.91, and 0.92, respectively.

Data Collection

Nurses were recruited using a haphazard sampling method based on the inclusion criteria. Those who agreed to participate voluntarily completed self-administered questionnaires between January and June 2023. The completion time for questionnaires was approximately 10-15 minutes.

Data Analysis

Statistical analyses were conducted using SPSS 25.0. Descriptive statistics were presented as percentages and frequencies. The skewness and kurtosis coefficients were used to assess the normality of data distribution, with values between -2 to +2 considered indicative of a normal distribution (14). Since the data followed a normal distribution, either the t-test or ANOVA was applied to analyze the study's main variables and the demographic profiles of the nurses. A p-value of <0.05 was considered statistically significant.

Ethical Consideration

We confirm that all procedures utilized in this study were conducted following the principles of the Helsinki Declaration. Ethical clearance and approval letters were secured from the Institutional Review Board (IRB) of the İzmir Bakırçay University of Ethics Committee (Approval Number: 2022-808, Approval date: 21.12.2022). All nurses agreed to voluntarily participate in the present study, verbal consent was obtained from all of them, and they were informed about the purpose of this study. During the data collection, the issue of confidentiality and privacy was assured by maintaining the anonymity of participants. Participants could withdraw from the study at any time if they were not happy with the survey. Written approval was obtained from hospital administrators to carry out the study. The necessary permission to utilize the scales discussed previously in this study was received from the authors.

RESULTS

Sociodemographic Characteristics of Nurses

The mean age of the nurses was 35.18±9.67 years (range: 18-58). The majority were female (81.7%), married (57.4%), and held a bachelor's degree (72.2%). Most nurses were employed as staff nurses (85.9%), with nearly half working in surgical clinics (35.4%). Additionally, 38.8% had ≥16 years of work experience.

Regarding AI awareness, 83.7% of nurses reported having some knowledge of AI; however, only 4.9% had received formal AI training, and just 9.1% had used AI technology in nursing care (Table 1).

Table 1. Comparison of nurses AIAS and sub-dimension scores according to descriptive features

Descriptive features (n=263)	n	%	Total score Mean±SD	Sub-dimensions			
				Learning Mean±SD	Job replacement Mean±SD	Sociotechnical blindness Mean±SD	AI Configuration Mean±SD
Gender							
Female	215	81.7	63.33±27.90	22.48±11.55	16.65±0.78	14.40±7.10	9.78±5.87
Male	48	18.3	54.91±25.93	20.97±13.71	13.71±1.98	12.16±6.58	8.02±5.14
t			1.912	0.789	2.190	1.997	1.918
p			0.057	0.431	0.029	0.047	0.056
Marial status							
Married	151	57.8	62.99±28.11	23.25±12.30	16.12±8.57	13.94±7.01	9.67±6.01
Single	111	42.2	60.15±27.16	20.78±11.37	16.12±8.11	14.07±7.14	9.17±5.46
t			0.859	1.679	0.038	-0.104	0.724
p			0.391	0.094	0.970	0.917	0.470
Education							
Master/ doctorate degree	25	9.5	52.76±26.79	20.04±11.39	14.16±7.77	10.80±5.43	7.76±4.87
Bachelor degree	190	72.2	61.67±28.41	21.56±11.84	16.13±8.71	14.33±7.33	9.63±5.93
Associate degree	26	9.9	68.03±21.25	26.07±13.08	18.19±6.78	13.84±5.08	9.92±5.56
Medical vocational high school	22	8.4	65.72±28.18	25.68±11.47	15.81±7.54	14.86±7.64	9.36±5.61
F			1.484	2.001	0.997	1.993	0.833
p			0.219	0.114	0.395	0.115	0.477
Professional experience							
≤1 year	35	13.3	61.80±25.25	22.02±11.00	17.28±6.90	13.48±6.11	9.00±4.83
2-5 years	55	20.9	60.36±27.62	20.36±12.08	15.34±7.90	14.72±7.23	9.92±6.61
6-10 years	40	15.2	61.42±28.44	21.52±12.03	16.57±9.00	14.12±6.93	9.20±5.33
11-15 years	31	11.8	55.87±21.96	21.09±9.58	13.64±7.14	12.74±5.86	8.38±4.43
≥16 years	102	38.8	64.50±29.87	23.88±12.81	16.72±9.09	14.10±7.68	9.79±6.15
F			0.634	0.926	1.130	0.444	0.514
p			0.638	0.449	0.343	0.777	0.725
Professional status							
Head nurse/supervisor/director	24	9.1	65.50±27.97	23.45±12.02	17.75±8.24	14.70±7.52	9.58±5.86
Staff Nurse	239	90.9	61.42±27.70	22.08±11.97	15.96±8.38	13.92±7.02	9.44±5.78
t			0.687	0.534	0.997	0.518	0.109
p			0.493	0.594	0.320	0.605	0.913

Table 1. Comparison of nurses AIAS and sub-dimension scores according to descriptive features

Descriptive features (n=263)	n	%	Total score Mean±SD	Sub-dimensions			
				Learning Mean±SD	Job replacement Mean±SD	Sociotechnical blindness Mean±SD	AI Configuration Mean±SD
Clinical department							
Operating room	16	6.1	57.56±27.88	20.00±12.68	16.68±8.69	13.40±7.03	8.87±5.60
Emergency	21	8.0	51.00±26.76	20.47±12.56	13.09±7.10	10.71±6.36	6.71±4.03
Intensive care	69	26.2	58.76±27.87	21.62±12.49	14.56±8.37	13.40±7.03	9.17±5.83
Medical clinic	64	24.3	64.25±24.62	22.85±10.04	17.00±7.68	14.75±6.65	9.64±5.30
Surgical clinic	93	35.4	65.51±29.30	22.97±12.65	17.26±8.84	15.00±7.22	10.26±6.28
F			1.658	0.427	1.941	2.271	1.759
p			0.160	0.789	0.104	0.062	0.137
Knowledge about AI							
Yes	220	83.7	60.79±27.62	21.29±11.69	16.00±8.45	14.04±7.17	9.45±5.91
No	43	16.3	66.90±27.85	26.93±12.36	16.72±8.02	13.74±6.49	9.51±5.10
t			-1.325	-2.865	-0.509	0.256	-0.064
p			0.186	0.005	0.611	0.799	0.949
Course on AI							
Yes	13	4.9	66.15±27.97	20.07±11.62	16.23±8.63	18.92±6.44	10.92±7.48
No	250	95.1	61.56±27.72	22.32±11.99	16.12±8.37	13.77±7.00	9.38±5.68
t			0.581	-0.659	0.046	2.610	0.730
p			0.562	0.510	0.963	0.010	0.479
Using AI in nursing care							
Yes	24	9.1	56.37±25.45	18.20±9.29	14.95±8.72	13.25±6.84	9.95±5.78
No	239	90.9	62.33±27.90	22.61±12.14	16.24±8.34	14.07±7.08	9.41±5.78
t			-1.005	1.726	-0.716	-0.543	0.442
p			0.316	0.085	0.475	0.588	0.659
Mean Age: 35.18±9.67 (med=34.0)							

Opinions of Nurses About AI

The majority of nurses' agreed that AI would increase patient satisfaction (62.7%), enhance quality of nursing care (70%), reduce medical errors (61.6%), minimize work accidents (73.4%) and occupational diseases (70.3%), lower the workload of nurses (79.1%), shorten hospital stays (63.5%) and decrease healthcare costs (53.6%). Additionally, more than half of the nurses believed that AI would improve professional skills (55%) and

would not lead to unemployment (76.8%). Although only 36.9% of nurses considered AI to be reliable, the majority agreed that AI is not dangerous for patients (74.9%), will not create ethical dilemmas for society (84%), and should be regulated within a legal framework (87.1%), (Table 2).

Regarding their emotions toward AI in healthcare, nurses reported feeling excitement (25.5%), curiosity (25.1%) and hope (19.8%) most frequently.

Table 2. Comparison of of nurses' views on the use of AI with AIAS total score (n=263)

Premises		n	%	Mean±SD	Test value	p
AI technologies used in nursing are reliable	Disagree	49	18.6	73.75±27.34	15.434a	0.000
	I agree	97	36.9	50.58±24.80		
	No idea	117	44.5	66.07±27.03		
AI technologies improve the quality of care	Disagree	79	30.0	68.27±29.31	2.512b	0.013
	I agree	184	70.0	59.01±26.57		
AI improves the quality of home care services	Disagree	78	29.7	71.03±26.93	3.593b	0.000
	I agree	185	70.3	57.89±27.15		
AI improves the quality of elderly care services	Disagree	77	29.3	71.92±26.90	3.918b	0.000
	I agree	186	70.7	57.60±27.00		
AI improves patient satisfaction	Disagree	98	37.3	68.64±27.68	3.142b	0.002
	I agree	165	62.7	57.72±26.98		
AI applications enrich my professional skills	Disagree	106	40.3	68.49±25.29	3.237b	0.001
	I agree	157	59.7	57.33±28.43		
AI increases my professional roles and responsibilities	Disagree	134	51.0	57.54±27.81	-2.563b	0.011
	I agree	129	49.0	66.20±26.98		
AI reduces the workload of healthcare professionals	Disagree	55	20.9	70.70±27.85	2.716b	0.007
	I agree	208	79.1	59.43±27.24		
AI shortens the length of hospital stays	Disagree	96	36.5	67.95±27.40	2.770b	0.006
	I agree	167	63.5	58.25±27.32		
AI applications reduce medical errors	Disagree	101	38.4	69.01±27.10	3.407b	0.001
	I agree	162	61.6	57.29±27.19		
Using AI in healthcare reduces the risk of occupational accidents	Disagree	70	26.6	70.32±25.73	3.056b	0.002
	I agree	193	73.4	58.69±27.80		
The use of AI in healthcare reduces the incidence of occupational diseases	Disagree	78	29.7	70.97±27.46	3.567b	0.000
	I agree	185	70.3	57.92±26.95		
AI applications reduce healthcare costs	Disagree	122	46.4	70.64±27.04	5.040b	0.000
	I agree	141	53.6	54.13±26.00±		
AI systems make racist, sexist, and discriminatory decisions that negatively affect society	Disagree	221	84.0	59.61±27.65	-2.976b	0.003
	I agree	42	16.0	73.28±25.26		
AI is dangerous for patients	Disagree	197	74.9	59.18±28.38	-2.673b	0.008
	I agree	66	25.1	69.59±24.12		
I may be unemployed in the future because of AI	Disagree	202	76.8	57.91±26.31	-4.251b	0.000
	I agree	61	23.2	74.62±28.70		
The use of AI technologies should be regulated within the legal framework	Disagree	34	12.9	70.64±22.36	2.008b	0.046
	I agree	229	87.1	60.48±28.21		

AI Anxiety Levels of Nurses

The total mean score of t AIAS among nurses was 61.79 ± 27.70 . The mean scores for the AIAS sub-dimensions were 22.21 ± 11.96 for learning, 16.12 ± 8.37 for job replacement, 13.99 ± 7.05 for sociotechnical blindness, and 9.46 ± 5.77 for AI configuration (Table 3).

When comparing the total AIAS mean scores with nurses' descriptive characteristics, no statistically significant differences were found ($p > 0.05$). However, analysis of the sub-dimensions revealed job replacement and socio-technical blindness scores were significantly higher among women ($p < 0.05$). Additionally, nurses who reported a lack of knowledge about AI exhibited

significantly higher anxiety levels in the learning sub-dimension ($p < 0.05$). The sociotechnical blindness sub-dimension score was also significantly higher among individuals who had received AI training ($p < 0.05$), (Table 1).

Nurses who disagreed that AI would increase patient satisfaction, enhance the quality of nursing care, and reduce medical errors, occupational accidents, occupational diseases, nurse workload, patient length of hospital stay, and healthcare costs had significantly higher total AIAS scores ($p < 0.05$). Furthermore, nurses who believed that AI would be dangerous for patients, cause ethical concerns in society, increase nurses' roles and responsibilities of nurses, and lead to unemployment also had significantly higher total AIAS scores ($p < 0.05$), (Table 2).

Table 3. Descriptive statistics and indicators related to scale

	AIAS	AIAS Sub-dimensions			
		Learning	Job replacement	Sociotechnical blindness	AI configuration
n	263	263	263	263	263
Number of scale items	21	9	5	4	3
Minimum-maximum	21-147	9-63	5-35	4-28	3-21
Mean$\pm$SD	61.79 ± 27.70	22.21 ± 11.96	16.12 ± 8.37	13.99 ± 7.05	9.46 ± 5.77
Cronbach's alpha coefficient	0.953	0.941	0.914	0.921	0.918
Skewness$\pm$SD	0.256 ± 0.15	0.777 ± 0.15	0.390 ± 0.15	0.246 ± 0.15	0.653 ± 0.15

DISCUSSION

Nurses must recognize the importance of adopting AI responsibly to obtain reliable information and ensure that AI remains a beneficial technology for patient care (15). However, as AI is still an emerging technology, a lack of knowledge about its applications may contribute to anxiety and hinder its impact its effective use (16). Li and Huang (2020) identified four primary sources of AI anxiety: direct negative experiences with AI, vicarious anxiety from observing others' difficulties with AI, fear based on information about AI's potential risks, and inherent fear due to uncertainty surrounding AI technology (17).

In the present study, nurses exhibited low levels of AI-related anxiety and generally held positive opinions regarding AI technologies. The low AIAS scores observed among nurses may be attributed to their positive perceptions of AI. However, the existing literature presents mixed findings on AI-related anxiety among healthcare professionals. Cobanoglu and Oguzhan (2023) and Seren Intepeler et al. (2022) reported low anxiety levels among nurses regarding AI (4,5). In their study, Othman et al. (2021) investigated the anxiety levels of nurses who working with AI. The researchers found that 28.5% of nurses in medical units exhibited high anxiety levels, while 43.7% of nurses in critical care units experienced moderate anxiety levels (6). Similarly, studies by Filiz et al. (2022) and Menekli & Senturk (2022)

indicated moderate concerns among healthcare professionals regarding AI in healthcare, primarily due to a lack of knowledge (7,8). Furthermore, Swan (2021) reported that over 70% of nurses had heard about AI in healthcare and had generally held positive attitudes toward its integration. However, less than 10% had actually used AI in nursing practice (18).

Previous studies have reported that AI-related anxiety is higher among individuals who do not use AI (4,19). Many of these concerns stem from misunderstanding and misconceptions about what AI is and how it (20). Thus, learning about AI technologies plays a crucial role in fostering more optimistic attitudes toward AI. In the present study, while the majority of nurses reported having general knowledge of AI, only a small proportion had received formal AI training or used AI in nursing care. This discrepancy may be attributed to uncertainty regarding how AI will be integrated into clinical practices, how it will impact nursing roles and responsibilities, and whether it will alter professional workflows. Research suggests that individuals experiencing higher levels of AI-related anxiety may be more motivated to learn about AI to mitigate uncertainty (12). Therefore, education and training in AI are crucial for ensuring the effective and sustainable integration of AI in healthcare (4). AI applications require individuals to acquire new knowledge and skills to adapt to both daily life and professional settings (21). A lack of knowledge about AI can lead to fear of inadequacy,

particularly in acquiring AI-related competencies, which in turn contributes to AI learning anxiety (12). The present study found that nurses who lacked knowledge about AI exhibited higher levels of anxiety related to AI learning. This finding aligns with expectations, as previous research suggests a negative correlation between AI knowledge and anxiety levels (6). Studies have also indicated that a better understanding of AI and its applications can reduce AI-related anxiety (22,23). Therefore, education and exposure to AI technologies may play a crucial role in fostering more positive and optimistic attitudes toward AI.

The present study found that socio-demographic characteristics had no significant impact on nurses' anxiety levels related to AI. This finding is consistent with previous research by Filiz et al. (2022) and Gumus & Kasap (2022), which reported no significant differences in AI anxiety levels based on age, gender, marital status, education level, work experience, employment status or clinical department (7,24). Thus, our results further support existing literature on the subject.

Despite the prevalent notion that AI will streamline tasks, increase efficiency, reduce costs, and improve care quality, AI-based technologies also give rise to concerns about privacy, discrimination, liability, employment security, and patient safety persist (25). The present study where nurses low anxiety levels regarding AI technologies, but those who believed AI could be dangerous for patients, pose ethical challenges to society, increase nurses responsibilities or cause unemployment had exhibited significantly higher AIAS scores. Similarly, a study conducted with midwifery students found that those who believed AI would harm humanity and increase unemployment were more anxious (19).

The view is commonly held that some tasks currently performed by nurses may be increasingly undertaken by AI technologies in the near future, which is expected to result in unemployment or job displacement (23,26). This notion—that AI will replace human labor, leading to higher unemployment rates—has become widely prevalent. One factor contributing to this perspective is sociotechnical blindness, which occurs when individuals fail to recognize that AI is ultimately managed and controlled by humans. Sociotechnical blindness leads to a narrow understanding of AI as a system interacting solely with technological components, rather than one that functions within a broader social context (20). In the present study, higher levels of anxiety regarding job replacement anxiety and sociotechnical blindness were observed among women. This finding is particularly plausible, given that the majority of the study's participants were female and that 23.2% of nurses expressed concern about the possibility of future unemployment due to AI advancements. These concerns align with projections that substantial investments are being made to replace 15% of the workforce with AI-based robots by 2025, with expectations that by 2050, the number of robots is expected in use will surpass the number of computers currently in operation (27). Furthermore, studies have indicated that women generally exhibit greater unemployment anxiety compared to men (28). The

heightened concerns about job replacement and sociotechnical blindness may, therefore, act as barriers for female nurses in adopting and integrating AI technologies into patient care. This could ultimately impede the full utilization of AI's potential in healthcare settings.

Limitations

The results of this study are based on self-reported data from nurses and do not include observational data, which may limit the accuracy and depth of the findings. Additionally, since this study was conducted at a single hospital, the results may not be generalizable to other healthcare settings.

CONCLUSION

Based on the findings of this study, it can be concluded that nurses demonstrated low levels of anxiety regarding artificial intelligence and expressed generally positive views about the technology. However, their actual use of artificial intelligence in nursing care remains relatively low. It is recommended that nurses receive ongoing and structured education and training in the use of artificial intelligence applications in healthcare. Such training programs should encompass both theoretical knowledge and hands-on practice to enhance nurses' confidence and competence in artificial intelligence-driven tools. Furthermore, fostering collaboration among nurses, artificial intelligence specialists, and healthcare administrators can facilitate the integration of artificial intelligence into routine clinical practice. Enhancing nurses' understanding and proficiency with artificial intelligence can not only alleviate anxiety but also lead to improved patient outcomes, greater adoption of artificial intelligence tools, and enhanced quality of care.

Conflict of Interests

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

Financial Disclosure

The authors declare that they have received no financial support for the study.

Ethical Approval

Ethical clearance and approval letters were secured from the Institutional Review Board (IRB) of the İzmir Bakırçay University of Ethics Committee (Approval Number: 2022-808, Approval date: 21.12.2022).

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