

NURSE READINESS TO USE ARTIFICIAL INTELLIGENCE IN PATIENT CARE: A SYSTEMATIC REVIEW AND META-ANALYSIS

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Abstract

Aim: This meta-analysis explores the readiness of registered nurses to apply artificial intelligence (AI) in patient care.

Background: AI will revolutionize the healthcare industry by enabling the provision of personalized, accurate, and innovative care to patients. AI will be an increasingly mandatory tool in the industry as it continues to be adopted for various purposes. Despite its importance, however, research on nurses' readiness to adopt this technology is scarce. This study examines nurses' readiness to utilize AI in patient care settings.

Materials and methods: Eligible studies were identified by conducting a systematic review based on the Preferred Reporting Items for Systematic Reviews and Meta-Analysis statement. Only quantitative peer-reviewed journal articles published between 2020 and 2024 were included in the study. The Cochrane Risk of Bias Tool for Randomized Trials and the Critical Appraisal Skills Program were used for quality assessment.

Results: Five studies were included in the meta-analysis, reporting the responses of 1,229 nurses and other healthcare professionals. The main outcomes for evaluating the readiness of nurses to use AI were perception and attitude. A statistically significant mean difference was found to separate positive perception from negative perception, which had a lower score. A nonsignificant mean difference was found to separate positive attitude from negative attitude, which had a lower score (mean difference [MD]: 0.92, 95% confidence interval [CI]: 0.41–1.42, P: .0004; MD: 0.60, 95% CI: -0.19–1.38, P: .14).

Conclusion: The nurses' perceptions of and attitudes towards applying AI in nursing practice were highly positive. A positive perception of and attitude toward technology adaptation are vital to improving patient care. The findings from this study and similar research will be critical in determining future healthcare policies and initiatives based on best practices. However, there is a need to implement more AI training and education programs to ensure that practicing nurses and nursing students can gain the skills necessary to successfully leverage AI in healthcare.

Keywords: artificial intelligence, patient care, meta-analysis, nurses

Introduction

Artificial intelligence (AI) has emerged as an essential disruptive technology, especially in the healthcare industry. AI is revolutionizing patient care delivery, enhancing clinical outcomes, and enhancing workflows in healthcare (1–3). One of the central goals of nursing is to ensure compassionate, evidence-based care for patients across diverse clinical settings (4,5). As frontline healthcare providers, nurses must be prepared to adopt any technology that improves overall patient outcomes. Thus, the integration of AI into nursing is inevitable. Therefore, there is a need to evaluate nurses' readiness to adopt AI to ensure its successful implementation in the healthcare industry (6,7).

This study adopts a meta-analytical approach to examine registered nurses' readiness to embrace AI use in patient care. The study synthesizes existing evidence and insights obtained from carefully selected peer-reviewed research. The meta-analysis comprehensively explores nurses' perspectives on, attitudes toward, and experiences with AI adoption in diverse regions globally. This study rigorously adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines, ensuring methodological transparency and reproducibility.

The eligibility criteria included peer-reviewed journal articles published from 2020–2024 in English that addressed registered nurses' perspectives on AI implementation in patient care settings. Quantitative studies were prioritized to ensure efficient data synthesis and alignment with the study's objectives.

The study results were informative concerning several critical themes, such as the nurses' positive attitudes towards AI, its perceived benefits, and barriers to its implementation. The results highlight the need for education and training on AI for nurses, AI incorporation in the nursing studies curriculum, and interdisciplinary collaboration to effectively integrate AI into nursing care delivery.

Background

The importance of AI is increasingly recognized in healthcare due to its potential to improve the field through accurate, personalized, and innovative solutions (8). In its initial phase of adaptation, the medical community has grown enthusiastic about AI integration, with its vast potential for improving clinical outcomes and enhancing efficiency in healthcare settings (9,2,3). Despite the growing enthusiasm, however, research on the perspectives of different stakeholders on AI use in healthcare is limited (10).

The differing perspectives on AI application in healthcare drive the enthusiasm for its implementation. Besides its perceived benefits, AI implementation in healthcare faces many challenges, such as data privacy concerns, regulatory compliance issues, and ethical considerations (8,11). To ensure the adoption of evidence-based care in the context of AI implementation, researchers must fill the gap in understanding nurses' perceptions of its implementation (12). Studies should concentrate more on AI's transformative potential in increasing productivity and introducing innovative delivery methods and consider other perspectives on its implementation (9).

Furthermore, AI implementation in healthcare faces additional challenges, such as data quality issues and uncertainty about its appropriate applications (13–15). Economic evaluations indicate that AI enhances medical quality and generates cost-saving approaches, especially in complex fields such as ophthalmology (16).

To ensure the full realization of the benefits of AI, it is crucial to address the barriers to its implementation. Some of the barriers identified in previous studies include workforce upskilling, ethical considerations, and the difficulty of effectively using AI technologies in real-world settings (17,18). All of these barriers directly pertain to healthcare professionals' readiness for AI adaptation.

AI is increasingly involved in healthcare, with tools such as fuzzy expert systems, Bayesian networks, artificial neural networks, and hybrid intelligent systems applied in clinical settings to enhance care delivery (19). Advanced systems are also being developed, such as deep-learning AI systems, which could perform tasks such as disease screening and workflow automation (20,21). AI's impact in the healthcare sector will, therefore, spread across diverse specialties, holding immense potential for enhancing clinical care, predicting risks, and streamlining the entire healthcare workflow (22,23).

Nurses face serious challenges in AI integration, such as ethical considerations, the need to adapt to new technologies, and the impact of these tools on nursing roles (24,25). As AI implementation advances, nurses must acquire the knowledge and skills necessary to leverage AI tools effectively (22,26). Research suggests that emotional intelligence improves nurses' interactions with AI, influencing patient care quality and nurses' ability to adapt to its use (27,28).

Against this background, our meta-analysis explored nurses' readiness to adopt AI. The study fills critical gaps in the research on the knowledge, skills, and attitudes necessary to effectively utilize AI in patient care settings. By assessing nurses' preparedness and identifying essential areas for improvement, the study informs strategies to enhance the integration of AI in nursing.

Hopefully, the study will encourage additional research in the area, thereby improving patient care quality, safety, and outcomes through AI-based care.

Aim

The primary aim of this study was to investigate the readiness of registered nurses to adopt AI in their patient care practices.

Research Question

This meta-analysis investigated the readiness of registered nurses to adopt AI in patient care, as described above. The study adopted a quantitative approach to fulfill this goal. The meta-analysis examined group comparisons and descriptions of nurses' experiences in the context of AI application. A straightforward research question is critical in conducting a systematic literature review. The team members who examined the selected peer-reviewed articles thus reported on the readiness of registered nurses based on a straightforward question: What is the preparedness of registered nurses to apply AI in nursing patient care?

PICOS

Population: The population studied was staff nurses.

Intervention: The application of artificial intelligence in nursing patient care was our focus.

Comparison: Conventional nursing patient care served as the control group for comparison.

Outcomes: Perception and attitude were used to assess the nurses' level of readiness.

Study Design: The inquiry was designed as a quantitative study.

Methods

Meta-Analysis Framework

The study adopted a meta-analytical approach to examine the readiness of registered nurses to integrate AI into patient care. Ahn and Kang (29) described meta-analysis as the systematic aggregation and statistical synthesis of the findings of different studies to increase our understanding of complex issues. Through a synthesis of existing evidence, our meta-analysis provides critical insights into the readiness of registered nurses and sheds light on gaps and areas for improvement.

Adherence to PRISMA Guidelines

By adhering to the PRISMA approach, we ensured explicit, systematic procedures throughout the study's methodology. PRISMA provides a standard framework for conducting systematic reviews and meta-analyses. By using the framework, we ensured transparency, reproducibility, and methodological rigor in the study (Figure 1).

Eligibility Criteria

One of the most crucial aspects of a meta-analysis is selecting eligibility criteria. Establishing proper eligibility criteria to select relevant studies determines the quality of the entire survey. In this case, the eligible studies were peer-reviewed journal articles published between 2020 and 2024 in English. The papers were focused on registered nurses' perspectives, such as their perceptions of and attitudes toward adapting AI in the nursing patient care setting. The analysis prioritized quantitative studies to ensure efficient data synthesis and statistical analysis that aligns with the study's objectives.

Literature Search Strategy

A systematic literature search strategy was enacted by leveraging the tools available on online libraries, such as filters and keywords. The search strategy was applied in established databases including PsycINFO, PROQUEST, EMBASE, PubMed, and Web of Science. The search included Boolean operators at the top of the keywords, ensuring that critical and relevant studies were captured. The search involved a supplementary review of the reference lists in the studies already identified to find overlooked yet relevant sources.

Study Selection and Data Extraction

After compiling the studies in the literature search stage, the study selection and data extraction stage adopted the Cochrane Collaboration's systematic review methodology (30). As part of this methodology, we used Covidence systematic review software (31), which helps reviewers assess studies at different screening stages. Discrepancies may arise in different stages, including the review of titles, abstracts, and full texts. Therefore, manual and automated checks were employed to remove duplicate studies and ensure the integrity and accuracy of the data (Table 1).

Decision-Making and Reporting

To ensure proper coordination in the research process, any study that might be questioned was included or excluded through collaborative decisions. This approach prioritized inclusivity and consensus building among the research team members. The excluded studies were, however, documented with a clear description of the reasons they were excluded. This approach adheres to established reporting guidelines.

Quality Assessment

The Critical Appraisal Skills Program (CASP) was used to assess the quality of the search strategies, selection criteria, study selection trustworthiness, and relevance of the studies. A matrix was developed to summarize each study's details and overall findings.

Meta-Analysis Results

Several themes emerged from the selected studies' similarities and differences. Generally, there was a positive attitude toward AI across the studies. This positive attitude was spread across organizational levels and disciplines. Nursing students, nurses, nurse leaders, and other healthcare professionals reported positive attitudes toward implementing AI in patient care. However, the studies also discovered limited AI knowledge (33). This limited knowledge is the result of a lack of proper adaptation of AI in nursing studies and other training programs in healthcare institutions.

Despite their limited knowledge, the participants in all five studies believed that AI will enhance patient care and healthcare delivery (32-36). All studies also identified barriers to AI adaptation, such as a lack of access to AI technologies, a lack of proper training, and concerns about losing jobs or role changes due to AI.

Data Synthesis and Analysis

To manage the resulting data, Review Manager (Revman) statistical software was used. The data analysis varied according to the outcomes of the included studies (ordinal data, continuous data, dichotomous/binary data, counts, and time-to-event data). The search results are reflected in the PRISMA flow diagram.

Analysis Plan

The data were analyzed using Review Manager. The averages and standard deviations of the responses of those who completed the questionnaires were computed to assess their perceptions and attitudes. Cochran's Q test and I² statistics were used to assess the heterogeneity between the studies. If the P-value on Cochran's Q test was not significant and the I² statistic was less than 50%, a fixed-effects model was applied. Otherwise, a random-effects model would be suitable. The outcome was a forest plot and funnel plot for each category, i.e., perception of AI use and attitude toward AI use. Mean differences are also reported for each of these categories (Tables 2 and 3).

Data Preparation

Since all studies evaluated data on a Likert scale, a cutoff point of 3.20 was used to make comparisons in the meta-analysis: scores lower than 3.20 were considered negative perceptions, and scores higher than 3.20 indicated positive perceptions. Seventy-four items were used to assess the nurses' perceptions of AI use. The negative items concerned the possibility that AI's capacities may be superior to those of humans, the threat of job loss, lack of knowledge, AI not being flexible, AI use being difficult, the ability to sympathize, the technology being developed by a specialist with little clinical experience, the time necessary to learn AI, ethical issues with AI, and not having access to the relevant AI tools to help with the learning process. For attitude, a cutoff point of 3.31 or less was considered

to indicate a negative attitude, and a value higher than 3.31 signified a positive attitude. Thirty-three items were used to measure the attitudes of the nurses toward AI application. The negative items concerned AI's negative effects on nurse well-being, the dangers of AI, ethical issues, the technology's capacity to undermine human decisions, the possibility that it performs worse than humans, the chance that it will only be beneficial to organizations and not employees, the lack of human interaction, the possibility that AI might be sinister or take control over nurses, errors caused by the technology, and the fear that nurses might be harmed by the technology (Tables 2 and 3).

Results

Study Characteristics

Most studies explored nurses' attitudes toward and perceptions of implementing AI in their practice. Sommer et al. (37) investigated AI implementation in nursing in Bavaria, Germany. Shinnars et al. (35) used the Shinnars Artificial Intelligence Perception questionnaire to evaluate nurses' perceptions of AI. Labrague et al. (32) investigated AI implementation in nursing education. Elsayed (34) investigated nurse managers' perceptions of and attitudes toward AI use in Mansoura University Hospitals. Combined, the studies obtained responses from 1,229 nurses and other healthcare professionals (32- 35,37). Al-Sabawy (33) revealed that 42.7% of the nurses learned about AI from informal sources. At the same time, 23.2% had no prior knowledge of AI. Most of the nurses exposed to AI had embraced it, with findings from all studies being above 50%. Significant limitations that cut across most of the studies included a lack of generalizability and reporting bias (32-35, 37) (Table 1).

The forest plot includes 5 studies with 74 total items in the fixed effects model. A significant mean difference was attributed to positive perception, which had a higher mean score than negative perception (mean difference [MD]: 0.92, 95% confidence interval [CI]: 0.41–1.42, P: 0.0004) (Figure 2).

A funnel plot indicated that there was no publication bias since the studies selected were distributed equally around the curve (Appendix 2).

For attitude, a fixed model was used. Only two of the five studies were included in the plot, for a total of 33 items. The mean difference was found to favor a positive attitude toward the application of AI in patient care [MD: 0.60, 95% CI: -0.19–1.38, P: .14] (Figure 3). Here again, a funnel plot revealed no publication bias (Appendix 3).

Figure 1: PRISMA flowchart

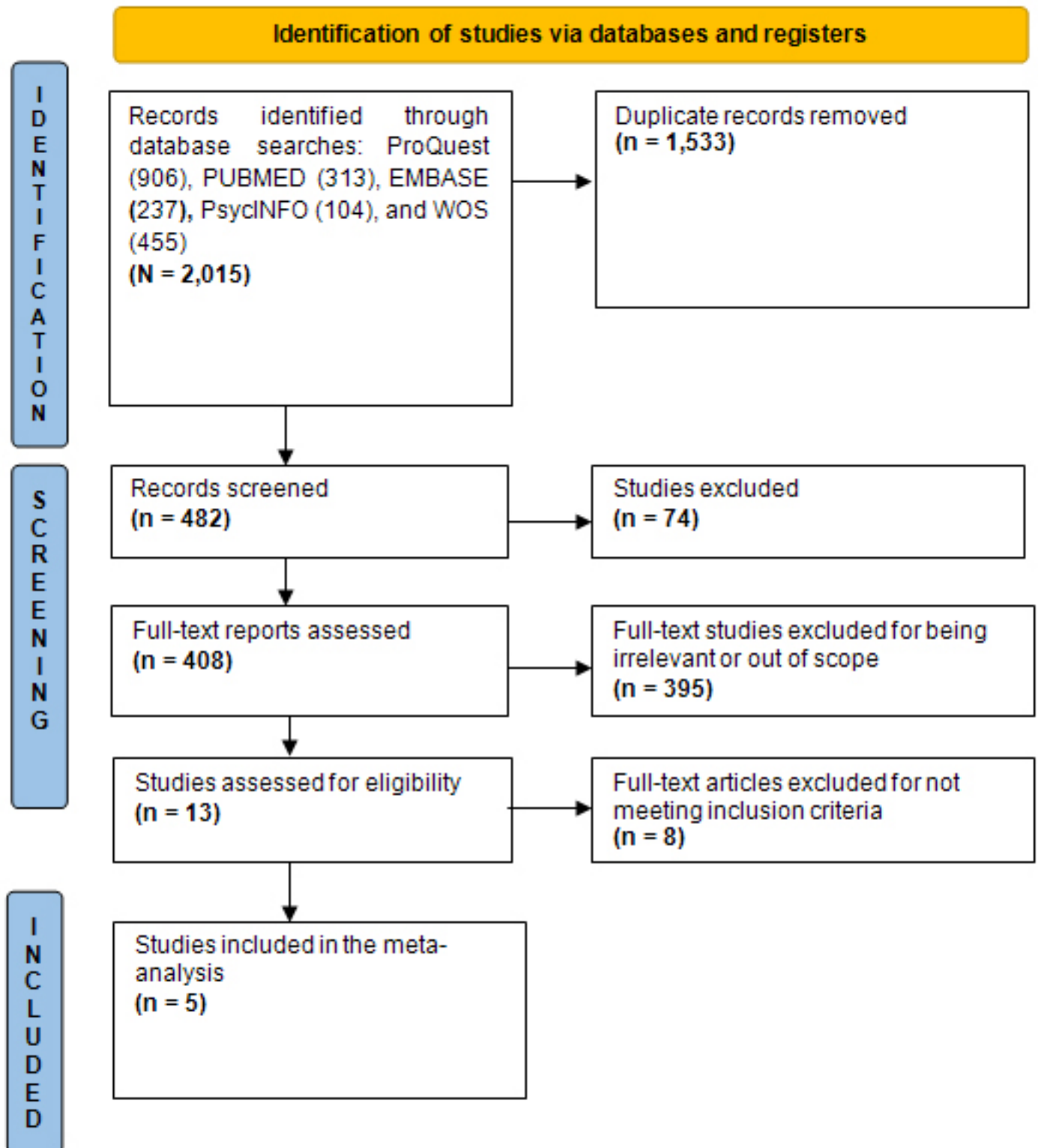


Table 1. Study characteristics and CASP scores

Study	Aims/objectives	Method	Participants	Key Findings	Limitations	CASP Score
Al-Sabawy, M. R. (2023)	Explore nurse attitudes and perceptions regarding the implementation of artificial intelligence in nursing practice	Cross-sectional exploratory survey	410 nursing professionals in various departments in Kirkuk	- 42.7% of nurses learned about AI from informal sources - 23.2% of nurses did not know about AI - Most nurses expressed positive views on using AI in daily life and job functions	- Limited generalizability since the participants were all from Kirkuk - Potential for response bias due to self-reporting	9/9
Elsayed, W. A., & Sleem, W. F. (2021)	Assess nurse managers' perceptions and attitudes regarding the adoption of AI at Mansoura University Hospitals in healthcare contexts	Cross-sectional descriptive research design using two questionnaires	130 nurse managers from Mansoura University Hospitals	- A positive attitude overall among managers toward AI - Nurse managers perceived AI to have more benefits than challenges	- The sample size and sampling methods limit generalizability - Potential response bias due to self-reported data	9/9
Labrague, L. J., Aguilar-Rosales, R., Yboa, B. C., & Sabio, J. B. (2023)	Study nursing student readiness to adapt AI in their education. The study also explores the students' exploration of AI-associated struggles, including perceived barriers of access to AI technology	Cross-sectional design using a structured questionnaire for data collection	323 nursing students enrolled at public nursing schools in the Philippines	- Moderate readiness for barriers to students accessing and using AI technologies - The main barriers to accessing AI technology include a lack of AI knowledge, limited awareness, time constraints, and limited skills in computing, which make it challenging to utilize AI tools	- Limited generalizability - Reliance on self-reported data - Limited ability to establish causality	9/9
Shinners, L., Grace, S., Smith, S., Stephens, A., & Aggar, C. (2022)	The study psychometrically evaluated and piloted the Shinners Artificial Intelligence Perception (SHAIIP) questionnaire. The tool is used to explore healthcare professionals' perceptions of AI	Cross-sectional design adopting a 5-point Likert scale on one item of the SHAIIP questionnaire	252 healthcare professionals from a regional health district in Australia	- AI significantly influenced healthcare professionals' perceptions of and preparedness for its implementation in healthcare - Different professionals had differing perceptions on implementing AI, with nurses embracing AI more than other healthcare professionals	Lack of clarity on the effects of socio-economic factors and geographic location on the results	9/9

<p>Georgadarellis et al. (2024)</p>	<p>Investigates the long-term impact of education on nurses' perceptions</p> <p>Captures the differences in perceptions and highlights the insights of nursing students, faculty, and professionals before and after learning about robotic technology for nursing care.</p>	<p>Pretest/post test surveys</p>	<p>118 nurses</p>	<ul style="list-style-type: none"> - Incorporated robotics education in nursing curricula - Frontline nursing knowledge must be incorporated throughout the design process to implement functional changes to create user-friendly, effective technology that improves patient care and nurse job fulfilment 	<p>Limited generalizability</p>	<p>9/9</p>
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Item\Study	Al-Sabawy, M. R. (2023)	Elsayed et al. (2021)	Labrague et al. (2023)	Shinners et al. (2022)	Georgadarellis et al. (2024)
1. Was the research question clearly stated?	Yes	Yes	Yes	Yes	Yes
2. Was the study design appropriate for the research question?	Yes	Yes	Yes	Yes	Yes
3. Were the participants recruited in a manner that minimized bias?	Yes	Yes	Yes	Yes	Yes
4. Was the exposure accurately measured to minimize bias?	Yes	Yes	Yes	Yes	Yes
5. Were the outcomes accurately measured to minimize bias?	Yes	Yes	Yes	Yes	Yes
6. Was there an appropriate control group or comparison?	Yes	Yes	Yes	Yes	Yes
7. Was the follow-up of participants complete and long enough?	Yes	Yes	Yes	Yes	Yes
8. Was the study conducted ethically?	Yes	Yes	Yes	Yes	Yes
9. Are the results of the study valid?	Yes	Yes	Yes	Yes	Yes

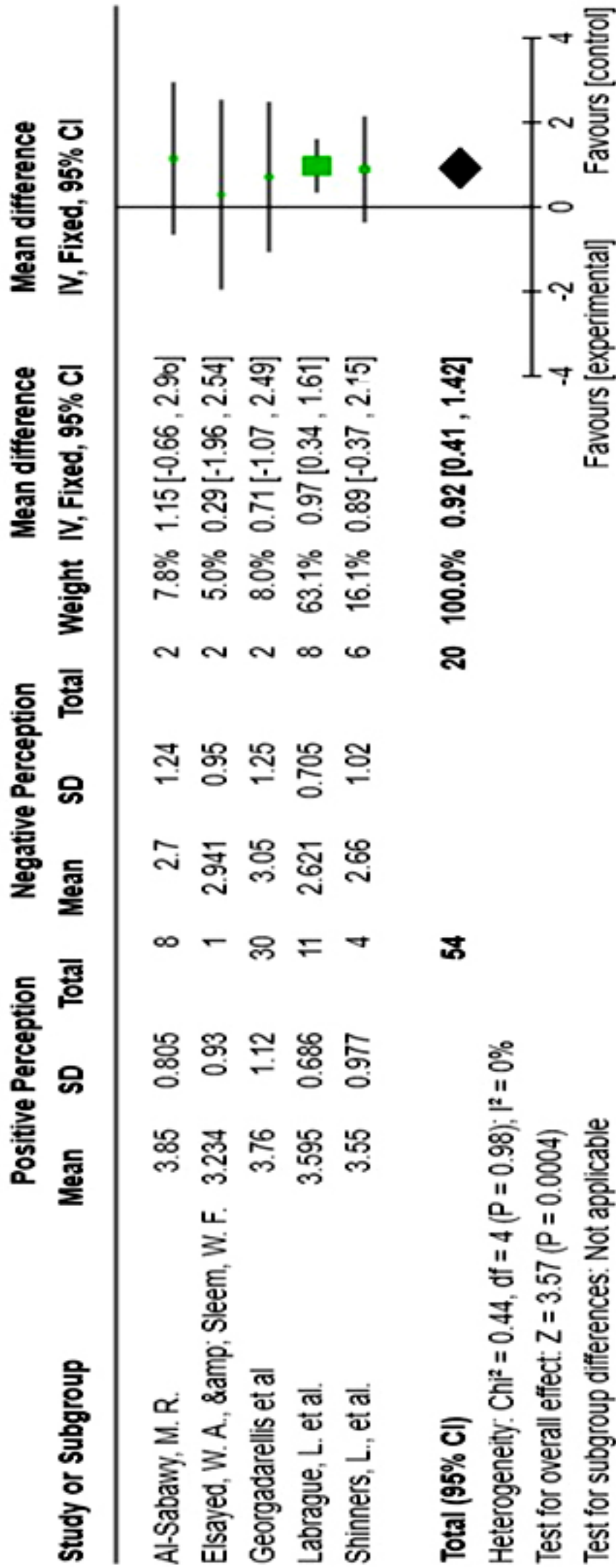


Figure 2. Perception: forest and funnel plots

Table 2. Perception: data transformation

Study ID	Total items in survey	Total mean \pm SD	Positive perception	Number of items	Item topics	Negative perception	Number of items	Item topics
Al-Sabawy, M. R. (2023)	10	3.6 \pm 0.877	3.8 \pm 0.805	8	AI offers speed, high hopes, less error, importance, unique solutions	2.7 \pm 1.24	2	Job loss and superiority to humans
Elsayed, W. A., & Sleem, W. F. (2021)	3	2.85 \pm 0.998	3.2 \pm 0.93	1	AI reduces medical errors, speeds up processes, and offers higher quality	2.9 \pm 0.95	2	Lack of knowledge of AI, superiority to humans, job loss, no hope in helping the health sector, difficulty, inflexibility, no sympathy, many limitations, developed by nonexperts in medical care
Labrague, L. J. et al. (2023)	19	2.94 \pm 0.69	3.595 \pm 0.686	11	Perceptions of specific possible applications of AI in nursing practice	2.62 \pm 0.705	8	Lack of AI knowledge and access to AI tools, lack of support at school
Shinners, L. et al. (2022)	10	3.02 \pm 1.0009	3.555 \pm 0.977	4	AI will improve patient care, improve clinical decision-making, and complement the role of medical professionals	2.66 \pm 1.02	6	AI will not reduce costs, health professionals are not ready, job losses, ethical issues, error
Georgadarellis et al. (2024)	32	3.40 \pm 1.18	3.76 \pm 1.12	30	AI can assist in surgery, diagnosis, cleaning, telepresence, delivery; assistive, total summated	3.05 \pm 1.25	2	AI is not helpful in surgical environments or as a companion

Figure 3. Attitude: forest and funnel plot

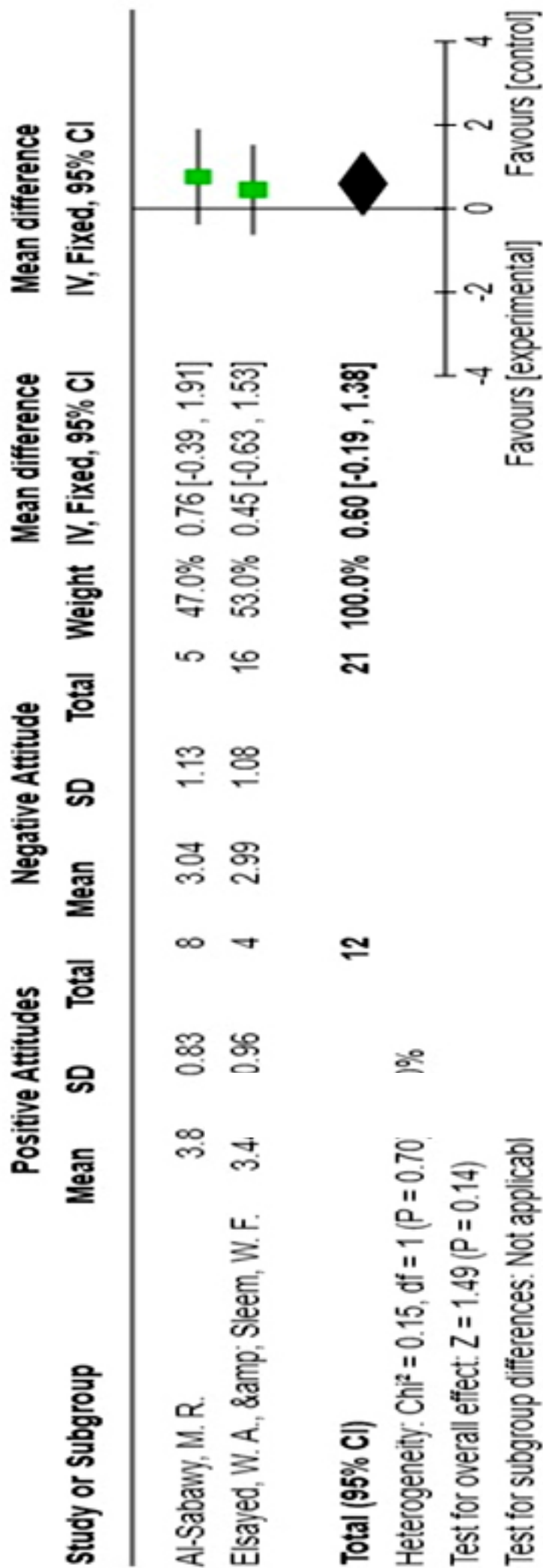


Table 3. Attitude: data transformation

Study ID	Total Items used in survey	Total Mean \pm SD	Positive attitude	Number of items	Item topics	Negative perception	Number of items	Item topics
Al-Sabawy, M. R. (2023)	13	3.60 \pm 0.39	3.80 \pm 0.83	8	Interesting, beneficial, economic opportunities, makes tasks easier, impressive results	3.04 \pm 1.13	5	Negative impact on nurse well-being; AI is dangerous, unethical, undermines human decisions
Elsayed, W. A., & Sleem, W. F. (2021)	20	3.09 \pm 1.26	3.44 \pm 0.96	4	Beneficial, exciting, economic opportunities, positive impacts	2.99 \pm 1.08	16	Does not perform better than human, only beneficial to organizations, no human interaction, unethical, dangerous, sinister, will take control over nurses, error, nurses might suffer

Discussion

Implications for Nursing and Health Policy

The findings from this study and similar research will be critical in determining future healthcare policies and initiatives based on best practices. A positive attitude toward technology adaptation among nurses is vital to improve patient care. There is a need to incorporate more training and AI education programs to ensure that practicing nurses and nursing students can gain the necessary skills to leverage AI in healthcare successfully.

Incorporating Shinnars (36) into the meta-analysis was vital because it acknowledges the importance of collaboration between nurses and other healthcare professionals in implementing AI in patient care. To ensure the implementation of evidence-based solutions, every healthcare professional should be engaged in knowledge exchange and policy formulation, which will advance the adoption of AI in nursing practice.

Limitations of the Study

Despite providing valuable insights into nurses' readiness to adopt AI in patient care, this study has a few potential limitations that should be acknowledged. The first is selection bias by virtue of the exclusion criteria, which only allowed studies between 2020 and 2024. The second issue is reliance on self-reported data in some studies, which could lead to response bias, affecting the accuracy of the results. Finally, the meta-analysis mainly focused on nurses' perspectives without mentioning other stakeholders, such as patients. Despite these limitations, the analysis offers insight into nurses' readiness for AI adoption.

Conclusion

This meta-analysis offers crucial information on the readiness of nurses across diverse regions globally to adopt AI in nursing patient care. The findings indicate the need to solve specific issues to increase the effective integration of AI into nursing. Investment in AI education and training is crucial to empowering nurses to embrace AI. Ensuring interdisciplinary collaboration in implementing AI solutions is essential to maintain evidence-based practices. Research into the effective implementation of AI in nursing can provide a model for future work on the adoption of other technologies.

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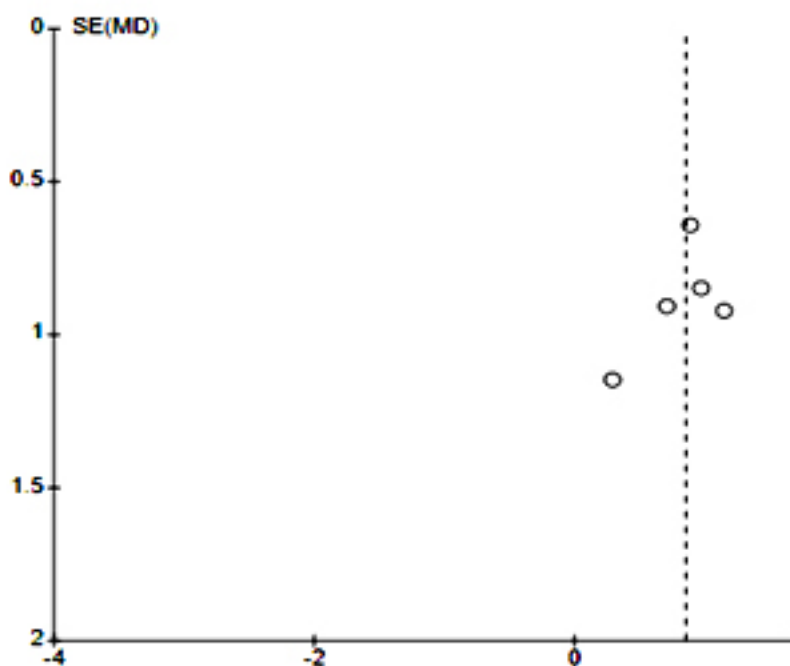
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Appendix 1. CASP Criteria

1. Was the research question clearly stated?
2. Was the study design appropriate for the research question?
3. Were the participants recruited in a manner that minimizes bias?
4. Was the exposure accurately measured to minimize bias?
5. Were the outcomes accurately measured to minimize bias?
6. Was there an appropriate control group or comparison?
7. Was the follow-up of participants complete and long enough?
8. Was the study conducted ethically?
9. Are the results of the study valid?

Appendix 2. Funnel plot representing perception of AI



Appendix 3. Funnel plot representing attitude toward AI use

