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Investigating Research Skills and Artificial Intelligence Attitudes Among Residents in Surgical Medicine Departments

Göksever Akpınar [1] *, Sercan Kantarcı [2]

[1] Department of General Surgery, Tepecik Education and Research Hospital, University of Health Sciences, İzmir, Türkiye,
0000-0002-0648-7767
[2] Department of Obstetrics and Gynaecology, Tepecik Education and Research Hospital, University of Health Sciences, Izmir, Türkiye,
0000-0001-5608-060X
* Corresponding author: Göksever Akpınar (gokseverakpinar@hotmail.com)

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Abstract

This research aims to examine the relationship between scientific research skills and attitudes towards artificial intelligence among residents in surgical medicine departments, considering gender and seniority. A quantitative research approach with a comparative correlational survey model was adopted; data was collected via online questionnaires from 127 surgical residents in training and research hospitals and university public hospitals in Ankara, Konya, and İzmir provinces. The findings revealed that participants' scientific research skills were at a moderate level, while their attitudes towards artificial intelligence were at a high level. Male participants showed significantly higher scientific research skills compared to their female peers, while no gender-based difference was found in attitudes towards artificial intelligence. As seniority increased, scientific research skills also increased significantly; however, attitudes towards artificial intelligence did not change with seniority. Regression analysis showed that attitudes towards artificial intelligence did not significantly predict scientific research skills. Based on these results, it is recommended to strengthen research methodology training in the early stages of specialist training, to investigate the causes of gender inequality using qualitative methods, to integrate artificial intelligence tools into the curriculum, and to expand the study to include a wider sample and different disciplines.

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Introduction

Medical specialization training constitutes the most critical link in postgraduate medical education, and at this stage, doctors are expected to develop both their clinical decision-making skills and their scientific thinking capacity (Mokhtari et al., 2024). Acquiring research skills in this process is of great importance not only for individual professional development but also for the dissemination of evidence-based practices for public health (Aneese et al., 2019). Doctors with high research competence are observed to adopt a more systematic and critical approach in clinical decision-making processes (Mohr et al., 2015). Accordingly, many medical faculties and specialization training programs are integrating medical education and scientific research components into their curricula (Livinți et al., 2021). Therefore, the role of research skills in the specialization training process and how these skills can be developed are increasingly being studied in the medical education literature (Wood et al., 2018; Woo et al., 2024).

In today's healthcare environment, where digital transformation is accelerating, artificial intelligence technologies have become an integral part of medical research and practice (Charow et al., 2021; Tolentino et al., 2024). AI has the potential to fundamentally transform healthcare services through the opportunities it offers in areas such as medical image analysis, clinical decision support systems, and big data processing (Lee et al., 2021). In this context, research on AI literacy and attitudes towards these technologies among surgical residents is increasing internationally (Mousavi Baigi et al., 2023; Rjoop et al., 2025). The relevant literature emphasizes that attitudes towards AI may differ according to professional training level, specialization area, and individual research experience (Heinrichs et al., 2025; AlZaabi et al., 2023). In this context, preparing medical education for the integration of artificial intelligence is directly related not only to raising technological awareness but also to reinforcing critical thinking and research skills (Civaner et al., 2022). Therefore, revealing the relationship between attitudes towards artificial intelligence and research skills is important for medical education policies.

Problem Statement

The inadequacy of research skills among surgical residents is considered one of the most significant problems in postgraduate medical education (Mokhtari et al., 2024). It is known that the vast majority of these students feel inadequate in research methodology, statistics, and scientific writing, while clinical intensity significantly restricts the time allocated to research (Carter et al., 2019). In addition to this problem, research self-efficacy is also seen as a determining factor. Relevant studies show that students with low research self-efficacy have significantly more limited scientific productivity (Livinți et al., 2021; Nyinge et al., 2024; Woo et al., 2024). However, it is observed that not only individual competencies but also institutional research culture and mentor support directly shape the research behavior of residents (Mohr et al., 2015). In this context, identifying deficiencies in research skills is a necessary first step for effectively restructuring educational programs (Özcan & Polat, 2023; Wood et al., 2018). Therefore, determining the research skills profile of surgical residents based on multidimensional measurements fills an important gap in this field.

It has been observed that surgical residents can simultaneously perceive artificial intelligence as both a potential

workforce threat and a tool that increases clinical efficiency (Pawelczyk et al., 2024; St John et al., 2024). However, it is seen that whether these students are ready to use artificial intelligence tools has not been sufficiently investigated, and most of the existing studies are limited to medical school students (AlZaabi et al., 2023; AlZaabi & Masters, 2025; Vosoughmatin, 2025). The relevant literature emphasizes that doctors' attitudes are decisive in the adoption of clinical decision support systems and AI-based diagnostic tools, and that these attitudes are directly linked to professional experience and education (Civaner et al., 2022; Khairat et al., 2018; Kouri et al., 2022). In this context, the relational pattern between attitudes towards artificial intelligence and research skills has not been systematically examined specifically within the context of medical specialization training.

The Gap in the Literature and the Importance of the Research

When examining research in medical education, it is observed that studies addressing research skills and attitudes towards artificial intelligence separately occupy a significant portion of the literature. However, studies that examine these two phenomena together on a relational basis, specifically in the context of residents in surgical medicine departments, remain limited (Mousavi Baigi et al., 2023; Tolentino et al., 2024). While a significant portion of studies focusing on attitudes towards artificial intelligence have been conducted with medical students, nursing students, or general practitioners, findings reflecting the unique dynamics of residency training remain quite limited (Abou Hashish & Alnajjar, 2024; Allam et al., 2024; Pinto Dos Santos et al., 2019). Furthermore, the vast majority of studies on research skills have focused on measurement tools and program evaluation, leaving the question of how research skills relate to individual attitudes in the background (Livinți et al., 2021; Wood et al., 2018). In this context, efforts to close this gap constitute a critical contribution to both medical education policies and discussions on the integration of artificial intelligence.

In the specific case of Turkey, the effective integration of artificial intelligence into medical specialty training depends on concretely measuring students' current attitudes and readiness levels (Civaner et al., 2022). In this regard, revealing the relationship between research skills and attitudes towards artificial intelligence will provide a valuable data source for educational planners, showing which student groups can benefit most from AI training and how this training can be personalized. Indeed, understanding the interaction between professional competence and attitudes towards technology adoption is crucial for developing digital transformation strategies for healthcare professionals. Investigating the moderating roles of sociodemographic variables such as specialty area, years of education, and gender on this relationship will increase the generalizability and explanatory power of the findings (Pawelczyk et al., 2024). In this context, the study is expected to create a unique knowledge base that will lay the groundwork for a holistic educational approach for surgical residents.

Research Skills in Medical Specialty Training

Research skills encompass complementary sub-competencies such as critically reading and evaluating scientific literature, formulating research questions, selecting appropriate methodologies, data analysis, and scientific writing (Aneese et al., 2019). Systematic reviews and meta-analyses have shown that evidence-based medicine components integrated into the curricula of residency programs significantly improve the research competencies

of resident doctors (Wood et al., 2018; Mohr et al., 2015). However, the relevant literature emphasizes that research skills should be reinforced not only through theoretical training but also through active research participation and mentorship support (Carter et al., 2019). Therefore, research skills should be positioned not only as a curriculum element in the design of residency training but also as an integral part of professional identity development (Aneese et al., 2019; Mokhtari et al., 2024). For this reason, adopting a systematic program approach in acquiring research skills is a decisive factor in terms of the quality of education.

The concept of research self-efficacy expresses an individual's belief in their ability to successfully complete research processes and is considered a strong predictor of research behavior (Livinți et al., 2021). In this context, studies conducted on doctoral students and researchers in the health sciences consistently show a positive and significant relationship between research self-efficacy and research productivity (Woo et al., 2024). Similarly, it is observed that individuals with low research self-efficacy among surgical residents avoid participation in research activities and lag behind in scientific production (Mokhtari et al., 2024). Accordingly, providing structured experiences in residency training programs aimed at increasing research self-efficacy will also positively support the academic identity development of individuals (Carter et al., 2019). In this context, the quality of the research training environment, the quality of the student-advisor relationship, and positive feedback loops also stand out as effective variables in strengthening self-efficacy (Livinți et al., 2021).

When evaluating the attitudes and challenges of surgical residents towards research, it is observed that students understand the importance of research for their professional development, but they face structural obstacles such as time constraints, inadequate methodological preparation, and lack of mentor support (Aneese et al., 2019). In this context, it is understood that residents, especially those working in intensive clinical rotations, may neglect their research responsibilities, and academic motivation shows significant differences depending on the semester and specialty area (Carter et al., 2019; Wood et al., 2018). It is thought that restructuring evidence-based medical education plays a critical role in overcoming these difficulties; in particular, the inclusion of supervised clinical research experiences and statistical applications in the curriculum has been observed to yield positive results (Mohr et al., 2015). Studies report that student participation and publication output significantly increase in models where research skills are taught in an integrated manner with clinical practice (Carter et al., 2019). Therefore, it is crucial to consider research skills not merely as a specialization requirement, but as the foundation of a learning culture that a physician will maintain throughout their entire professional life.

Integration of Artificial Intelligence Technologies into Medical Education and Research

The integration of artificial intelligence into medical education has gained importance in recent years, and many medical schools and specialty programs are beginning to include AI literacy in their curricula (Lee et al., 2021; Paranjape et al., 2019). Research shows that consensus frameworks are being developed for the inclusion of AI competencies in medical curricula; these frameworks are seen to encompass data literacy, algorithmic thinking, and AI ethics as key components (Ang, 2025; Çalışkan et al., 2022). When examining the integration of AI into medical research processes, it is seen that this technology is beginning to be used in a wide range of applications, from literature review and data analysis to image interpretation and clinical decision support systems (Michel et

al., 2021; Fischer et al., 2023).

When evaluating the factors influencing the adoption of clinical decision support systems and machine learning-based diagnostic tools in healthcare, it is understood that users' level of knowledge and attitudes towards technology play a decisive role (Khairat et al., 2018; Kouri et al., 2022). In this context, the integration of artificial intelligence tools into research processes is directly related not only to the technical infrastructure but also to the researchers' readiness level for these tools (Pumplun et al., 2021; AlZaabi & Masters, 2025). Various qualitative studies report that professional training level, area of expertise, and institutional incentive mechanisms are effective in the adoption of AI-supported research tools (Fischer et al., 2023; Pumplun et al., 2021). Furthermore, it is observed that this integration brings with it ethical, confidentiality, and accountability dimensions, and these concerns can negatively affect the adoption of artificial intelligence, especially in clinical applications (Çalışkan et al., 2022; Michel et al., 2021). Accordingly, it is believed that surgical residents who can successfully integrate artificial intelligence into their research processes can gain significant advantages in terms of both their scientific productivity and critical thinking skills.

Attitudes and Usage Trends of Artificial Intelligence Among Doctors Undergoing Specialty Training

Attitudes towards artificial intelligence among healthcare professionals and medical students have been extensively studied in different countries and specialties in recent years (Mousavi Baigi et al., 2023; Lambert et al., 2023). Findings from these studies reveal that, in general, attitudes towards AI are moderately positive; however, concerns, uncertainty, and ethical anxieties also play a significant role (Pinto Dos Santos et al., 2019). Multicenter studies conducted with medical students and resident doctors show that while there is a widespread belief that AI can contribute to diagnostic and treatment processes, concerns about potential threats to professional roles cannot be ignored (Rjoop et al., 2025; Sit et al., 2020). In this context, it is noteworthy that attitudes differ according to specialty; AI applications in fields such as radiology and surgery show both positive and negative attitudes more sharply (Pawelczyk et al., 2024). Similarly, relevant studies consistently report that individuals who have received AI training adopt more positive and knowledge-based attitudes toward this technology (AlZaabi et al., 2023; Heinrichs et al., 2025; Stewart et al., 2023). Therefore, it is considered that attitudes toward AI are not a fixed individual characteristic but can be shaped through intervention and experience.

When AI usage trends are examined, it is seen that the speed at which healthcare professionals adopt these technologies is determined by a complex interaction of individual, institutional, and systemic factors (Lambert et al., 2023). At the individual level, AI literacy, technological self-efficacy, and risk perception can be said to have a decisive impact on the tendency to use them (Baumgartner et al., 2022). At the institutional level, it is observed that technical infrastructure, peer support, and managerial incentive mechanisms facilitate the adoption process (Wang et al., 2024). However, several mixed methods studies highlight that a lack of trust and concerns about transparency negatively impact doctors' willingness to use clinical decision support systems (Khairat et al., 2018; Pumplun et al., 2021). On the other hand, it is observed that increased awareness of artificial intelligence alone does not translate into a positive attitude towards its use; practical experience and critical evaluation skills must

also be acquired (Ziapour et al., 2025). In this context, relating artificial intelligence usage trends to the level of professional development raises a research question that has both descriptive and predictive value for educators (Heinrichs et al., 2025).

The Relationship Between Research Skills and Attitudes Towards Technology

Research suggests that professionals with high research self-efficacy are more open to new tools and methodologies, and therefore more inclined to integrate innovative technologies such as artificial intelligence into their research processes (Kouri et al., 2022; Livinți et al., 2021; Woo et al., 2024). In this context, it can be said that a researcher who has acquired critical thinking and evidence evaluation skills can also more accurately assess the limitations of artificial intelligence algorithms. Supporting this relationship, conceptual frameworks emphasize that digital health literacy includes cognitive and practical components that overlap with research skills (Abou Hashish & Alnajjar, 2024; Baumgartner et al., 2022). However, empirical evidence regarding the direction and strength of the relational pattern between the two variables remains quite limited (Ziapour et al., 2025). While examining technology adoption patterns reveals that perceived usefulness and ease of use play a decisive role in influencing attitudes and behavioral intentions, professional competence level appears to have a moderating function in this relationship (Khairat et al., 2018). In this context, it can be said that individuals with high research skills will have a more qualitative understanding of the nature of integration through their subjective assessment of whether artificial intelligence contributes to research processes. Similarly, it is stated that residents who learn to use AI tools as a component of evidence-based medical education achieve positive gains in terms of both research productivity and attitude towards technology (AlZaabi & Masters, 2025; Tolentino et al., 2024). It should also be considered that the relationship between research skills and attitudes towards artificial intelligence may be shaped by factors such as sociodemographic variables, institutional context, and area of expertise (Allam et al., 2024; Ang, 2025; Livinți et al., 2021). Accordingly, establishing multivariate models that consider the relationship between the two variables, along with possible moderator and mediator effects, will enable a more detailed understanding of causal mechanisms. In this context, the research aims to make a meaningful and original contribution to the field by quantitatively examining the relationship between research skills and attitudes towards artificial intelligence, specifically among surgical residents.

The aim of this research is to determine the relationship between the scientific research skills and attitudes towards artificial intelligence of residents in surgical medicine departments, in terms of certain variables. Based on this general aim, the following questions were investigated:

1. What is the level of scientific research skills and attitudes towards artificial intelligence among residents in surgical medicine departments?
2. Do the scientific research skills and attitudes towards artificial intelligence of residents in surgical medicine departments differ according to their gender?
3. Do the scientific research skills and attitudes towards artificial intelligence of residents in surgical medicine departments differ according to their seniority in the specialty?
4. Do the attitudes towards artificial intelligence of residents in surgical medicine departments predict their scientific research skills?

Method

Research Model

This study was conducted using a comparative correlational survey model within a quantitative research approach. This type of research aims to identify relationships between variables (Karasar, 2005). In other words, a model that aims to measure the relationships between two or more variables and determine cause-and-effect relationships between these variables is defined as a correlational survey model (Johnson & Christensen, 2008). In a survey model, the tendencies, attitudes, and opinions of a sample selected from a population are described quantitatively and numerically (Creswell & Creswell, 2017). Therefore, in such studies, the relationships between variables are also expressed numerically. In this study, the scientific research skills and attitudes towards artificial intelligence of surgical residents were examined relationally in terms of gender and seniority variables.

Research Group

This study, which assesses the scientific research skills and attitudes towards artificial intelligence of surgical residents, was conducted through a literature review followed by a comprehensive, relational and complementary research. The study was carried out in Ankara, Konya, and Izmir provinces of Turkey, at training and research hospitals and university public hospitals providing medical specialty training in surgical branches. Purposive sampling was employed. Inclusion criteria were being in the surgical specialty training process and voluntary participation. The demographic distribution of the research group is presented in Table 1.

Table 1. Demographic Distribution of Participants

Variables	Options	Frequency	Percent
Gender	Female	56	44.1
	Male	71	55.9
Branch	General Surgery	35	27.6
	Gynecology	32	25.2
	Cardiovascular Surgery	19	15.0
	Ear-Nose-Throat Surgery	9	7.1
	Orthopedics and Traumatology	9	7.1
	Other	23	18.1
Specialist Training Seniority	1 Year	32	25.2
	2 Years	30	23.6
	3 Years	31	24.4
	4-5 Years	34	26.8
	Total	127	100.0
Age	Mean	29.13	
	St. Dev.	3.26	

Data was collected from surgical residents in surgical branches at public and university hospitals, primarily via

the "Google Forms" application. The forms were distributed to participants through WhatsApp groups and individual communication, and 133 participants voluntarily completed the forms. However, 6 questionnaires were excluded from the study due to incomplete information, resulting in a total of 127 participants.

Data Collection Tools

Survey data was used to collect research data. The survey form contains a total of 45 items. The first section contains 5 demographic survey items, the second section contains 20 survey items about the scientific research skills of surgical residents, and the third section contains 20 survey items about participants' attitudes towards artificial intelligence.

Scientific Research Skills Scale

The Scientific Research Ability Scale was developed by Velioğlu and Özdemir (2023). The scale, which is in Likert form with five points, consists of 20 items. Velioğlu and Özdemir (2023) conducted Exploratory Factor Analysis and Confirmatory Factor Analysis to test the construct validity of the scale. In the factor analysis process, the KMO value was found to be 0.953. After determining that the Kaiser-Meyer-Olkin (KMO) and Bartlett values were appropriate, the other analyses of the scale development process were carried out, and factor analysis was performed. As a result of the factor analysis, it was observed that the item factor loadings were above 0.40. The result of the confirmatory factor analysis was found to be chi-square (c2/df) = 2.613, RMSEA = 0.066; and SRMR = 0.034. NFI = 0.94; NNFI = 0.942; CFI = 0.963; The RFI was obtained as 0.926. The Cronbach's Alpha reliability coefficient of the scale was calculated as 0.80. In light of all this information, the data obtained show that the scale has acceptable construct validity and reliability.

Attitude Scale Towards Artificial Intelligence

The scale of items regarding the attitudes of surgical residents towards artificial intelligence was developed by Schepman and Rodway (2020), adapted and validated in Turkey by Kaya et al. (2022). The Attitude Towards Artificial Intelligence Scale developed by Kaya et al. (2022) stands out as a scale designed to assess individuals' attitudes towards artificial intelligence. This scale includes various statements to measure positive and negative attitudes towards artificial intelligence. The scale contains two sub-dimensions, negative attitudes towards artificial intelligence and positive attitudes towards artificial intelligence, and 20 questions. The scale is scored on a 5-point Likert scale. This scoring system is a 5-point Likert type scale consisting of Strongly disagree, Disagree, Undecided, Agree, and Strongly agree. This scoring system is used to qualitatively evaluate participants' attitudes towards artificial intelligence. The total mean score reflects the participant's attitude towards artificial intelligence. In this context, a high average score indicates a positive attitude, while a low average score indicates a negative attitude. In the study conducted by Kaya et al. (2022), the Cronbach Alpha value was calculated for the reliability analysis of the Attitude Towards Artificial Intelligence Scale. The obtained Cronbach Alpha value was found to be 0.87. The reliability coefficient was calculated as 0.85 on the participants of this study. These values show that the scale has high internal consistency and reliably measures the attitudes of the participants.

Data Analysis Techniques

In the data analysis processes, the SPSS 26 software package was used to perform statistical evaluations. Frequency and percentage distributions were given for the demographic characteristics of the participants. Descriptive statistics values were obtained for the scores of the artificial intelligence attitude and scientific research skills scales. Since the number of data points (N>50) was high, skewness and kurtosis values were examined to determine the normality of the scale scores. If these values are between ±2, the distribution is normal (George and Mallery, 2010). Regression analysis was used to examine the relationship between artificial intelligence attitude and scientific research skills scale scores. In relation to this method, the necessary assumptions regarding the continuity of the dependent variable, normality, and multicollinearity were tested, and the relevant assumptions were met. Parametric methods, namely the Independent Samples t-test and F-test techniques, were used to determine whether there was a difference in artificial intelligence attitude and scientific research skills scores according to the demographic characteristics of the participants. In statistical comparisons, evaluations were carried out using the criterion of $p < .05$ as the significance level.

Findings

This section of the study first presents the descriptive statistics of the scores obtained by medical surgical residents on scales measuring scientific research skills and attitudes towards artificial intelligence. Then, the mean scores obtained by the participants on these scales are compared according to gender and training duration/seniority variables. Table 2 shows the descriptive statistics of the scores obtained by surgical residents on the scientific research skills and artificial intelligence attitudes scales. According to the findings, the mean scores on the scientific research skills scale ranged from 1.05 to 5.00, with an average score of 3.31±0.88. Furthermore, the average score obtained by the participating surgical residents on the artificial intelligence attitudes scale was calculated as 4.16±0.76. Based on these average values, it was understood that the scientific research skills of the surgical residents were at a moderate level, while their attitudes towards artificial intelligence were at a high level.

Table 2. Descriptive Analysis of Scientific Research Skills and AI Attitudes of Surgical Residents.

	N	Minimum	Maximum	Mean	Std. Deviation
Scientific Research Skills	127	1.05	5.00	3.31	0.88
AI Attitude	127	1.00	5.00	4.16	0.76

As shown in Table 3, the mean score on the scientific research skills scale for female and male surgical residents is (*M*=3.10), while the mean score for male participants is (*M*=3.48).

Table 3. A Comparison of Scientific Research Skills of Medical Surgical Residents by Gender

	Gender	N	Mean	Std. Deviation	t	p
Scientific Research Skills	Female	56	3.10	0.81	-2.456	0.015*
	Male	71	3.48	0.91		

*p<0.05

An Independent Samples t-test was used to analyze whether the differences in mean scores between genders were statistically significant, and it was found that the mean scores differed significantly ($p<0.05$). Based on the group means, it was found that male participants had significantly higher scientific article writing skills compared to their female peers.

As shown in Table 4, the mean score on the scientific research skills scale for female and male surgical residents is (M=4.11), while the mean score for male participants is (M=4.20). The differences in mean scores on artificial intelligence attitudes based on gender were found to be statistically insignificant ($p>0.05$).

Table 4. A Comparison of AI Attitudes of Medical Surgical Residents by Gender

	Gender	N	Mean	Std. Deviation	t	p
AI Attitude	Female	56	4.11	0.51	-0.670	0.504
	Male	71	4.20	0.91		

Table 5 shows the results of a comparison of the mean scores on the scientific research skills scale among medical specialty training participants based on their training duration. The differences between the mean scores based on specialty training seniority were analyzed using the F-test to determine if they were statistically significant, and it was found that the mean scores differed significantly ($p<0.05$). Further analysis using the Tukey test revealed that participants with 3 years and 4-5 years of specialty training seniority possessed higher scientific research skills compared to those with 1 or 2 years of specialty training seniority.

Table 5. Comparison of Scientific Research Skills of Medical Surgical Residents According to Specialist Training Seniority

	Specialist Training Seniority	N	Mean	Std. Deviation	F	p
Scientific	1 year	32	2.05	0.91	5.81	0.001**
Research	2 years	30	2.95	0.98		
Skills	3 years	31	3.38	0.62		
	4-5 years	34	3.71	0.79		

**$p<0.01$

Table 6 shows the results of a comparison of the mean scores on the artificial intelligence attitude scale among medical specialty training participants based on their training duration. No significant difference was found in the mean artificial intelligence attitude scores of the participants based on their specialty training seniority ($p>0.05$).

Table 6. Comparison of AI Attitudes of Medical Surgical Residents According to Specialist Training Seniority

	Specialist Training Seniority	N	Mean	Std. Deviation	F	p
AI Attitude	1 year	32	4.23	0.81	0.670	0.504
	2 years	30	4.19	0.51		
	3 years	31	3.93	0.86		
	4-5 years	34	4.26	0.59		

According to Table 7, scientific problem-solving skills are the dependent variable, and attitudes towards artificial intelligence are the independent variable. Participants' attitudes towards artificial intelligence did not significantly explain the variation in scientific research skills (F= 2.093, p>0.05). There is a low, non-significant correlation between attitudes towards artificial intelligence and scientific research skills (β=-0.126; p>0.05). Furthermore, attitudes towards artificial intelligence explain only 1.6% of scientific research skills.

Table 7. Results of Simple Regression Analysis Between Participants' Scientific Research Skills and Attitudes towards Artificial Intelligence

	Unstandardized Coefficients		Standardized Coefficients		
	β	Std. Error	β	t	p
(Constant)	2.689	0.437		6.155	0.000
AI Attitude	0.149	0.103	0.128	1.447	0.150
Dependent Variable: Scientific Article Writing Skills					
$R=0.128$; $R^2=0.016$; $F=2.093$; $p>0.05$					

Discussion and Conclusion

This research aimed to examine the relationship between the scientific research skills and attitudes towards artificial intelligence (AI) of surgical residents. The research findings indicate that surgical residents have a moderate level of research skills and a high level of attitudes towards AI. Furthermore, the effects of gender and residency seniority on research skills were examined; however, these variables did not significantly differentiate attitudes towards AI. The findings regarding the predictive effect of AI attitudes on scientific research skills clearly highlight the necessity of addressing research culture and digital transformation processes together in medical residency training. Within this framework, the findings are discussed in the context of the relevant literature, and inferences that will contribute to the development of the field are presented.

Regarding the first research question, the findings reveal that surgical residents have a moderate level of scientific research skills. This finding indicates that while surgical residents are willing to participate in research processes, they have significant deficiencies in terms of methodological preparation and skill levels. The relevant literature highlights that surgical residents feel inadequate in research methodology, statistics, and scientific writing (Aneese et al., 2019; Mokhtari et al., 2024; Pinto Dos Santos et al., 2019). In this context, this finding is consistent with previous studies showing that clinical intensity and insufficient mentoring significantly restrict the development of research skills (Carter et al., 2019; Wood et al., 2018). In surgical branches specifically, this gap may be further amplified by the master-apprentice learning model that dominates operating theatre settings, where procedural competence is prioritized over research engagement. In this context, the structural difference between practical surgical training and academic skill development may represent a discipline-specific factor that distinguishes surgical residents from those in internal medicine branches and may also partially explain potential differences in attitudes towards artificial intelligence between these two training contexts.

The study determined that participants had a high level of positive attitude towards artificial intelligence,

indicating that resident doctors working in surgical fields are open to adopting AI as a tool to increase clinical efficiency. International literature indicates that healthcare professionals and resident doctors generally have positive attitudes towards AI; however, ethical concerns and perceptions of professional threats cannot be ignored (Allam et al., 2024; Pawelczyk et al., 2024; Pinto Dos Santos et al., 2019). In this context, it is known that both positive and negative attitudes are more clearly observed in fields where AI applications are significantly felt, such as radiology and surgery (Pawelczyk et al., 2024; St John et al., 2024). Therefore, the findings of this study reveal that surgical residents have already developed a high level of interest and positive attitudes towards AI; however, the research infrastructure to support this attitude is not sufficiently strong. The combined evaluation of these two findings strongly supports the need for an integrated approach to research skills and technological literacy in specialist training programs.

The findings related to the second research question reveal that male participants have significantly higher scientific research skills compared to female participants. This finding indicates that the impact of gender-based differences on research behaviors in the context of medical specialty training should be carefully considered. The relevant literature reports that female researchers in academic settings face various structural barriers compared to their male colleagues, and this can negatively affect research productivity (Andersson, 2025; Carter et al., 2019; Mokhtari et al., 2024). However, it should not be overlooked that this difference may be related not only to individual competency levels but also to institutional pressures based on gender roles, mentoring inequalities, and imbalances in clinical workload distribution (Wood et al., 2018). Medical education research shows that female resident doctors do not lag behind their male peers in terms of academic achievement and competency levels; However, it reveals that structural opportunities and access to mentorship are not equal (Livinți et al., 2021). In this context, the findings of the current research support this discussion in the literature with empirical data specific to surgical branches and highlight the need to design gender-sensitive research training programs.

It is noteworthy that no significant gender-based difference was found in attitudes towards artificial intelligence. This finding indicates that positive attitudes towards artificial intelligence are widespread in surgical residency training, regardless of gender. Similar findings are reported in international studies; it is seen that attitudes towards artificial intelligence are shaped by individual and professional experience, and that gender alone is not a determining factor (AlZaabi et al., 2023; Mousavi Baigi et al., 2023). This situation shows that artificial intelligence literacy training can be designed for all surgical residents regardless of gender, while research skills training needs to be restructured from a gender equality perspective.

The findings related to the third question of the study reveal that scientific research skills differ significantly depending on seniority; participants with three years or more of seniority exhibit significantly higher research skills compared to participants with one or two years of seniority. This finding confirms that research skills develop as a result of a cumulative learning process over time. The relevant literature shows that research participation, conference presentations, and publication experiences in the later years of specialist training significantly increase scientific productivity (Carter et al., 2019; Mokhtari et al., 2024; Wood et al., 2018). However, the relatively low level of research skills in the early years of seniority indicates that research support is insufficient in the initial stages of specialist training and that there is a high need for structured intervention

programs during this period (Aneese et al., 2019). The positive relationship between research self-efficacy and seniority can be interpreted as individuals' confidence in research and their perception of competence strengthen as they gain experience (Livinți et al., 2021; Woo et al., 2024). In contrast, attitudes towards artificial intelligence do not differ significantly according to specialist seniority. This finding indicates that positive attitudes towards artificial intelligence remain relatively high at all seniority levels, regardless of experience. This finding aligns with related studies suggesting that healthcare professionals' attitudes toward artificial intelligence are shaped by individual awareness, personal interest, and environmental stimuli rather than their level of professional experience (Heinrichs et al., 2025; Lambert et al., 2023). In this context, it is considered necessary to support the enhancing effect of seniority on research skills at the program level, particularly by making structured research experiences mandatory for early-stage surgical residents.

The findings related to the fourth question of the study reveal that the attitudes towards artificial intelligence of surgical residents do not statistically significantly predict their scientific research skills. This finding shows that a positive attitude towards artificial intelligence alone does not stand out as a determining factor in research skills. Indeed, the relevant literature emphasizes that empirical evidence regarding the direction and strength of the relational pattern between attitudes towards artificial intelligence and research skills is still quite limited (Ang, 2025; Pumplun et al., 2021; Ziapour et al., 2025). In this context, this finding supports the theoretical discussions that an increased level of awareness regarding artificial intelligence alone does not directly contribute to research skills. When examining technology adoption models, although the determining roles of perceived usefulness and ease of use on attitudes and behavioral intentions are known, it is seen that the level of professional competence plays a moderating function in this relationship (Khairat et al., 2018; Pumplun et al., 2021). However, it is considered that the effect of attitude towards artificial intelligence on research skills may not be direct, but indirect, through mediating variables such as professional experience, critical thinking, and the use of applied technology (Woo et al., 2024). Therefore, it is understood that measuring only the attitude level is insufficient, and the actual integration of artificial intelligence tools into research processes should also be considered. AlZaabi and Masters (2025) report that residents who use artificial intelligence tools practically as a component of evidence-based medical education achieve positive gains in terms of both research productivity and attitude towards technology. Therefore, the finding of this research highlights the importance of designing multi-component training models that aim not only at attitude measurement but also at the integration of artificial intelligence into research practice.

The findings of this research offer significant theoretical and practical implications regarding research skills and attitudes towards artificial intelligence within the context of medical residency training. At the theoretical level, this study, conducted within the framework of research self-efficacy theory and technology adoption models, empirically confirms that these theoretical structures also serve an explanatory function in medical residency training. However, the lack of a statistically significant relationship between attitudes towards artificial intelligence and research skills suggests that one-dimensional explanatory models directly linking these two variables may be insufficient; it highlights the need to examine this relationship using more comprehensive multivariate models that include moderator and mediator variables.

At the practical level, the findings contain critical guidelines for the content and structure of residency training

programs. The fact that research skills develop significantly with residency seniority clearly indicates that programs should offer structured research experiences, evidence-based medicine modules, and active mentoring mechanisms, particularly for first and second-year students. The impact of gender-based differences on research skills necessitates the adoption of gender-sensitive approaches in educational settings and the implementation of institutional policies that guarantee equal opportunities. The generally high level of positive attitudes towards artificial intelligence indicates that educational initiatives in this field are well-established; it also emphasizes the need to move beyond attitude development and adopt applied education models that actively integrate AI tools into research practice.

Several limitations must be considered when interpreting the findings of this study. Firstly, the research was limited to individuals undergoing surgical specialty training in specific research and university hospitals in Ankara, Konya, and Izmir provinces in Turkey; this restricts the generalizability of the findings to different geographical regions, specialties, and institutional structures. Secondly, the use of purposeful sampling and voluntary participation is considered a methodological factor limiting the representativeness of the sample. Since the research has a cross-sectional design, it is not possible to establish causal relationships between variables; the findings only point to relational patterns, and longitudinal studies are needed to explain causal mechanisms.

The assessment of both scientific research skills and attitudes towards artificial intelligence using self-report scales can lead to social desirability bias and subjective response tendencies. While the use of adapted and validated versions of the measurement tools in Türkiye provides significant assurance of reliability, content validity needs to be further examined within the context of the unique dynamics of surgical specialty training. These limitations necessitate a cautious interpretation of the study's findings and require future research to be designed to address these constraints.

Recommendations

Based on the findings, several recommendations are offered for both current practice and future research. Specialty training programs, especially for first-year residents, should include mandatory research components encompassing structured evidence-based medicine modules, research workshops, and statistical applications. Designing these components to provide both theoretical knowledge and practical experience will contribute to the earlier reinforcement of research skills. To address gender-based disparities, it is crucial that academic mentoring programs are structured with a gender-sensitive perspective and that institutional mechanisms supporting the academic productivity of female residents are strengthened. While high levels of positive attitudes towards artificial intelligence have been identified, adopting applied training models that actively integrate AI tools into research processes is necessary for this positive attitude to translate into research practice. Future research is recommended to utilize longitudinal designs to uncover causal mechanisms between variables, while simultaneously testing the generalizability of findings with larger and more diversified samples. Future research should also consider that the role of artificial intelligence in surgical training is not limited to practical skill acquisition. In this context, AI-based systems are expected to play an important role in supporting surgical residents' access to current clinical guidelines, rapid knowledge synthesis, and evidence-based clinical decision-

making processes. It is thought that for surgical residents working under intensive clinical conditions, AI-supported tools can contribute to the more effective use of current literature and guideline knowledge, thereby strengthening evidence-based surgical practice. Therefore, future studies should evaluate the role of artificial intelligence in surgical education not only at the level of theoretical knowledge, but also in terms of its effects on clinical application and decision-making processes. Finally, mixed-methods studies that examine the multidimensional relationship between research skills, attitudes towards artificial intelligence, and professional performance indicators, along with moderator and mediator variables, will make significant contributions to the field.

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