


An Investigation into the Current Landscape, Challenges, and Training Imperatives of Clinical Research Among Anesthesiologists in China

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Objective: This study aimed to investigate the status of anesthesiologists in clinical research in China, identify challenges, and propose strategies to improve research quality and anesthesiology services.

Materials and Methods: A cross-sectional online survey was conducted among registered clinical anesthesiologists in China from April to May 2023. The questionnaire, which was developed by a multidisciplinary team following a workshop, covered socio-demographic characteristics, clinical research status, skills, motivations, challenges, and training needs. Data were analyzed using descriptive statistics, chi-square tests, and logistic regression to examine the factors associated with research publications.

Results: Of the 878 analyzed respondents, 85.08% showed positive attitudes towards clinical research, yet the publication rates were low (59.68% in Chinese, 14.24% in English). Professional title promotions (78.70%) and solving clinical problems (69.48%) were the primary motivators. The respondents reported needing training in statistical analysis (74.69%), research design (73.86%), and topic selection (72.34%). The self-reported deficiencies included ability (73.01%), time (69.93%), and funding (60.71%). Significant differences ($P < 0.01$) existed between publishers and non-publishers regarding age, education, title, research experience, training, and hospital characteristics. Educational background, professional title, research experience, and training were identified as independent factors that influenced publication rates.

Conclusion: This study identified major obstacles in anesthesiologists' research engagement, including time constraints, skill deficits, and funding issues, despite high interest. Career advancement was the primary motivation for the study. This study emphasizes the need for enhanced training in statistics and research designs. Factors such as education, title, experience, and training independently impact publication output.

Keywords: clinical research, anesthesiologists, clinical research current landscape, clinical research challenges, clinical research training imperatives

Introduction

The realm of biomedical research encompasses a broad spectrum of investigations, ranging from foundational studies to applied and translational research, all geared towards expanding our understanding of medicine.¹ This diverse field forms the bedrock upon which medical knowledge and practices continue to evolve. Within this domain, clinical research is a critical component, characterized by its unique focus on direct patient involvement.² This approach, centered on individuals receiving care, is instrumental in driving medical advancements by enabling practical testing and validation of theoretical principles. Through the engagement of subjects with specific health conditions, these studies yield crucial insights that substantially contribute to the progress of healthcare and medical science as a whole. Clinical research in anesthesiology is of significant value, as it directly contributes to the advancement of patient outcomes, care, and safety. The efficacy and safety of anesthetic procedures, along with the quality of postoperative recovery, are closely linked to

the clinical judgment and practices of anesthesiologists, highlighting the critical role of research in improving these outcomes within this specialized field.³ Despite widespread recognition of its significance, the field of anesthesiology has experienced a gradual decline in both research output and scholarly activity in recent years.⁴ Anesthesiologists face a variety of challenges that substantially hinder the progress and quality of their research efforts. These challenges are complex and arise from several key factors that limit their capacity to conduct effective clinical investigations. Firstly, the heavy clinical workload and long working hours leave anesthesiologists with limited time and energy to dedicate to research, making it difficult to balance both responsibilities effectively.^{5,6} Secondly, inadequate funding and resources present a major obstacle, as sufficient financial support is crucial for conducting high-quality studies.^{7,8} Thirdly, a lack of specialized training in research methodologies limits anesthesiologists' ability to design and conduct rigorous clinical trials. This includes challenges in areas such as statistical analysis, data interpretation,⁹ and manuscript writing,⁷ which are essential for producing high-quality research. Additionally, the lack of adequate clinical research infrastructure and difficulties in data acquisition often hinder the progress of clinical studies.¹⁰ Finally, the absence of strong institutional support and a collaborative research environment further discourages sustained engagement in research activities. In light of these challenges, this study aims to provide a comprehensive analysis of the current state of clinical research among anesthesiologists. Specifically, it seeks to explore the factors influencing both their research capabilities and motivations, as well as the obstacles they encounter. By examining sociodemographic characteristics, training needs, and the factors impacting research publication, this study aims to identify critical gaps in the existing research environment. The findings will not only enhance our understanding of the barriers anesthesiologists face but also offer actionable insights for improving research engagement, optimizing resources, and fostering a culture of research within the field of anesthesiology. Through this investigation, we hope to inform targeted strategies that will strengthen both the proficiency and enthusiasm of anesthesiologists in contributing to meaningful clinical research.

Method

Study Design and Recruitment

Figure 1 outlines the two-stage process of our study: the questionnaire design and survey implementation. We kicked off by organizing workshops at the Beijing Tongren Hospital, affiliated with the Capital Medical University. These sessions brought together clinical anesthesiologists to discuss their research experiences, challenges, and needs. The workshop

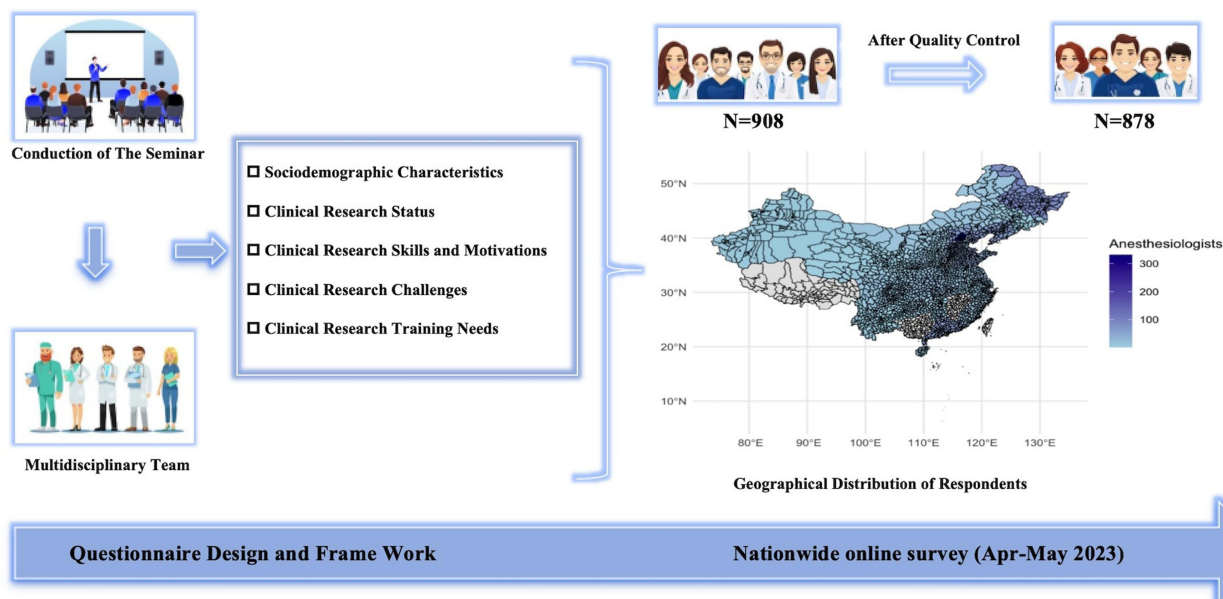


Figure 1 Study workflow. Questionnaire development involved clinical anesthesiologist workshops, multidisciplinary input, and peer review. A nationwide online survey was conducted in mainland China (April-May 2023) with quality control measures. Of 908 completed questionnaires, 878 valid responses were included in the final analysis. A heat map illustrates the geographical distribution of participating anesthesiologists, with color intensity indicating respondent density by region.

discussions yielded significant insights that informed the subsequent development of our questionnaire. Building on these findings, we formed a multidisciplinary team (MDT) to define the objectives of the study and craft the survey. The MDT included three clinical anesthesiologists, a clinical research expert, a medical informatics specialist, and a clinical statistician. To fine-tune the questionnaire, we asked 20 additional clinical anesthesiologists to review it for clarity and practicality. After thorough preparation, we conducted a nationwide cross-sectional survey in mainland China from April 1 to May 1, 2023. The questionnaire was distributed via the online survey platform WenJuanXing, with the link or quick response code sent to the target population through Email and professional social media platforms (such as WeChat and QQ). Distribution channels included national anesthesiology conferences, online anesthesiology platforms, and anesthesiology-related social media groups. To ensure the validity of the responses, participants were required to confirm at the beginning of the questionnaire that they held a valid anesthesiologist certification. We implemented measures to ensure data quality, including IP address restrictions to prevent duplicate submissions. Our analysis focused only on complete responses. A total of 908 participants were included in the study, selected through voluntary sampling from an estimated population of approximately 90,000 anesthesiologists nationwide.^{11,12} All participants were licensed anesthesiologists currently practicing in China.

Ethical Considerations

This study employed an online informed consent form. Participants were presented with a digital consent form detailing the study context, objectives, methods, and confidentiality measures. To protect privacy, no signatures were required; instead, participants indicated their consent by clicking a “Continue” button at the form’s end. In line with data protection principles, we collected no personal identifiers such as names or affiliations. The research protocol was approved by the Ethics Committee of Beijing Tongren Hospital, Capital Medical University (approval number: TREC2022-KY013).

Questionnaire Design

The questionnaire comprised five sections: sociodemographic characteristics, clinical research status, clinical research skills and motivations, clinical research challenges, and clinical research training needs. A complete version of the questionnaire is available in the [Supplementary Materials](#). We implemented a dual-pronged approach to maintain data integrity. First, based on preliminary testing and expert consensus within our team, we established a minimum completion time of two minutes. Responses submitted more rapidly were deemed potentially unreliable and thus excluded. Second, responses were considered invalid if participants selected an incorrect answer to a common-sense question positioned as the 15th item in the questionnaire.

Statistical Analysis

Statistical analyses were conducted solely on valid responses to the questionnaires. Data concerning sociodemographic characteristics, clinical research status, clinical research skills and motivations, clinical research training needs, and clinical research challenges were categorized. Sociodemographic characteristics were described using frequencies and relative frequencies. Clinical research skills and motivations, clinical research challenges, and clinical research training needs were presented using bar and pie charts. Chi-square tests were conducted to examine potential associations between publication history and factors such as age, sex, educational background, title, postgraduate tutor qualification, willingness to initiate clinical research, experience in initiating or participating in clinical research, previous participation in clinical research training, willingness to participate in clinical research, hospital nature, teaching hospital qualification, or hospital grade. We conducted a multivariate logistic regression analysis to identify independent predictors of publication. Variables for this model were selected based on the univariate analysis results and included age, educational background, title, hospital level, hospital nature, teaching hospital qualification, experience in participating in or initiating clinical research, and experience in clinical research-related training. The model was constructed using a forward stepwise approach, with entry and removal thresholds set at 0.05 and 0.1, respectively. Statistical analyses were performed using SPSS 25.0 (IBM Inc., Chicago, IL, USA) and R software (version 4.3.1; R Foundation for Statistical Computing, Vienna, Austria) with a significance level of $P < 0.05$.

Result

Sociodemographic Characteristics

A total of 908 questionnaires were collected. After applying our quality control measures, 878 responses were deemed valid, with a validity rate of 96.7%. Among the invalid questionnaires, none were excluded due to completion times of less than two minutes. However, 30 responses were discarded because of incorrect answers to common-sense questions. Table 1 presents descriptive statistics of the participants' demographic characteristics. The survey results indicated that 52.96% of the anesthesiologists who participated in this study were female. The age distribution was primarily concentrated between 31–40 years old, accounting for 43.96% of the respondents. Most physicians (58.20%) came from tertiary hospitals, and more than half were from public hospitals. Almost all anesthesiologists (98.06%) had at least a bachelor's degree or higher. In terms of professional titles, attending physicians were the most common, representing 38.50% of participants.

Clinical Research Status

Regarding the current state of clinical research, the majority of anesthesiologists (60.02%) were willing to conduct clinical research. However, only 28.82% of anesthesiologists were interested in and currently engaged in clinical research (Figure 2A), whereas 48.06% had never led or participated in any clinical research (Figure 2B). Approximately 45.2% of

Table 1 Sociodemographic Characteristics

Characteristics	Participants, n (%)
Age, years (%)	
20–30	154 (17.54)
31–40	386 (43.96)
41–50	269 (30.64)
51–60	68 (7.74)
>60	1 (0.11)
Sex, male (%)	413 (47.04)
Educational background (%)	
College	17 (1.94)
Bachelor	476 (54.21)
Master	305 (34.74)
Doctor	80 (9.11)
Title (%)	
Resident doctor	227 (25.85)
Attending physician	338 (38.50)
Deputy chief physician	227 (25.85)
Chief physician	86 (9.79)
Research supervisor (%)	
Master tutor	1 (0.11)
Doctoral supervisor	36 (4.10)
None	841 (95.79)
Hospital level (%)	
Class III, Class A	511 (58.20)
Class III, Class B	124 (14.12)
Class II, Class A	163 (18.56)
Class II, Class B	28 (3.19)
Others	52 (5.92)
Hospital types (%)	
Public hospital (%)	776 (88.38)
Teaching hospital (%)	630 (71.75)

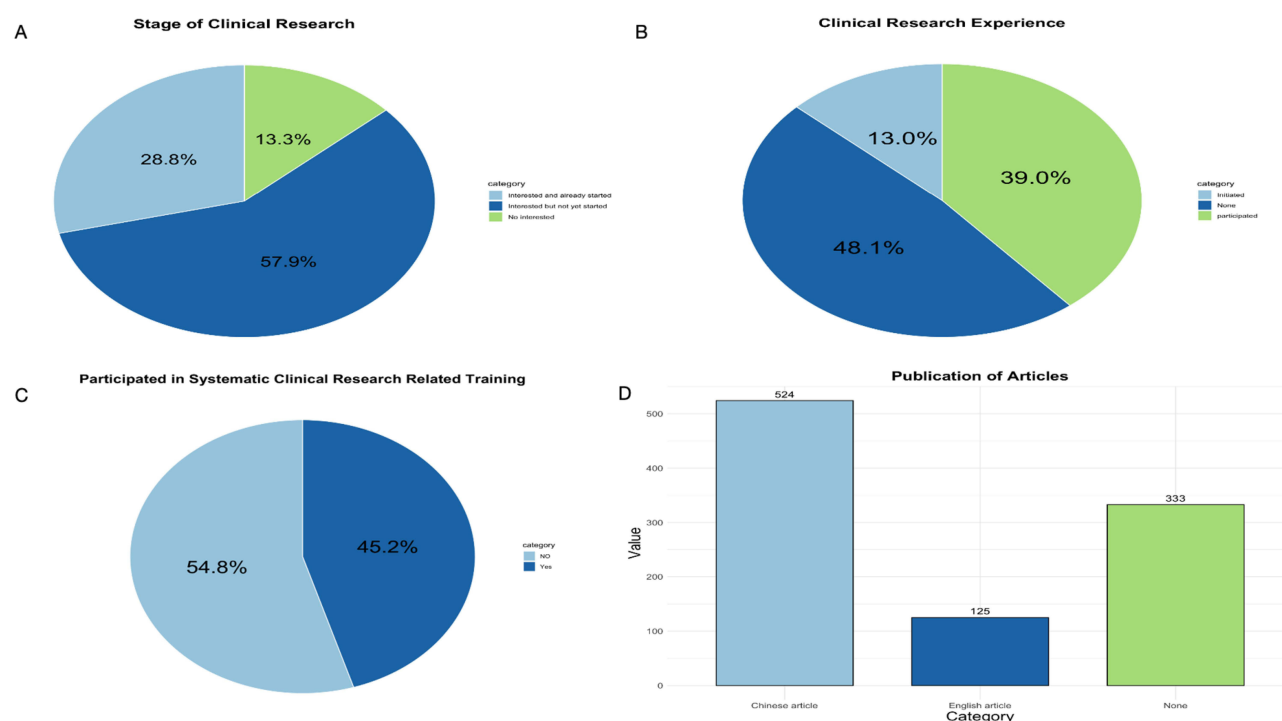


Figure 2 Overview of clinical anesthesiologists' current status clinical research. **(A)** Pie chart showing the current stage of clinical anesthesiologists' participation in clinical research. **(B)** Pie chart depicting the experience of clinical anesthesiologists in initiating or participating in clinical research. **(C)** Pie chart illustrating whether clinical anesthesiologists have received formal training in clinical research. **(D)** Pie chart presenting the publication status of clinical anesthesiologists in academic journals.

anesthesiologists had received systematic clinical research training (Figure 2C), and the vast majority (82.35%) expressed a desire to participate in clinical research-related training. In terms of publications, 37.93% of physicians had not yet published any clinical research papers. Most physicians (59.68%) published articles in Chinese, while a smaller proportion (14.24%) published articles in English (Figure 2D).

Clinical Research Capability and Motivations

Most physicians reported deficiencies in their clinical research capabilities. Over half of the physicians surveyed perceived inadequacies in various aspects of research skills, including statistical analysis (73.12%), research design (69.02%), research implementation (58.31%), paper writing (56.26%), research ideas (53.53%), and literature search and reading (51.48%) (Figure 3A). Furthermore, the primary motivation for most physicians to engage in clinical research is professional title promotion (78.70%), followed by solving clinical problems (69.48%) (Figure 3B).

Clinical Research Challenges

During the clinical research process, physicians commonly reported several challenges, including insufficient time (73.01%), inadequate skills (69.93%), and a lack of funding (60.71%) (Figure 3C).

Clinical Research Training Needs

Regarding training needs, a substantial proportion of anesthesiologists reported inadequate training in key areas of research. Statistical analysis was identified as a primary concern by 540 respondents (61.50%), closely followed by research design (534 respondents, 60.82%) and topic selection (523 respondents, 59.57%). Furthermore, a significant number of participants expressed urgent training needs in other critical aspects of research: clinical trial implementation (55.81%), literature search and review (52.28%), scientific writing (51.82%), and clinical trial registration (51.37%).

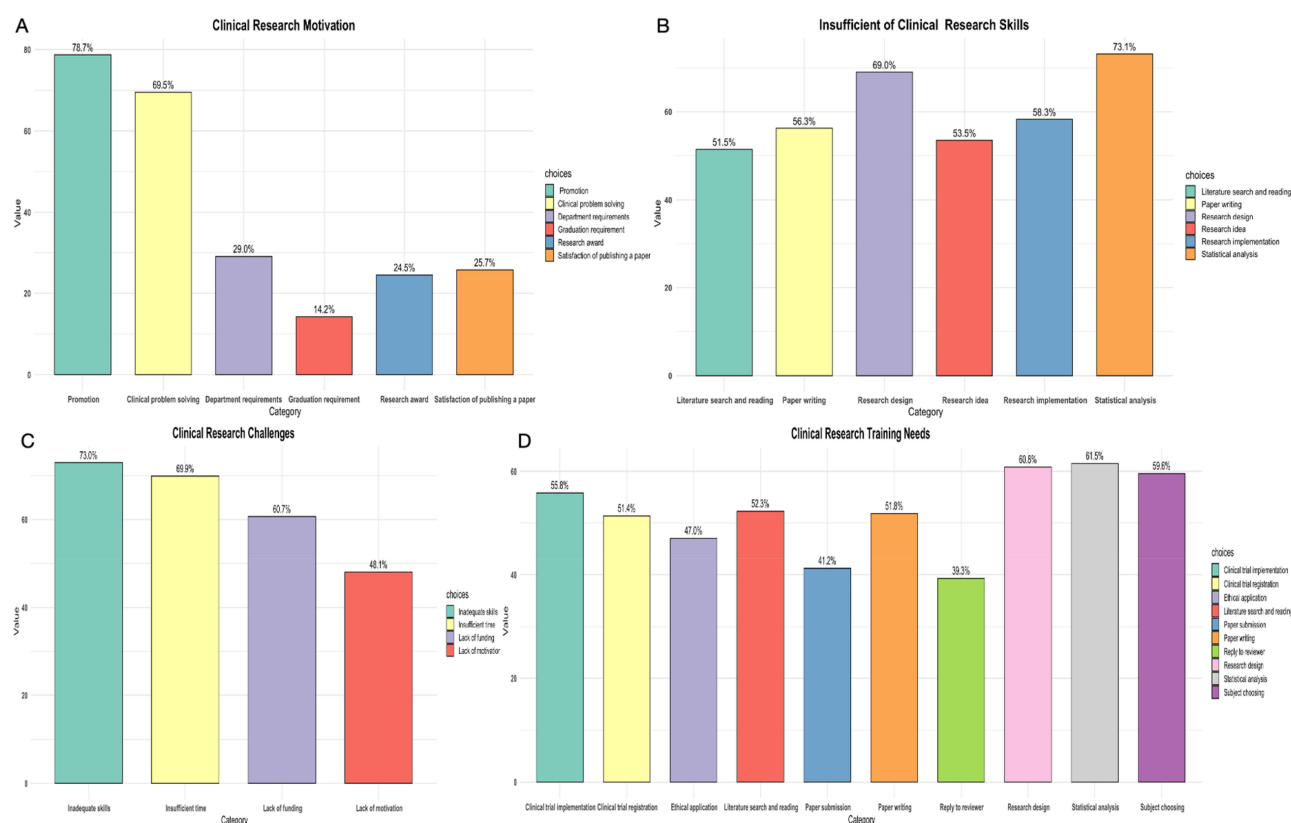


Figure 3 Clinical anesthesiologists' participation in clinical research: Motivation, deficiencies, challenges and training needs (A) Bar graph depicting the current motivations for clinical anesthesiologists to participate in clinical research. (B) Bar graph illustrating the areas where clinical anesthesiologists lack sufficient clinical research capabilities. (C) Bar graph showing the major challenges faced by clinical anesthesiologists in participating in clinical research training. (D) Bar graph representing clinical anesthesiologists' needs for clinical research training.

These findings underscore the widespread demand for comprehensive research training among anesthesiologists across various domains of the research process. (Figure 3D).

Factors Related to Publication Analysis

The results, as illustrated in Figure 4, indicate that anesthesiologists who have published articles exhibit a greater volume of publications after the age of 30 years compared to their non-published counterparts. Furthermore, those with a graduate degree or higher tend to have a higher publication rate. Anesthesiologists with attending physician status or above demonstrated increased publication activity. Additionally, individuals who possess mentorship qualifications as well as those with experience in clinical research training or who have participated in or initiated clinical research are more prolific in their publishing endeavors. Lastly, anesthesiologists affiliated with hospitals classified as Class III, Class B, or higher, public hospitals, and teaching hospitals showed a significantly greater tendency to publish articles.

Based on the results of the univariate analysis, we selected variables including age, educational background, professional title, hospital grade, hospital type, teaching hospital qualification, experience in participating in or initiating clinical research, and experience in clinical research-related training for multivariate logistic regression. The final multivariate logistic model for factors associated with article publication included educational background, professional title, clinical research experience, and clinical research training status (Table 2). Specifically, having an educational level below a master's degree as well as a lack of involvement in initiating or participating in clinical research and clinical research training are negatively correlated with the likelihood of publishing articles. Conversely, holding a residency title or higher was positively associated with the publication rate.



Figure 4 Comparison of characteristics between clinical anesthesiologists who have published articles and those who have not (A) Bar graph comparing age groups of clinical anesthesiologists with and without publications. (B) Bar graph illustrating gender distribution among clinical anesthesiologists with and without publications. (C) Bar graph showing educational background differences between clinical anesthesiologists with and without publications. (D) Bar graph depicting professional title differences between clinical anesthesiologists with and without publications. (E) Bar graph comparing graduate supervisor qualification status between clinical anesthesiologists with and without publications. (F) Bar graph illustrating differences in systematic clinical research training experience between clinical anesthesiologists with and without publications. (G) Bar graph showing differences in clinical research initiation or participation experience between clinical anesthesiologists with and without publications. (H) Bar graph comparing willingness to participate in clinical research training between clinical anesthesiologists with and without publications. (I) Bar graph depicting differences in willingness to participate in clinical research between clinical anesthesiologists with and without publications. (J) Bar graph illustrating differences in hospital tier affiliation between clinical anesthesiologists with and without publications. (K) Bar graph showing differences in hospital nature between clinical anesthesiologists with and without publications. (L) Bar graph comparing differences in hospital teaching status (teaching vs non-teaching hospitals) between clinical anesthesiologists with and without publications.

Discussion

Our nationwide survey offers a panoramic view of the clinical research landscape within anesthesiology, unveiling the complex interplay between aspirations and impediments. The data present a paradox: while anesthesiologists exhibit high enthusiasm for research involvement, their scholarly output remains significantly behind this apparent zeal, a finding that is consistent with similar studies conducted previously.¹³ This discrepancy underscores the critical gap between intention

Table 2 Results of Logistic Regression Analysis

Variate	p.value	OR	95% CI
Education background			
Master degree	<0.001		1.00
Bachelor degree	<0.001	0.12	(0.07–0.21)
College degree	0.024	0.18	(0.04–0.80)
Doctor degree	0.994	1.00	(0.34–3.01)

(Continued)

Table 2 (Continued).

Variate	p.value	OR	95% CI
Title			
Resident doctor	<0.001		1.00
Attending physician	<0.001	4.84	(2.51–9.31)
Deputy chief physician	<0.001	36.19	(15.16–86.41)
Chief physician	<0.001	121.13	(22.81–643.17)
Participated or initiated in clinical research			
Participated in clinical research	<0.001		1.00
Initiated in clinical research	0.242	1.99	(0.63–6.33)
Neither participated or initiated in clinical research	<0.001	0.30	(0.19–0.46)
Participated in systematic clinical research training	0.030	0.63	(0.42–0.96)

Abbreviations: OR, odds ratio; CI, confidence interval.

and execution in the realm of clinical investigations. Self-assessment data revealed widespread perceived deficiencies in research competencies, suggesting a fundamental barrier to active participation. Intriguingly, career advancement has emerged as the primary motivator for scientific pursuits, hinting at the need for a cultural shift towards intrinsic research valuation.

This study identifies a triumvirate of obstacles time scarcity, skill shortfalls, and funding constraints that collectively hinder research productivity. The acute demand for enhanced proficiency in statistical analysis and study design is particularly notable, indicating key areas for targeted educational interventions. Our analysis further elucidated several independent factors influencing publication rates, including educational background, professional standing, prior research exposure, and specialized training. These findings provide crucial insights for developing tailored strategies to bolster research engagement and output within the anesthesiology community.

Moreover, previous research has highlighted that although many anesthesiologists generate valuable ideas during their clinical practice, only a small fraction successfully translate these concepts into actionable research projects.¹⁴ This gap between ideation and implementation underscores the critical bottleneck in the research process. The enthusiasm for research participation is evident, yet structural barriers persist. In the Chinese healthcare context, anesthesiologists often face grueling work schedules, typically exceeding 40 hours per week.^{5,11} Such intense clinical demands severely constrain the time available for developing research skills, leading to reduced research output and diminished opportunities for securing funding. This creates a self-perpetuating cycle of limited research productivity.

Anesthesiologists exhibit a significant need for training in statistical analysis and research design, which aligns with their self-assessed insufficiency in these areas. Strengthening training in these domains is crucial for enhancing anesthesiologists' research capabilities. This study found that both clinical research experience and training background were independent factors contributing to the publication of articles. As physicians progress in their careers, they do not automatically acquire the knowledge and skills necessary for clinical trials.¹⁵

While professional title advancement has emerged as a primary driver for research engagement, the potential for addressing clinical challenges and improving healthcare quality seems to be underutilized as a motivating factor. Previous studies also indicate that professional title promotion is a key factor in article publication, with the number of publications being a critical determinant of the likelihood of successful promotion.¹⁶ These data suggest a nuanced relationship between career progression and research output. Notably, attaining the position of the attending physician or higher was independently correlated with increased publication rates. Factors such as solving clinical problems and improving the quality of healthcare services are attractive to some anesthesiologists. However, overall, intrinsic motivation for clinical research remains underdeveloped. Educational background also plays a crucial role, with graduate-level qualifications serving as independent predictors of publication success. This observation underscores the value of advanced academic training for cultivating research skills and scientific writing proficiency. The research-intensive

nature of graduate programs likely equips physicians with the tools essential for conducting and disseminating clinical studies.

The current research ecosystem in China reveals significant structural deficiencies, notably the scarcity of specialized research personnel and technological limitations in data management.¹⁷ Existing electronic medical record systems often lack the sophistication required for comprehensive research endeavors, creating substantial obstacles for clinicians seeking to engage in scientific investigations.^{9,18} These limitations hinder the ability to efficiently collect, integrate, and analyze data, which are essential components of high-quality research. As a result, researchers face challenges in producing reliable and impactful scientific findings.

This study's findings offer key recommendations to enhance clinical research engagement and output among anesthesiologists by addressing identified barriers and challenges. To overcome the challenges identified in this study, a multifaceted approach is required. Healthcare institutions must strategically adjust physician work schedules to reduce burnout among anesthesiologists⁶ and increase investment in research funding to build a solid foundation for clinical studies.⁸ These measures collectively aim to cultivate an environment conducive to research and to create pathways for professional growth within the field. Additionally, regular targeted training,¹⁹ along with the establishment of mechanisms such as enhanced research incentives and increased opportunities for clinical research training in various settings,²⁰ will actively encourage anesthesiologists to initiate and participate in clinical research. This approach will not only facilitate the development of clinical research expertise but also promote the subsequent translation of research findings into scholarly publications and other outcomes.²¹ While professional title promotion remains a significant external motivator, strengthening intrinsic motivation is equally essential. This can be achieved by increasing research funding, introducing innovative incentive mechanisms, and providing greater rewards for high-quality research outputs.²² To cultivate and maintain a proactive research team, bureaucratic hurdles should be minimized, and the involvement of team leaders should be maximized.²³ These insights highlight the need for earlier integration of research training in medical education. Introducing robust clinical research curricula at the undergraduate level could accelerate the development of research competencies among future physicians.²⁴ Designing curricula that stimulate research-oriented thinking, curiosity, and positive self-efficacy will further enhance students' enthusiasm for research.²⁵ Finally, establishing robust databases and information-sharing platforms is crucial for lowering research barriers. These resources would give physicians easier access to valuable research materials and support.^{26,27} Additionally, fostering multidisciplinary collaboration should be prioritized, as joint clinical studies across diverse fields will broaden the scope and depth of research efforts.¹⁴

This study had some limitations. First, certain subjective factors inherent to participants may have introduced bias into the results. Second, while the questionnaire content was meticulously crafted based on symposium outcomes and the expertise of a multidisciplinary team, it cannot be considered exhaustive in its coverage of all aspects pertinent to anesthesiologists' clinical research. For instance, there is a lack of comprehensive assessment of anesthesiologists' knowledge of clinical research methodologies. Finally, this study only captured data on anesthesiologists' clinical research-related issues within a specific temporal window. The implementation of targeted clinical training programs aims to enhance both the capacity and motivation of anesthesiologists in conducting clinical research. Subsequently, longitudinal follow-up studies will be conducted to evaluate the efficacy of these interventions and to track progress over time.

Conclusion

In summary, the findings of this study underscore the critical barriers and opportunities for enhancing the involvement of anesthesiologists in clinical research. While there is a strong interest in research, barriers such as lack of time, insufficient research skills, and limited funding opportunities significantly hinder research productivity. These challenges suggest a pressing need for targeted interventions to support anesthesiologists in overcoming these obstacles. Career progression remains a central driver of participation, emphasizing the importance of creating pathways that align research involvement with professional development. Furthermore, the study highlights the importance of specialized training, particularly in areas like statistical analysis and research design, to enhance research competence. Notably, factors such as educational background, professional title, and prior research

experience were found to play a significant role in shaping research output. These findings suggest that addressing these challenges through improved resources, targeted training programs, and structural support will be crucial for fostering a more robust and sustainable research culture within the field of anesthesiology. By implementing these changes, we can better equip anesthesiologists to contribute meaningfully to clinical research, ultimately advancing the field and improving patient outcomes.

Data Sharing Statement

The corresponding author can provide the datasets used and analyzed in this study upon reasonable request.

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Disclosure

The authors declare no competing interests in this work.

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