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Heterogeneity of research competence among operating room nurses in eastern China: A latent profile analysis

Chenghuan Zhang
The Third Affiliated Hospital of Soochow University, The First People's Hospital of Changzhou)
Qingqing Zhang
The Third Affiliated Hospital of Soochow University, The First People's Hospital of Changzhou)
Xiaomeng Wen
The Third Affiliated Hospital of Soochow University, The First People's Hospital of Changzhou)
Linjia Feng
The Third Affiliated Hospital of Soochow University, The First People's Hospital of Changzhou)
Zhuyue Jiang
The Third Affiliated Hospital of Soochow University, The First People's Hospital of Changzhou)
Xiaoyun Han
hxy1427@qq.com

The Third Affiliated Hospital of Soochow University (The First People's Hospital of Changzhou)

Research Article

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Abstract

Background

Research competence is essential for evidence-informed perioperative nursing practice, yet operating room nurses' research competence may be heterogeneous. Evidence on competence profiles and associated factors in this workforce remains limited. This study aimed to identify latent profiles of research competence among operating room nurses, and examine factors associated with profile membership.

Methods

A cross-sectional online survey was conducted in July 2025 among operating room nurses working in tertiary hospitals in eastern China. Measures included the Nursing Research Competence Self-Assessment Scale, the Research Motivation Scale, and the General Self-Efficacy Scale. Latent profile analysis was performed using Mplus 8.3. Profile differences were examined using appropriate tests for categorical and continuous variables. Multivariable multinomial logistic regression was used to identify factors associated with profile membership, using the high-competence profile as the reference.

Results

A total of 1,654 nurses participated in this study. Three profiles were identified: low-competence (47.5%), moderate-competence (43.2%), and high-competence (9.3%). Multivariable multinomial logistic regression revealed that, membership in the low-competence profile was associated with lower general self-efficacy, lower educational attainment, more irregular (less regular) literature reading, lack of research project involvement, stronger failure-avoidance motivation, and lack of research training experience. Membership in the moderate-competence profile was associated with lower general self-efficacy, more irregular (less regular) literature reading, lack of research project involvement, and stronger failure-avoidance motivation ($P < 0.05$).

Conclusions

Operating room nurses in eastern China showed substantial heterogeneity in research competence, with most nurses classified into low or moderate profiles. Strategies to strengthen research competence should prioritize self-efficacy enhancement, structured research training access, and supported pathways for participation and leadership in research projects, while addressing maladaptive failure-avoidance motivation.

1. Introduction

Perioperative nursing is delivered in high-risk, time-critical, and technology-intensive environments, where even minor deviations in clinical processes may disproportionately compromise patient safety. Consequently, strengthening perioperative nurses' capacity to appraise and generate evidence is fundamental to sustaining safe practice, quality improvement, and evidence-based practice (EBP) within operating room settings[1]. However, translating evidence into local workflows and initiating practice-oriented clinical inquiry require nurses to possess not only awareness of EBP principles but also the competence to actively engage in and conduct research activities[2, 3].

Nursing research competence, also referred to as nursing research capability, is commonly conceptualized as a multidimensional construct encompassing problem identification, critical appraisal of the literature, research design,

data collection and analysis, interpretation of findings, and dissemination of results. This competence enables nurses to undertake research independently or collaboratively within clinical settings[2, 4]. Recent methodological studies further indicate that existing assessment instruments capture overlapping yet distinct domains of research competence, with considerable variability in psychometric quality across tools. These findings underscore the need for context-specific assessment and targeted capacity-building strategies rather than uniform, generalized training approaches[5].

Despite sustained policy initiatives and professional advocacy to promote nurses' research engagement, empirical evidence consistently demonstrates low levels of participation in research-related activities, such as involvement in research projects, conference presentations, and scholarly publication. Such limited engagement is influenced by both individual and organizational factors, including educational background, research self-efficacy, mentorship availability, protected research time, and institutional support structures[3, 6, 7]. Similarly, studies on research utilization highlight persistent barriers such as time constraints, limited research literacy, and inadequate organizational support, suggesting that effective research capacity development must be embedded within supportive workplace environments[8, 9].

Importantly, research competence among nurses is unlikely to be homogeneous. Variable-centred analyses based on mean scores may obscure meaningful subgroups with distinct competence profiles and differentiated training needs. Person-centred analytical approaches, such as latent profile analysis (LPA), have increasingly been applied in nursing research to identify competence patterns and examine their associations with individual and contextual factors, thereby generating evidence to inform precision training and management strategies[10, 11]. However, research profiling among operating room nurses remains scarce, and the latent structure of research competence and its correlates among operating room nurses in Eastern contexts is largely unexplored. Accordingly, this study aimed to: (1) identify latent profiles of research competence among operating room nurses using LPA, and (2) to examine individual and workplace factors associated with profile membership. The findings are expected to provide empirical evidence to inform tailored competence development initiatives and targeted managerial interventions, ultimately strengthening research capacity in perioperative nursing practice.

2. Methods

2.1. Study Design and Participants

A cross-sectional, web-based survey was conducted in July 2025 among operating room nurses working in tertiary hospitals in eastern China. Participants were recruited using convenience sampling. Eligible participants were registered nurses currently employed in operating rooms of tertiary hospitals who held a valid nursing practice certificate within the official registration period and provided informed consent to participate. Nurses who were student nurses, interns, or trainees were excluded. In addition, nurses who were not actively working during the survey period (e.g., due to sick leave or maternity leave) were also excluded. Simulation and methodological research suggests that larger sample sizes improve the likelihood of correctly identifying the true number of latent profiles and yield more stable parameter estimates, particularly when profile separation is limited and the number of indicators is moderate to large[12–14]. Accordingly, we aimed to recruit as many eligible operating room nurses as possible. Questionnaires with incomplete or invalid responses were retained during the initial data collection phase. The final analytic sample comprised 1,654 participants, which was considered adequate for conducting latent profile analysis with 30 indicators as well as subsequent regression analyses.

2.2. Measurements

2.2.1. General Information Questionnaire

A self-administered questionnaire was used to collect participants' demographic and occupational characteristics, including age, gender, highest educational attainment, years of nursing practice, and years of operating room experience. In addition, information on research-related exposure was collected. Research-related variables comprised frequency of reading nursing-related scientific literature, categorized according to predefined response options; experience in publishing scientific papers (yes/no); experience in research project involvement (yes/no); and participation in research training activities (yes/no or ordinal categories, as applicable).

2.2.2. Nursing Research Competence Self-Assessment Scale

Nursing research competence was assessed using the Nursing Research Competence Self-Assessment Scale (30 items), which covers six domains: problem identification, literature comprehension, research design, research implementation, data processing/analysis, and academic writing[15]. Each item is rated on a 5-point scale from 0 ("completely unable") to 4 ("completely able"), with higher scores indicating stronger self-assessed research competence (total score range: 0–120). The scale has been used in Chinese nurse populations with good internal consistency[16]. The reported Cronbach's α for the overall scale in this study is 0.902.

2.2.3. Research Motivation Scale

The Chinese version of the Research Motivation Scale (RMS) was translated and revised by Ji[17] in 2012. The revised Chinese version comprises 19 items across three dimensions: internal motivation, avoiding-failure motivation, and external motivation. Items are rated on a 5-point Likert scale, with higher scores indicating stronger research motivation. The mean score of each dimension was calculated as the dimension score. The scale has been used in Chinese nurses with good internal consistency[18]. The Cronbach's α was 0.88 in this research.

2.2.4. General Self-Efficacy Scale

General self-efficacy was assessed using the General Self-Efficacy Scale (GSES) (10 items). Each item is rated on a 4-point scale (1–4), with total scores ranging from 10 to 40; higher scores indicate higher general self-efficacy. The scale was originally developed by Matthias Jerusalem and Ralf Schwarzer, and has been validated in Chinese populations[19, 20]. In the present study, internal consistency was evaluated using Cronbach's α (0.82).

2.3. Data collection

The survey was administered online using Wenjuanxing (https://www.wjx.cn/). An information page presented the study purpose, confidentiality statement, and instructions, and electronic informed consent was obtained before participants could proceed. The survey link was disseminated through the WeChat group of the Operating Room Nursing Professional Committee of the Jiangsu Nursing Society. The survey was open during July 2025. After closure, submitted questionnaires were screened for completeness and internal logical consistency; questionnaires failing these checks were excluded (n = 26). A total of 1,654 questionnaires were retained for analysis, representing 98.45% of submitted questionnaires (1,654/1,680).

2.4. Statistical Analysis

All statistical analyses were conducted using IBM SPSS Statistics version 26.0 and Mplus version 8.3. Categorical variables are presented as frequencies and percentages, whereas continuous variables are reported as means with standard deviations or medians with interquartile ranges, as appropriate. Group differences were examined using χ^2 tests for categorical variables and one-way analysis of variance (ANOVA) or Kruskal–Wallis tests for continuous variables, depending on data distribution. A two-tailed p value < 0.05 was considered statistically significant. LPA was performed using the 30 item-level scores of the Nursing Research Competency Self-Assessment Scale, with each item scored on a 5-point scale ranging from 0 to 4. A series of models specifying one to five latent profiles were estimated and compared. Model selection was based on a combination of statistical fit, classification precision, and substantive

interpretability. Specifically, the Akaike information criterion (AIC), Bayesian information criterion (BIC), and sample-size adjusted BIC (aBIC) were used, with lower values indicating better fit[21]. Classification quality was evaluated using entropy, with values > 0.80 indicating good separation. In addition, the bootstrap likelihood ratio test (BLRT) and the Lo–Mendell–Rubin adjusted likelihood ratio test (LMR-LRT) were used to assess whether adding an additional class yielded a statistically significant improvement in fit[22]. The final number of classes was determined by jointly considering these criteria, theoretical interpretability, and the minimum class size. After identifying the optimal latent profile solution, individuals were assigned to the profile with the highest posterior membership probability. Multivariate multinomial logistic regression analyses were subsequently conducted to examine factors associated with latent profile membership. Predictor variables that were statistically significant in univariate analyses were entered into the multivariate model. Results are reported as odds ratios (ORs) with corresponding 95% confidence intervals (CIs).

2.5. Ethical Consideration

This research was approved by the Medical Ethics Committee of First People's Hospital of Changzhou (Approval No. 2025.109). All participants were informed of the purpose of the study prior to recruitment. Only individuals who voluntarily agreed to participate in this anonymous survey were invited to complete the questionnaire, and informed consent was obtained from all participants. To protect the individual's privacy, all data were preserved anonymously and treated with strict confidentiality.

3. Results

3.1. Participant characteristics

A total of 1,654 valid questionnaires from operating room nurses working in tertiary hospitals in Jiangsu Province were included in the analysis. The mean total score on the Nursing Research Competence Self-Assessment Scale was 47.82 ± 21.56. Among the participants, 34.10% were aged ≤ 30 years (n = 564), and 47.58% were registered nurses (n = 787). Additionally, 522 nurses (31.56%) reported ≤ 5 years of operating room experience. Further details regarding participants' demographic and occupational characteristics are presented in Table 1.

Table 1
Comparison of demographic and occupational characteristics between the three profiles by latent profile membership (*n* = 1654)

Variables	Total sample (*n* = 1654)	C1 (*n* = 786)	C2 (*n* = 714)	C3 (*n* = 154)	x^2	*P*
Gender					6.225	0.044
Male	194 (11.73)	76 (9.67)	96 (13.45)	22 (14.29)		
Female	1460 (88.27)	710 (90.33)	618 (86.55)	132 (85.71)		
Education background					24.452	< 0.001
College or below	186 (11.25)	74 (9.41)	90 (12.61)	22 (14.29)		
University	1444 (87.30)	710 (90.33)	612 (85.71)	122 (79.22)		
Masters or above	24 (1.45)	2 (0.25)	12 (1.68)	10 (6.49)		
Age (Years)					32.355	< 0.001
≤ 30	564 (34.10)	239 (30.41)	248 (34.73)	77 (50.00)		
31 ~ 40	731 (42.20)	389 (49.49)	289 (40.48)	53 (34.42)		
41 ~ 50	286 (17.29)	128 (16.29)	140 (19.61)	18 (11.69)		
≥ 51	73 (4.41)	30 (3.82)	37 (5.18)	6 (3.90)		
Professional title					28.949	< 0.001
Registered Nurse	787 (47.58)	361 (45.93)	334 (46.78)	92 (59.74)		
Charge Nurse	650 (39.30)	344 (43.77)	258 (36.13)	48 (31.17)		
Chief Nurse Practitioner	217 (13.12)	81 (10.31)	122 (17.09)	14 (9.09)		
Operating room work experience (Years)					32.819	< 0.001
≤ 5	522 (31.56)	217 (27.61)	234 (32.77)	71 (46.10)		
6 ~ 10	356 (21.52)	186 (23.66)	139 (19.47)	31 (20.13)		
11 ~ 20	537 (32.47)	284 (36.13)	220 (30.81)	33 (21.43)		

Note C1: Low-competence profile, C2: Moderate-competence profile, C3: High-competence profile

Variables	Total sample (n = 1654)	C1 (n = 786)	C2 (n = 714)	C3 (n = 154)	x^2	P
≥ 21	239 (14.45)	99 (12.60)	121 (16.95)	19 (12.34)		
Status as a specialized nurse					11.306	0.004
yes	250 (15.11)	97 (12.34)	132 (18.49)	21 (13.64)		
no	1404 (84.89)	689 (87.66)	582 (81.51)	133 (86.36)		
Frequency of literature reading					69.364	< 0.001
low frequency	299 (18.08)	126 (16.03)	133 (18.63)	40 (25.97)		
moderate frequency	70 (4.23)	12 (1.53)	43 (6.02)	15 (9.74)		
high frequency	12 (0.73)	3 (0.38)	3 (0.42)	6 (3.90)		
irregularly	1273 (76.96)	645 (82.06)	535 (74.93)	93 (60.39)		
Publication experience					7.692	0.021
yes	950 (57.44)	441 (56.11)	433 (60.64)	76 (49.35)		
no	704 (42.56)	345 (43.89)	281 (39.36)	78 (50.65)		
Experience in research project involvement					43.943	< 0.001
no	1362 (82.35)	697 (88.68)	554 (77.59)	111 (72.08)		
yes	292 (17.65)	89 (11.32)	160 (22.41)	43 (27.92)		
Participation in research training					48.57	< 0.001
yes	597 (36.09)	216 (27.48)	310 (43.42)	71 (46.10)		
no	1057 (63.91)	570 (72.52)	404 (56.58)	83 (53.90)		
Research motivation					88.555	< 0.001
Intrinsic Motivation	700 (42.32)	285 (36.26)	323 (45.24)	92 (59.74)		
Avoidance of Failure	374 (22.61)	250 (31.81)	118 (16.53)	6 (3.90)		

Note C1: Low-competence profile, C2: Moderate-competence profile, C3: High-competence profile

Variables	Total sample (n = 1654)	C1 (n = 786)	C2 (n = 714)	C3 (n = 154)	x^2	P
Extrinsic Motivation	580 (34.07)	251 (31.93)	273 (38.25)	56 (36.36)		
General self-efficacy	27.03 ± 4.67	25 (21,29)	30 (27,30)	30 (30, 33)	414.79	< 0.001

Note C1: Low-competence profile, C2: Moderate-competence profile, C3: High-competence profile

3.2. Latent profile analysis of nursing research competence

LPA analysis (Table 2) specifying one to five profiles were estimated and compared. With increasing numbers of profiles, the information criteria (AIC, BIC, and aBIC) decreased monotonically, indicating improved statistical fit for models with more profiles. Classification accuracy was high across candidate models, with entropy ranging from 0.978 to 0.988. The LMR-LRT and BLRT supported improvements in fit for the 2-, 3-, and 4-profile solutions compared with their respective (k–1)-profile models (all p < 0.001). For the 5-profile solution, the LMR-LRT was not significant (p = 0.064), suggesting that adding a fifth profile did not yield a statistically meaningful improvement over the 4-profile model. Although the 4-profile solution showed slightly better information criteria than the 3-profile solution, inspection of the profile patterns indicated that the additional profile mainly reflected a parallel shift in item scores rather than a qualitatively distinct competence pattern. Given the aim of deriving actionable and interpretable subgroups for targeted capacity-building, we therefore selected the more parsimonious three-profile solution, which demonstrated excellent classification quality (entropy = 0.987) and provided clear, practically meaningful strata for subsequent analyses.

Table 2
Fit indices of the latent profile analysis

Latent Profile	AIC	BIC	aBIC	Entropy	P (LMR-LRT)	P (BLRT)	Proportion of each profile
1-profile	129252.01	129576.665	129386.06	-	-	-	1
2-profile	102288.91	102781.301	102492.21	0.983	< 0.001	< 0.001	0.539/0.461
3-profile	91762.601	92422.737	92035.162	0.987	< 0.001	< 0.001	0.475/0.432/0.093
4-profile	83950.504	84778.379	84292.322	0.988	< 0.001	< 0.001	0.119/0.376/0.413/0.092
5-profile	81470.911	82466.526	81881.986	0.978	0.064	< 0.001	0.114/0.326/0.151/0.318/0.090

Note: AIC, akaike information criteria; BIC, bayesian information criteria; aBIC, adjusted bayesian information criterion; LMR-LRT, Lo–Mendell–Rubin adjusted likelihood ratio test; BLRT, bootstrapped likelihood ratio test

Three distinct profiles of nursing research competence were identified and labelled as the low-competence, moderate-competence, and high-competence profiles (Table 3). The majority of participants were classified into the low- and moderate-competence profiles, whereas a smaller proportion belonged to the high-competence profile (9.3%, n = 154). As shown in Fig. 1, the three profiles exhibited a graded pattern across the 30 item indicators: the low-competence profile scored consistently lowest across all competence domains, the moderate-competence profile showed intermediate scores, and the high-competence profile demonstrated uniformly higher scores, indicating broadly

consistent separation across domains rather than domain-specific peaks. Mean total competence scores increased stepwise across profiles (Table 3). Specifically, the low-competence and moderate-competence profiles had mean total scores of 29.73 ± 10.24 and 58.37 ± 7.50, respectively; the high- competence profile had the highest total score.

Table 3
Distribution of nursing research competence in the 3-profile model

Group	*N (%)*	Research competence total score (*M* ± *SD*)
Low-competence profile	786(47.5)	29.73 ± 10.24
Moderate-competence profile	714(43.2)	58.37 ± 7.50
High-competence profile	154(9.3)	91.23 ± 11.19
Note: M, mean; SD, standard deviation.		

3.3. Factors associated with latent profile membership

Univariate analyses (Table 1) demonstrated that latent profile membership differed significantly across multiple demographic and occupational characteristics, including gender, educational background, age, professional title, years of operating room experience, specialised nurse status, frequency of literature reading, publication experience, experience in research project involvement, participation in research training, and research motivation (all $P < 0.05$). Variables that were statistically significant in univariate analyses were subsequently entered into a multinomial logistic regression model, with high-competence profile serving as the reference category (Table 4).

For the low-competence profile compared with the high-competence profile, higher general self-efficacy was associated with lower odds of being classified into the low-competence profile (OR = 0.592, 95% CI 0.548–0.639). Compared with nurses holding a master's degree or above, those with lower educational attainment were significantly more likely to belong to the low-competence profile. Compared with irregular literature reading, low-frequency and moderate-frequency literature reading were associated with reduced odds of low-competence membership (low frequency: OR = 0.561, 95% CI 0.332–0.945; moderate frequency: OR = 0.245, 95% CI 0.096–0.621). Nurses without experience in research project involvement were more likely to be classified into the low-competence profile (OR = 2.851, 95% CI 1.584–5.131). Stronger avoidance-of-failure motivation was positively associated with low-competence membership (OR = 6.675, 95% CI 2.435–18.294), whereas research training experience was associated with lower odds of belonging to the low-competence profile (OR = 0.526, 95% CI 0.329–0.840). For the moderate-competence profile compared with the high-competence profile, higher general self-efficacy was associated with lower odds of moderate-competence membership (OR = 0.743, 95% CI 0.692–0.798). Compared with irregular literature reading, high-frequency literature reading was associated with substantially lower odds of moderate-competence membership (OR = 0.088, 95% CI 0.018–0.431). In contrast, lack of involvement in research projects (OR = 1.910, 95% CI 1.122–3.250) and stronger avoidance-of-failure motivation (OR = 4.004, 95% CI 1.487–10.781) were associated with increased odds of belonging to the moderate-competence profile.

Table 4
Multinomial logistic regression analysis of the latent profile

Variables	Low-competence vs High-competence					Moderate-competence vs High-competence				
	B	*SE*	*P*	*OR*	*95% CI*	*B*	*SE*	*P*	*OR*	*95% CI*
General self-efficacy	-0.525	0.039	< 0.001	0.592	0.548–0.639	-0.297	0.036	< 0.001	0.743	0.692–0.798
Gender										
Male	-0.237	0.322	0.461	0.789	0.420–1.483	0.113	0.294	0.702	1.119	0.629–1.993
Female	Ref					Ref				
Age (Years)										
≤ 30	-0.146	0.963	0.880	0.864	0.131–5.706	-0.591	0.906	0.514	0.554	0.094–3.270
31 ~ 40	0.305	0.868	0.725	1.357	0.248–7.436	-0.121	0.816	0.882	0.886	0.179–4.382
41 ~ 50	0.669	0.647	0.301	1.953	0.550–6.936	0.514	0.601	0.393	1.672	0.515–5.431
≥ 51	Ref					Ref				
Professional title										
Registered Nurse	-0.346	0.631	0.584	0.708	0.205–2.438	-0.423	0.594	0.476	0.655	0.204–2.099
Charge Nurse	0.044	0.487	0.927	1.045	0.403–2.713	-0.281	0.452	0.534	0.755	0.311–1.831
Chief Nurse Practitioner	Ref					Ref				
Operating room work experience (Years)										
≤ 5	-0.452	0.763	0.553	0.636	0.143–2.836	0.291	0.718	0.685	1.338	0.327–5.467
6 ~ 10	-0.098	0.720	0.892	0.907	0.221–3.715	0.332	0.681	0.626	1.393	0.367–5.291
11 ~ 20	0.099	0.638	0.876	1.105	0.316–3.857	0.319	0.600	0.596	1.375	0.424–4.462
≥ 21	Ref					Ref				
Status as a specialized nurse										
Yes	-0.064	0.359	0.859	0.938	0.464–1.897	-0.024	0.336	0.944	0.977	0.506–1.886
No	Ref					Ref				

Variables	Low-competence vs High-competence					Moderate-competence vs High-competence				
	B	*SE*	*P*	*OR*	*95% CI*	*B*	*SE*	*P*	*OR*	*95% CI*
Education background										
College or below	3.399	1.284	0.008	29.939	2.416-370.928	1.321	0.687	0.055	3.747	0.975–14.403
University	3.363	1.236	0.007	28.863	2.559-325.578	0.873	0.609	0.152	2.395	0.726–7.906
Masters or above	Ref					Ref				
Frequency of literature reading										
Low frequency	-0.579	0.266	0.03	0.561	0.332–0.945	-0.471	0.245	0.055	0.624	0.386–1.01
Moderate frequency	-1.408	0.476	0.003	0.245	0.096–0.621	-0.584	0.373	0.118	0.557	0.268–1.159
High frequency	-1.306	0.864	0.13	0.271	0.05–1.471	-2.434	0.813	0.003	0.088	0.018–0.431
Irregularly	Ref					Ref				
Experience in article publication										
Yes	-0.180	0.301	0.551	0.836	0.463–1.508	-0.379	0.285	0.184	0.685	0.392–1.197
No	Ref					Ref				
Experience in research project involvement										
Not involved in the project	1.048	0.3	< 0.001	2.851	1.584–5.131	0.647	0.271	0.017	1.91	1.122–3.25
Participation in research projects	Ref					Ref				
Research Motivation										
Intrinsic Motivation	-0.134	0.224	0.551	0.875	0.564–1.358	-0.186	0.208	0.371	0.83	0.553–1.248
Avoidance of Failure	1.898	0.514	< 0.001	6.675	2.435–18.294	1.387	0.505	0.006	4.004	1.487–10.781
Extrinsic Motivation	Ref					Ref				
Research training experience										

Variables	Low-competence vs High-competence					Moderate-competence vs High-competence				
	B	*SE*	*P*	*OR*	*95% CI*	*B*	*SE*	*P*	*OR*	*95% CI*
Yes	-0.643	0.239	0.007	0.526	0.329–0.84	-0.12	0.222	0.589	0.887	0.574–1.37
No	Ref					Ref				

4. Discussion

In this cross-sectional survey of operating room nurses in tertiary hospitals in eastern China, we identified marked heterogeneity in nursing research competence using a person-centred approach (LPA). Three distinct competence profiles were observed: low-competence, moderate-competence, and high-competence, with most nurses concentrated in the low and moderate profiles. Profile membership was independently associated with individual characteristics: higher self-efficacy and greater engagement in research-related learning and practices were associated with a lower likelihood of belonging to the low or moderate-competence profiles, whereas stronger failure-avoidance motivation showed the opposite association. These findings indicate that research competence among operating room nurses is not uniformly distributed, underscoring the potential value of tiered, trait-specific strategies rather than one-size-fits-all training to strengthen research capacity.

Three distinct research competence profiles among operating room nurses were identified, highlighting meaningful heterogeneity that may be obscured by traditional mean-based analyses. This pattern is consistent with recent profile-based studies conducted in Chinese nursing populations, which likewise reported a three-tiered competence structure, typically characterized by a dominant intermediate group and a relatively small high-competence subgroup[11]. The comparatively large proportion of nurses classified within the low-competence profile in our operating room sample may be attributable to the unique demands of the perioperative environment, where high workflow intensity, frequent interruptions, and competing clinical priorities constrain opportunities for literature appraisal, data analysis, and scholarly dissemination[23]. This interpretation is supported by evidence from the perioperative EBP literature, which suggests that although perioperative nurses generally report positive attitudes toward evidence use, the translation of evidence into routine practice is often limited by time constraints, variability in research literacy, and insufficient organizational support[24]. More broadly, systematic reviews have consistently identified setting-related barriers, most notably insufficient protected time during work hours to implement new ideas, as major impediments to research utilisation. These findings reinforce the notion that efforts to build research competence should be coupled with structural and organizational enablers, rather than delivered as stand-alone training initiatives[9, 25].

Building on the multivariable findings, profile membership was independently associated with general self-efficacy, avoidance-of-failure motivation, and indicators of research engagement and exposure (e.g., more frequent literature reading, participation in research training, and involvement in research projects). Several mechanisms may account for these associations. First, social cognitive theory posits that perceived self-efficacy influences whether individuals initiate challenging tasks, the effort they invest, and their persistence in the face of obstacles[26]. In nursing populations, higher general self-efficacy has been empirically linked to greater competence, suggesting a plausible pathway whereby more confident nurses are more willing to engage in complex research tasks, accumulate mastery experiences, and progressively build research competence[27]. Second, avoidance-of-failure motivation aligns conceptually with performance-avoidance tendencies driven by fear of failure, which have been shown to undermine intrinsic motivation and performance; such tendencies may discourage nurses from engaging in uncertain or evaluative activities (e.g., proposal development, data analysis, manuscript preparation), thereby impeding competence development[28, 29]. Third, behavioral engagement indicators, such as regular literature reading, participation in research training, and involvement in research or quality improvement projects, likely serve as “practice opportunities”

that increase exposure to research methods, feedback, and mentorship. Consistent with the nursing leadership literature, which identifies limited training, mentorship, and protected time as major barriers to nurses' research engagement, access to these enabling conditions may facilitate progression toward higher-competence profiles[30]. Taken together, these mechanisms underscore the importance of providing scaffolded mastery opportunities, supported by mentorship and protected time, within a psychologically safe learning environment.

In addition to individual psychological factors, the associations between educational level and research-related exposures (e.g., literature reading, research training, and project involvement) and profile membership likely reflect differential access to, and accumulation of, "opportunity structures" for building research competence. Nurses with higher levels of educational preparation are more likely to have stronger foundations in research methods and academic writing, facilitating evidence appraisal and more meaningful participation in research activities[6, 7]. Likewise, frequent engagement with the literature, participation in formal research training, and hands-on involvement in research or quality improvement projects may be conceptualized as experiential learning pathways that offer repeated practice, feedback, and mentorship, elements consistently identified as central to the development of clinical nurses' research capacity[3]. Importantly, syntheses of the nursing capacity-building literature emphasize that individual learning is most effective when embedded within supportive organizational contexts (e.g., mentorship or facilitation, access to methodological support, and protected time), whereas limited exposure to such enabling conditions may impede competence development even among highly motivated nurses.

Given the pronounced heterogeneity in research competence among operating room nurses, characterized by low, moderate, and high-competence profiles, and the independent associations of profile membership with self-efficacy, avoidance-of-failure motivation, and research exposure (e.g., literature reading, training, and project participation), perioperative nursing practice should prioritize tailored, phased capacity-building pathways rather than uniform training approaches. Strengthening self-efficacy represents a key leverage point, as self-efficacy theory links stronger efficacy beliefs to greater task initiation, sustained effort, and persistence, behaviors essential for progressing from evidence awareness to the completion of research or quality improvement tasks. In practice, nurses in the low-competence profile should be prioritized for foundational, competence-based development in EBP, including clinical question formulation, evidence appraisal, and the implementation and evaluation of practice change[31]. For nurses in the moderate-competence profile, emphasis should shift toward structured "learning-by-doing" opportunities, such as mentored participation in research and regular, facilitated journal-club–style engagement with the literature[3]. At the unit level, these strategies are unlikely to be sustained without attention to context. Consistent with implementation frameworks, effective capacity building requires the alignment of evidence, context, and facilitation, underscoring the need for locally embedded mentors or facilitators (often drawn from high-competence nurses), access to methodological support, and protected time integrated into routine operating room workflows[32]. Given that setting- and time-related constraints are consistently identified as major barriers to research utilization, operating room leadership should treat time allocation and workflow support as integral components of capacity-building interventions rather than as background conditions[25].

This study has several limitations. First, the use of a web-based convenience sample recruited may have introduced self-selection and coverage bias, potentially limiting representativeness and overestimating research engagement among more motivated nurses. Second, all measures were self-reported and collected at a single time point, raising the possibility of common method variance and social desirability bias. Third, the cross-sectional design precludes causal inference regarding factors associated with profile membership. Finally, the sample was drawn exclusively from tertiary hospitals in a single province, which may limit the generalizability of the findings to other regions and care settings.

5. Conclusions

This study identified three distinct latent profiles of research competence among operating room nurses: low-, moderate-, and high-competence. Most nurses clustered within the low-to-moderate-competence profiles, while only a small proportion demonstrated high research competence. Profile membership was independently associated with several modifiable factors, including general self-efficacy, avoidance-of-failure motivation, educational preparedness, and indicators of research exposure and engagement (e.g., literature reading, research training, and project participation). Together, these findings underscore the need for phased, profile-specific competence-building strategies supported by appropriate organizational enablers within the perioperative setting. Such targeted approaches may strengthen nurses' research capacity and support the advancement of evidence-based perioperative nursing practice.

Abbreviations

EBP
evidence—based practice
GSES
General Self—Efficacy Scale
LPA
latent profile analysis

Declarations

Ethics Approval and Consent to Participate

This research was approved by the Medical Ethics Committee of First People's Hospital of Changzhou (Approval No. 2025.109). All participants were informed of the purpose of the study prior to recruitment. Only individuals who voluntarily agreed to participate in this anonymous survey were invited to complete the questionnaire, and informed consent was obtained from all participants. To protect the individual's privacy, all data were preserved anonymously and treated with strict confidentiality.

Conflicts of Interest

The authors declare no conflicts of interest.

Consent for Publication

Not applicable.

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Author Contribution

C.H.Z., X.M.W, X.Y.H: study conception and design. C.H.Z, Q.Q.Z.: data collection. C.H.Z, X.M.W.: analysis and interpretation of results. C.H.Z.: draft manuscript preparation. We confirm that all listed authors meet the authorship criteria and that all authors are in agreement with the content of the manuscript.

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Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Figures

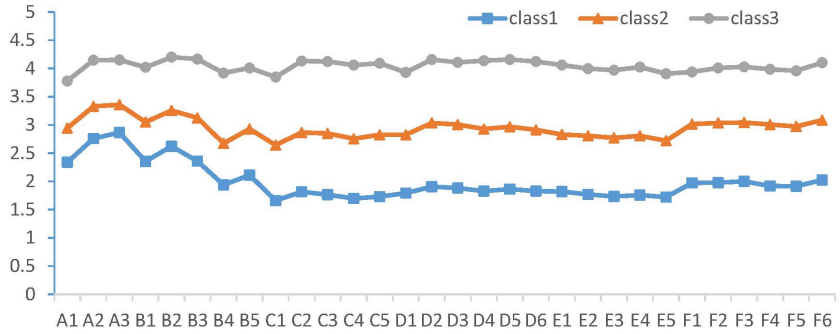


Figure 1

Latent profiles of research competence among operating room nurses

Note: Items A1–A3 represent the Problem Identification dimension; items B1–B5 represent the Literature Review dimension; items C1–C5 represent the Research Design dimension; items D1–D6 represent the Research Practice dimension; items E1–E5 represent the Data Analysis dimension; and items F1–F6 represent the Paper Writing dimension.