RESEARCH

The impact of head nurse empowerment on clinical nurses' innovative behavior: the mediating role of organizational climate and professional autonomy

Yifan Lu[1,2], Shuqi Zhai[2], Qinqin Liu[2], Jie Liu[1*] and Chaoran Chen[1,2*]

Abstract

Background As nursing evolves, innovations in management, technology, and services are critical. The innovative capacity of nurses directly influences healthcare quality, making it essential to explore the factors driving nurses' innovative behaviors.

Aims This study aimed to examine the impact of head nurse empowerment on the innovative behavior of clinical nurses and to explore the mediating role of organizational climate and professional autonomy.

Methods This study surveyed 676 clinical nurses from June to September 2024, using scales for head nurse empowerment, innovative behavior, organizational climate, and professional autonomy. Data analysis was conducted using SPSS 25.0, while AMOS 26.0 was utilized for model mapping and mediation path analysis.

Results Head nurse empowerment was significantly and positively related to clinical nurses' innovative behavior, organizational climate and professional autonomy. Clinical nurses' organizational climate and professional autonomy acted as chain mediators between empowerment and innovative behavior. The overall effect of empowerment on clinical nurses' innovative behaviors ($\beta = 0.635$) consisted of both direct ($\beta = 0.185$) and indirect ($\beta = 0.450$) forms, with the mediating effect accounting for 70.70% of the total effect. The mediator model demonstrated a good fit ($\chi^2/df = 3.248$, GFI = 0.930, AGFI = 0.908, RMR = 0.027, NFI = 0.971, RFI = 0.966, IFI = 0.980, TLI = 0.976, CFI = 0.980, RMSEA = 0.058).

Conclusions Head nurse empowerment positively predicts clinical nurses' innovative behaviors, with organizational climate and professional autonomy acting as chain mediators. This study constructs and validates both dual and chain mediation models, systematically revealing the mechanisms through which empowerment influences nurses' innovative behavior. These findings provide a new theoretical perspective and practical insights for research on innovation in the nursing field. Hospitals should enhance head nurse empowerment, optimize the organizational climate, and support professional autonomy to promote innovative behaviors among clinical nurses.

*Correspondence:
Jie Liu
603838964@qq.com
Chaoran Chen
kfccr@126.com
Full list of author information is available at the end of the article

Introduction

With the advancement of the nursing profession, innovations in nursing management theories, technologies, and services have become crucial for advancing clinical practice and improving care quality. The International Academy of Nursing emphasizes the need for innovation in nursing practice to promote health, reduce health risks, prevent disease, improve healthy living behaviors, and optimize treatment strategies and procedures [1]. The American Nurses Association stresses that all nurses should be leaders within the profession, advocating for policy change and fostering innovation [2]. Similarly, the Chinese Nursing Association highlights the importance of reform and innovation to drive the development of the nursing discipline [3]. Research shows that nurses' innovative behaviors can enhance patient care quality, reduce medical costs, and improve patient outcomes. For example, innovations in workflow can shorten hospital stays, reduce patient fall risks, and lower annual medical expenses. Additionally, nurse-driven innovations in new technologies and service processes improve the effectiveness of patient care and medical services [4, 5]. Thus, nursing managers who effectively leverage the innovative potential of their teams can significantly enhance operational efficiency and strengthen the overall competitiveness of hospital nursing departments.

Background

Innovation is a key factor in the core competitiveness of healthcare organizations, enabling them to remain adaptive and competitive in a changing environment [6]. Nurses, as primary agents of innovation in hospitals, play a critical role in advancing the nursing discipline and contributing to the overall development of healthcare institutions [7]. Nurses as one of the main subjects of innovation in hospitals, nurse innovation behavior has an important role in promoting the nursing discipline as well as the overall development of hospitals [1, 8] However, the high-pressure, demanding nature of nursing work often limits opportunities and motivation for nurses to engage in innovative practices. Therefore, it is essential for managers to motivate and support nurses' innovative behaviors. Empowerment is a management model in which leaders give employees certain autonomous decision-making power and responsibilities in the management process [9]. As a positive leadership style, empowerment enhances nurses' autonomy and support, bolstering their confidence and sense of innovation, ultimately encouraging them to explore new approaches in their work. Zhang et al. (2010) demonstrated that leader empowerment effectively stimulates the innovative potential of employees [10]. Employees who perceive leadership empowerment also stimulate innovative and creative abilities at work, which positively affects employee innovation performance [10]. Moreover, studies of by Lv et al. [11], Zhang et al. [12, 13], and Dan et al. [14] have confirmed that managerial empowerment positively influences the innovative behaviors of clinical nurses, fostering autonomy and creativity, which motivates them to explore new methods and processes to enhance care quality. Despite these findings, the mechanisms underlying the relationship between empowerment and nurses' innovative behavior remain underexplored.

Organizational factors also play a pivotal role in shaping employees' innovative behaviors. Employee innovation requires the support of organizational resources, with organizational climate being a key determinant. Organizational climate refers to employees' collective perception of various organizational aspects, such as social relations, management style, and support systems. It reflects the shared values and behavioral norms within the organization, which significantly influence employees' attitudes and behaviors [15]. According to social cognitive theory, individual behaviors are shaped by both external environmental factors and cognitive influences [16]. A supportive organizational climate enhances employees' self-efficacy and intention to innovate, leading to increased innovative behaviors. Bock et al. (2005) noted that a positive organizational climate stimulates employees' innovative thinking and facilitates its practical application [17]. Similarly, Wang et al. (2020) found a significant positive correlation between organizational climate and the innovative behaviors of clinical nurses [18]. Employees who perceive greater organizational support are more engaged, committed, and likely to display innovative behaviors. Moreover, the empowerment of head nurses can foster an innovation-friendly atmosphere within departments. According to social exchange theory, leaders' empowerment behaviors, which convey trust and support, contribute to the formation of a positive organizational climate, enhancing employees' sense of responsibility and belonging [19]. Therefore, organizational climate may mediate the relationship between head nurse empowerment and clinical nurse innovation behaviors.

Professional autonomy is a core characteristic of nursing, encompassing autonomous decision-making, responsibility, and the ability to manage clinical tasks independently [20]. As the core of the nursing team, head

nurses play a pivotal role in empowering nurses by providing learning opportunities, information support, and work autonomy. This empowerment fosters nurses' motivation and autonomy, ultimately improving the quality of care [21]. Empowerment has been shown to significantly increase professional autonomy, which in turn enhances nurses' motivation and initiative in the workplace [22]. According to self-determination theory, fulfilling the need for autonomy stimulates intrinsic motivation, thereby promoting innovative behavior [23]. Wang et al. [24] found that when nurses have the right to make choices and decisions autonomously in their work, it stimulates their enthusiasm for innovation and increases their willingness to adopt innovative behaviors based on their own ideas. Therefore, professional autonomy may mediate the relationship between head nurse empowerment and clinical nurses' innovative behaviors.

Self-determination theory further suggests that employees are better able to satisfy their need for autonomy in a supportive environment, thus enhancing their intrinsic motivation [23]. A European study on nurses found a significant positive correlation between professional autonomy and innovative behaviors, demonstrating that a higher level of autonomy fosters greater innovation [25]. Thus, the relationship between head nurse empowerment and clinical nurses' innovative behaviors may be influenced first through organizational climate and then through clinical nurses' professional autonomy.

In summary, although existing research has revealed a positive relationship between empowerment and innovative behavior, there is a lack of in-depth exploration of the mechanisms underlying this relationship, particularly regarding the role of organizational climate and professional autonomy as mediating variables. Based on the above analysis, the following hypotheses were made (Fig. 1), to explore how head nurse empowerment affects clinical nurses' innovative behaviors through organizational climate and professional autonomy. It is expected that the research findings will provide theoretical support for nursing management and healthcare policy, thereby promoting nurses' innovative behaviors and ultimately enhancing the quality of nursing services and the overall innovation capacity of hospitals.

Hypothesis 1 Organizational climate mediates the role of head nurse empowerment and clinical nurses' innovative behaviors.

Hypothesis 2 Professional autonomy mediates the relationship between head nurse empowerment and clinical nurses' innovative behaviors.

Hypothesis 3 Head nurse empowerment influences clinical nurses' innovative behavior through the chain-mediated role of organizational climate and professional autonomy.

Methods
Study design
This cross-sectional study was conducted from June to September 2024 and collected data from a diverse group of nurses in two tertiary care hospitals in Henan Province, China. The aim of this study was to investigate the mediating role of organizational climate and professional autonomy in head nurse empowerment and clinical nurses' innovative behaviors. This study was conducted and reported in accordance with the STROBE guidelines to ensure the quality and transparency of the reporting.

Participants and data collection
Prior to data collection, the research team communicated formally with the nursing departments of the two hospitals, detailing the background, purpose, and significance of the study, and gained the recognition and support of the nursing departments. With the support and coordination of the nursing departments of the hospitals, the questionnaires were distributed and collected online through WeChat groups, such as nurse leaders' workgroups and departmental workgroups, and nurses who met the requirements participated in the surveys and completed the questionnaires through the links, which would be automatically collected by the system. Thus, the coverage and participation of potential participants were optimized. The entire process was anonymous and voluntary, ensuring participant consent and data confidentiality. Of the 692 distributed surveys between June and September 2024, all incomplete questionnaires were excluded, and 676 were considered valid and complete for inclusion in the analysis, enhancing the robustness of the dataset. Post-hoc analyses using G*Power were conducted to assess the statistical power, confirming that the final sample size was sufficient to meet analytical requirements.
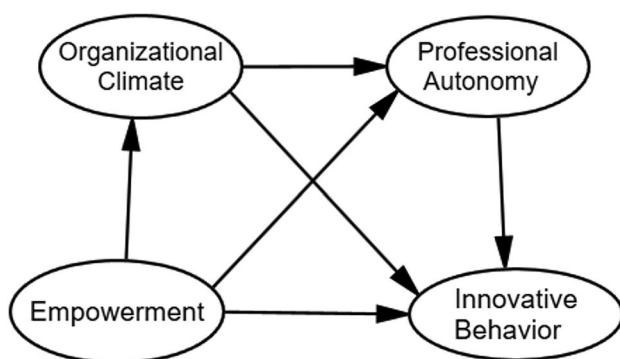

Fig. 1 Conceptual framework and hypothesis

Lu *et al. BMC Nursing*   (2025) 24:574

Page 4 of 9

Inclusion Criteria: (a) Clinical registered nurses; (b) Nurses directly involved in the clinical care of patients; and (c) Nurses who gave informed consent and voluntarily cooperated in this survey. Exclusion criteria (a) nurses in further training; and (b) nurses who were on leave during the survey period.

Measures
Empowerment
Head nurse empowerment behaviors were measured by Nurse Managers′ Empowering Behavioral Scale for Staff Nurses Scale, which was developed by Sasaki [26] and revised by Wen Juan [27], with 5 dimensions and 47 entries, using a 5-point Likert scale, with scores ranging from 1 to 5 on a scale from "strongly disagree" to "strongly agree". The total score ranged from 47 to 235, with higher scores indicating that the head nurse's empowerment behaviors were better perceived by the nursing staff. The overall Cronbach's alpha coefficient of the scale was 0.957, and in this study, the Cronbach's alpha coefficient of the scale was 0.989.

Innovative behavior
Nurses' innovative behavior was measured by the Nurses' Innovative Behavior Scale, which was developed by Bao Ling et al. [28] and contains 10 items in 3 dimensions. A 5-point Likert scale was used, with scores ranging from 1 to 5 corresponding to "never"never to"frequently", and total scores ranging from 10 to 50. The higher the score, the more innovative the nurse's behavior. The overall Cronbach's a coefficient of the scale was 0.879, and the Cronbach's alpha coefficient of the scale was 0.939 in this study.

Organizational climate
The Nursing Organizational Climate Scale developed by He [29], and consists of 4 dimensions with 24 items: fair and supportive behavior (10 items), co-worker behavior (5 items), interpersonal climate behavior (4 items) and intimate and aggressive climate behavior (5 items). A 5-point Likert scale was used, ranging from "very non-compliant" to "very compliant", with higher scores indicating a better organizational climate. The Cronbach's coefficient for the scale was 0.927, and in this study, the Cronbach's alpha coefficient for the scale was 0.983.

Professional autonomy
Nurses' professional autonomy was measured using the Nurses' Professional Autonomy Scale developed by Taiwanese nursing expert Mei-Chih Ou Li [30], which has 8 dimensions and 41 entries. The scale was rated on a 6-point Likert scale, with 1 to 6 ranging from "very non-compliant" to "very compliant", and the total score ranging from 41 to 246, with the level of score representing the level of nurses' professional autonomy. The overall Cronbach's a coefficient of the scale was 0.906, with good reliability and validity, and the Cronbach's alpha coefficient of the scale in this study was 0.989.

Ethical approval
This study was approved by the Ethics Committee of Henan University (Ethical Review No. HUSOM2022-375), and permission was obtained from the nursing departments and hospital administrations of the participating institutions. This study was conducted in accordance with the principles of the Declaration of Helsinki. It strictly adhered to the principles of informed consent, voluntary participation, and data anonymity to ensure compliance with ethical standards and safeguard participant privacy.

Data analysis
We used SPSS 25.0 and AMOS 26.0 for data analysis. First, descriptive statistics were used to measure participants' demographic characteristics and head nurses' empowerment, innovative behaviors, organizational climate, and professional autonomy. Second, Pearson correlation analysis was used to examine the relationship between the four variables of empowerment, innovative behavior, organizational climate, and professional autonomy [31]. Skewness and kurtosis were used to test the normality of the data. Finally, the chain mediation model was tested using AMOS 26.0, where empowerment is the independent variable, innovative behavior is the dependent variable, and organizational climate and professional autonomy are the mediators. In addition, to investigate the effect of head nurse empowerment on clinical nurses' innovative behavior, we performed bias-corrected percentile bootstrapping with a 95% confidence interval calculated from a bootstrap sample of 5000. p-values were two-tailed and $p < 0.05$ was considered statistically significant.

Results
Participant characteristics
A total of 676 nurses were incorporated into this research. The characteristics of the nurses are displayed in Table 1.

Pearson's correlation analysis
The results of our statistical analyses show significant correlations between the key variables as shown in Table 2. The correlation coefficients between these variables ranged from 0.540 to 0.790, indicating moderate to strong positive correlations, and all correlations were statistically significant with p-values less than 0.001. The results showed that empowerment was significantly and positively correlated with innovative behavior ($r = 0.296$),

Lu *et al. BMC Nursing*   (2025) 24:574

Page 5 of 9

Table 1 Demographic characteristics (*N* = 676)

Variables		N	%
Age	≤ 25	121	12.70
	26–35	516	48.20
	36~45	393	35.50
	> 46	47	3.60
Gender	Male	108	15.98
	Female	568	84.02
Married status	Single	122	18.00
	Married	538	79.60
	Divorced or widowed	16	2.40
Departments	Internal Medicine	234	34.62
	Surgery	221	32.69
	Gynaecology	19	2.81
	Paediatrics	16	3.37
	Emergency	33	4.88
	Outpatient	47	6.95
	ICU	39	5.77
	Operating theatre	29	4.29
	Others	38	5.62
Educational background	Junior college or below	26	3.80
	Bachelor's	604	89.30
	Master's or above	46	6.80
Professional title	Nurse	136	20.10
	Senior nurse	345	51.00
	Nurse-in-charge	149	22.00
	Deputy chief nurse or above	46	6.80
Years of working	< 2	32	4.70
	2–5	108	16.00
	6–10	150	22.20
	> 10	386	57.10
Labor and personnel relations	Formal establishment	129	19.10
	Personnel agency	68	10.10
	Contract system	465	68.80
	Labor dispatch worker	14	2.10
Monthly income (¥)	≤ 4000	75	11.10
	4001~7000	374	55.30
	7001~10,000	145	21.40
	≥ 10,001	82	12.10
Average number of night shifts per month	0 time	91	13.50
	1–4 times	189	28.00
	5–8 times	298	44.10
	> 8 times	98	14.50
Average daily working hours	< 8 h	56	8.30
	8–10 h	537	79.40
	> 10 h	83	12.30

organizational climate (*r* = 0.540), and professional autonomy (*r* = 0.510).

Multiple mediation analysis and hypothesis testing
As shown in Fig. 2. Head nurse empowerment behaviors (β = 0.19, *p* < 0.001), organizational climate (β = 0.45,

p < 0.001), and professional autonomy (β = 0.29, *p* < 0.001) significantly and positively predicted innovative behaviors of clinical nurses.

To verify the mediating role of organizational climate and professional autonomy between empowerment and innovative behavior, we used the Bootstrap method with percentile bias correction. The results indicate that organizational climate and professional autonomy mediated significantly between the two variables, with a total indirect effect of 0. 450. Specifically, the mediation in this study consisted of 3 paths. The first path was the indirect effect of head nurse empowerment on clinical nurses' innovative behaviors through organizational climate, which verified Hypothesis 1; the second path was the indirect effect of head nurse empowerment on clinical nurses' innovative behaviors through professional autonomy, validating Hypothesis 2; the third pathway is that organizational climate and job autonomy act as chain mediators between nurse leaders' empowerment and innovative behaviors, validating hypothesis 3. Details are shown in Table 3; Fig. 2.

Model fit analysis
As presented in Table 4. The model fit was assessed using multiple indices. The $\chi^2/df = 3.248$ (< 5.0) indicates an acceptable fit. The GFI = 0.930 and AGFI = 0.908 (> 0.90) suggest a good model-data fit. The RMR = 0.027, a measure of residuals, is within an acceptable range. The NFI = 0.971 and RFI = 0.966 (> 0.90) indicate a strong relative fit. The IFI = 0.980, TLI = 0.976, and CFI = 0.980 (> 0.90) confirm a good incremental fit [32]. Finally, the RMSEA = 0.058 (< 0.08) suggests a reasonable fit, accounting for model complexity. Collectively, these indices support the model's good fit to the data, supporting the robustness of our structural equation model.

Discussion
First, the results indicate that head nurse empowerment positively predicts clinical nurses' innovative behaviors, with organizational climate serving as a mediator. This finding aligns with previous research, such as Zhang et al. [33], who found that leader empowerment fosters trust, reduces employee anxiety, and enhances psychological safety, ultimately promoting creativity and a positive work climate. Organizational factors such as perceived fairness [34] and an innovative climate [35] are crucial in shaping employees' innovative behaviors. As an integral part of the organizational environment, an innovation-supportive climate strengthens the psychological bond between hospitals and nurses, influencing their motivation and engagement in innovation [36]. Research by Zhang [37] and Yao et al. [38] further confirms that managerial empowerment positively correlates with an organizational innovation climate, which, in turn,

Table 2 Descriptive statistics and correlations of the study variables (*N* = 676)

Variable	Empowerment	OC	PA	IB	Mean	Standard deviation
Empowerment	1				32.29	8.89
OC	0.540**	1			69.39	17.27
PA	0.510**	0.651**	1		161.97	42.92
IB	0.629**	0.790**	0.781**	1	31.27	7.10

Note: OC: Organizational Climate; PA: Professional Autonomy; IB: Innovative Behavior
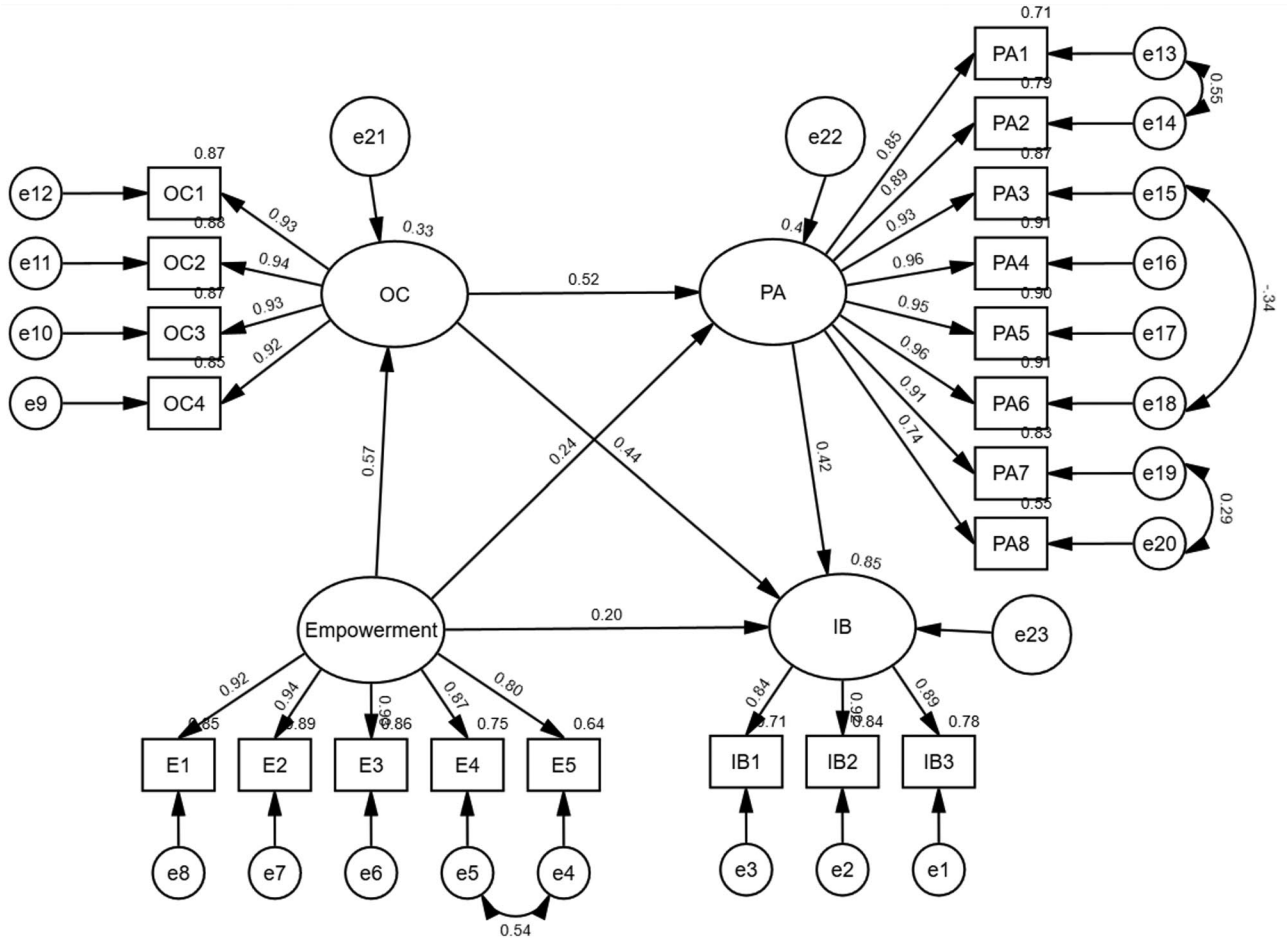
** *P* < 0.01 (Two tailed)

Fig. 2 Path analysis diagram of empowerment, organizational climate, professional autonomy and innovative behavior. Note: OC: Organizational Climate; PA: Professional Autonomy; IB: Innovative Behavior; OC1-OC4: represent four dimensions of organizational climate; PA1-PA8: represent eight dimensions of professional autonomy; E1-E3: represent five dimensions of empowerment; IB1-IB3: represent three dimensions of innovative behavior

enhances employees' intrinsic motivation for innovation and improves work performance [35, 39, 40]. These findings suggest that head nurse empowerment exerts a dual influence—both direct and indirect—on innovation by fostering an organizational climate that facilitates communication and idea sharing. A psychologically safe and open climate, reinforced by empowering leadership, allows nurses to feel valued and supported, which is essential for stimulating bottom-up innovation. Moreover, by nurturing a sense of collective efficacy and shared vision, empowered leadership can foster sustained engagement in innovative behaviors, which is vital for

addressing complex clinical challenges and improving care outcomes.

Second, our findings suggest that professional autonomy mediates the relationship between head nurse empowerment and clinical nurses' innovative behaviors. This implies that when head nurses provide greater empowerment and support, nurses' autonomy is enhanced, which further fosters their innovative behaviors. For instance, studies on oncology nurses have shown that managerial empowerment strengthens work autonomy [21], which in turn stimulates creativity [41, 42]. By reinforcing nurses' sense of professional control,

Table 3 Overall, direct and indirect effects of perceived overqualification on turnover intention (N = 676)

Effect	Path relationship	Effect	Boot-strap SE	Boot-strap 95% CI
Direction effect	Empowerment→OC	0.186	0.026	(0.136 to 0. 239)
Indirect effect	PO→OC→TI	0.239	0.023	(0.195 to 0. 286)
	PO→CC→TI	0.094	0.018	(0.061 to 0.132)
	PO→OC→CC→TI	0.117	0.014	(0.092 to 0.146)
Total mediating effect	PO→TI	0.450	0.032	(0.136 to 0.239)
Total effect	Total indirect effect	0.635	0.041	(0.556 to 0.716)

Note: OC: Organizational Climate; PA: Professional Autonomy; IB: Innovative Behavior

empowerment not only enhances their willingness to explore innovative care practices but also contributes to improved patient outcomes. These results highlight that autonomy is not only a product of structural delegation but also a psychological state reinforced by a supportive leadership approach. When nurses perceive that their professional judgment is respected and their contributions are acknowledged, they are more inclined to take initiative and explore new solutions. This autonomy-driven motivation plays a pivotal role in enabling nurses to translate clinical observations into practice-based innovations, especially in fast-evolving and resource-constrained healthcare environments.

Furthermore, professional autonomy was found to mediate the relationship between organizational climate and innovative behaviors. This suggests that a positive organizational climate enhances nurses' professional autonomy, which subsequently promotes their innovative behaviors. This finding is in line with Deci and Ryan's self-determination theory [43], which posits that a supportive organizational climate enhances employees' sense of autonomy, leading to greater intrinsic motivation and creativity. Moreover, employees with higher autonomy are more likely to proactively solve workplace challenges and contribute to care process improvements [44]. A favorable climate characterized by fairness, open communication, and recognition of contributions creates the conditions necessary for nurses to fully exercise their professional competencies. Such an environment not only increases confidence in decision-making but also reinforces a sense of ownership and purpose. These psychosocial resources are critical for sustaining innovation

behavior and aligning personal goals with organizational objectives. Therefore, the interaction between organizational climate and autonomy functions as an important mechanism through which innovation can be embedded into everyday nursing practice.

Implications
Firstly, strengthening leadership empowerment. Hospitals should enhance the leadership competencies of head nurses through structured, multi-dimensional training programs, including evidence-based leadership, conflict resolution [45], effective management strategies, emotional intelligence development [46], and decision-making and execution skills [47]. Regular evaluations and seminars should be conducted to assess the application and effectiveness of these programs, ensuring ongoing quality improvement and alignment with organizational goals [40, 48].

Secondly, optimizing organizational climate. Creating an open and inclusive organizational culture is essential. Nurse managers should promote transparent communication, recognize staff contributions, and facilitate team-building and interdepartmental collaboration to strengthen trust, cohesion, and a positive work atmosphere [49]. Task assignments should be aligned with team members' strengths and supported by appropriate delegation and incentives to improve efficiency and morale [50].

Furthermore, enhancing professional autonomy. Healthcare organizations should prioritize creating a supportive work environment for clinical nurses by fostering a positive workplace atmosphere [51], establishing clear unit policies, ensuring adequate resources, and maintaining appropriate workloads. Such measures can enhance nurses' professional autonomy [52]. Additionally, nursing managers should progressively delegate decision-making authority to nurses, enabling them to exercise professional judgment in their daily practice. For instance, allowing nurses to propose personalized improvements to nursing processes or adjustments to patient care plans can foster confidence in their ability to innovate [53].

Supporting continuous professional development. Healthcare institutions should provide ongoing training in both clinical competencies and innovation-related skills. This includes inviting external experts for workshops and offering courses focused on innovative thinking and independent learning. Such initiatives help nurses enhance their autonomy and develop practical solutions for complex clinical scenarios [54], ultimately encouraging them to explore and implement innovative

Table 4 Model fit summary

Model Fit	χ^2/df	GFI	AGFI	RMR	NFI	RFI	IFI	TLI	CFI	RMSEA
	3.248	0.930	0.908	0.027	0.971	0.966	0.980	0.976	0.980	0.058

Lu *et al. BMC Nursing*   (2025) 24:574

Page 8 of 9

approaches in their daily work, thereby improving the overall quality of care.

Limitations
There are some limitations to this study. First, our study population consisted of nurses working in tertiary hospitals in China, which may limit the generalizability of our findings. To enhance sample representativeness, future studies could adopt more diverse sampling strategies, such as multicenter sampling or random sampling, to improve the applicability of the results across different healthcare settings. Second, the cross-sectional design of this study can reveal associations between variables but cannot establish causal relationships. Future research could employ longitudinal designs or experimental studies to further explore the causal mechanisms between empowerment and innovative behavior. Third, reliance on self-reported survey instruments may introduce common method bias. To improve data validity and reduce potential biases, future studies could integrate multiple data sources, such as peer assessments, supervisor evaluations, or objective performance indicators. Finally, given that healthcare systems and cultural contexts may vary across regions, future research should consider conducting cross-cultural studies to validate the findings in different healthcare systems and cultural contexts, so as to assess the robustness and broader applicability of the results.

Conclusion
The findings indicate that head nurse empowerment positively influences nurses' innovative behaviors, with organizational climate and professional autonomy as key mediators. To foster nursing innovation, nursing leaders and policymakers should prioritize creating a supportive organizational climate and enhancing nurses' professional autonomy, thereby encouraging innovation and improving care quality. This study underscores the critical role of leadership in implementing empowerment strategies and cultivating an environment conducive to innovation. Future research should explore longitudinal studies and targeted interventions to further validate the impact of empowerment.

Abbreviations
OC   Organizational Climate
PA   Professional Autonomy
IB   Innovative Behavior

Declarations

Ethical approval
All participants in our study voluntarily participated after being fully briefed about the research. And his research was supported by relevant ethics committee, ID number: HUSOM2022-375.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Author details
[1]Nursing Department of Huaihe Hospital, Henan University, Kaifeng, China
[2]Institute of Nursing and Health, College of Nursing and Health, Henan University, Jinming Avenue, Kaifeng, Henan 475004, China

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Lu *et al. BMC Nursing*   (2025) 24:574

Page 9 of 9

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