Received: 12 January 2022 | Revised: 3 July 2022 | Accepted: 23 July 2022

DOI: 10.1111/jonm.13749

ORIGINAL ARTICLE

WILEY

Leaders' innovation expectation and nurses' innovation behaviour in conjunction with artificial intelligence: The chain mediation of job control and creative self-efficacy

Xianmiao Li PhD, Associate Professor | Mengting Cheng MD, Student | Jicheng Xu MD, Student

School of Economics and Management, Anhui University of Science & Technology, Huainan, China

Correspondence
Mengting Cheng and Xianmiao Li, School of Economics and Management, Anhui University of Science & Technology, Huainan, China.
Email: chengmengting1314@163.com and 3478802358@qq.com

Funding information
Anhui Education Humanities and Social Science Research Major Program, Grant/Award Number: SK2020ZD18; Anhui University of Science and Technology Innovation Fund Program, Grant/Award Number: 2021CX2133; University Students Science Popularization Innovation and Scientific Research Education Demonstration Program, Grant/Award Number: KYX202126

Abstract

Aim: The aim of this work is to investigate the influence of leaders' innovation expectation on nurses' innovation behaviour in conjunction with artificial intelligence, as well as explore the chain mediating effect of job control and creative self-efficacy between leaders' innovation expectation and nurses' innovation behaviour.

Background: The nurses' innovation behaviour is crucial in promoting medical artificial intelligence. Thus, clarifying the influencing factors of nurses' innovation behaviour has become a priority.

Methods: A cross-sectional survey was conducted with 263 Chinese nurses from tertiary hospitals and secondary hospitals in Hefei, Anhui province.

Results: Leaders' innovation expectation was positively related to nurses' innovation behaviour. Creative self-efficacy and job control respectively mediated the relationship between leaders' innovation expectation and nurses' innovation behaviour. Furthermore, creative self-efficacy and job control played a chain mediation role between leaders' innovation expectation and nurses' innovation behaviour.

Conclusion: Leaders' innovation expectation helps to enhance nurses' creative self-efficacy and job control, thereby enhancing nurses' enthusiasm for innovation.

Implications for Nursing Management: Hospital managers and leaders formulate intervention measures to increase leaders' innovation expectation, nurses' creative self-efficacy and job control, and encourage nurses' innovation behaviour.

KEYWORDS
creative self-efficacy, job control, leaders' innovation expectation, nurses' innovation behaviour

1 | INTRODUCTION

In 2019, the "Epidemic Black Swan" swept the world, significantly affecting human health and the economy worldwide. In addition, it provided an impetus to the test scenario for medical artificial intelligence (AI) and promoted its commercialization. The annual output value of medical AI devices in China increased considerably from 125 million yuan in 2019 to 292 million yuan in 2020, with a yearly increase of 134%, and is expected to reach 507 million yuan in 2021 (China Business Intelligence Network, 2021). By August 2021, 19 medical AI devices had been approved by China's State Drug Administration (NMPA) as part of the third category of medical device certificates (China Net Medical Channel, 2021).

Medical AI is based on intelligent algorithms and techniques, such as machine learning, representational learning, and deep learning, to attain the auxiliary diagnosis, risk prediction, disease triage, health

management and hospital management, and other functions of the application (He et al., 2019). Medical AI technology adopted by nurses could enhance work efficiency and accuracy (Qin et al., 2017; Vockley, 2017) and improve hospital management (Griffin et al., 2016). Kuo et al. (2012) stated that one of the prerequisites for maximizing the value of medical AI is that nurses should make full use of it or carry out innovation, such as improving, adjusting, or extending AI technology. In the application scenario of medical AI, nurses play a dual role. As core users of medical AI, nurses have a better understanding of the underlying requirements for medical AI (Martikainen et al., 2020). At the same time, as participants in technological innovation, nurses can execute incremental innovation. However, Martikainen et al. (2020) reported that 85.1% of health care workers believe developers are not interested in their viewpoints and development ideas. Nurses' innovation behaviour is vital in adopting and popularizing medical AI.

A nurse's innovation behaviour refers to the behaviour process of finding and developing new techniques or working ways, and applying them to promote health, prevent diseases, and enhance nursing quality (Bao et al., 2012). It comprises three phases: idea generation, obtaining support, and idea realization. To maximize the efficiency of medical AI in nursing, nurses will think about how to improve or adjust the medical AI based on work experience, patient needs, and current state. Given that leaders are thought to be one of the most influential predictors of nurses' innovation behaviour, researchers have displayed a growing interest in examining the effects of leaders on nurses' innovation behaviour (Salas-Vallina et al., 2018; Wang et al., 2019; Yang et al., 2019). Several studies have already proven that a leader's innovation expectation is positively related to an employee's innovation behaviour (Adil & Ab Hamid, 2019; Adil et al., 2018; Jiang & Gu, 2017). Nevertheless, in the medical AI scenario, little research has been conducted on how leaders' innovation expectation affects innovation behaviour of nurses as technical innovation participants.

According to the Pygmalion effect, leaders with higher expectation for nurses' innovation behaviour exhibit innovation support (e.g., providing innovative resources), which strengthens nurses' creative self-efficacy and stimulate nurses' innovation behaviour (Tierney & Farmer, 2004). In addition, the application of medical AI puts forward higher requirements for the knowledge and skills of medical staff. According to the Job Demand-Control-Support model, job control can relieve the tension and problem-solving caused by job demands and enhance the employee's skill development (Van Yperen & Hagedoorn, 2003). Job control can be beneficial only to those who believe they can use it effectively (Häusser et al., 2010; Karasek, 1979). Reportedly, job control has a positive influence on nurses' innovation behaviour (Yan et al., 2020). Therefore, based on the Pygmalion effect and the Job Demand-Control-Support model, this study takes creative self-efficacy and job control as the mediating variables to elucidate the influence of leaders' innovation expectation on nurses' innovation behaviour.

The contributions of this study are threefold. First, this study empirically testes the association of leaders' innovation expectation on nurses' innovation behaviour, which responds to Tierney and Farmer (2004) appeal for "future tests of the Pygmalion process for creativity within different settings" and enriches the application scenarios of medical AI. Second, this study validates the path mechanism of leaders' innovation expectation influencing nurses' innovation behaviour and investigates the chain mediation role of creative self-efficacy and job control. This study corroborates previous conclusions (Jiang & Gu, 2017; Yan et al., 2020) and provides a new perspective for improving nurses' innovation behaviour from the Job Demand-Control-Support model. Third, the conclusions of this study could provide references for improving the management efficiency of hospitals, medical enterprises, and other relevant institutions in the application of medical AI.

2 | LITERATURE REVIEW AND RESEARCH FRAMEWORK

2.1 | Leaders' innovation expectation and nurses' innovation behaviour

A leader's innovation expectation denotes the expectation of leaders for employees to exhibit innovation behaviour (Jiang & Gu, 2017). The Pygmalion effect highlights that expectation from the expectant would dramatically cause the positive response of the expectant subject (Rosenthal, 2002) and that positive external expectation leads to higher performance outcomes for individuals (Carmeli & Schaubroeck, 2007). In the scenarios of medical AI, the head nurses or other leaders expect or require that the nurses actively think positively about using medical AI, generate new ideas, and take action to improve medical AI. Nurses face the dual job demands of being able to use medical AI and technological innovation. Nurses are concerned about the uncertainty and risk of AI technology itself, as well as worry that jobs will be replaced by AI (Longoni et al., 2019). If the external environment is full of challenges and uncertainties, such as the need for high-level innovation, the Pygmalion effect on individuals is more significant (Adil & Ab Hamid, 2019; Adil et al., 2018). Leaders are one of the crucial organizational factors that influence an employee's innovation behaviour (Labrague et al., 2021; Raso et al., 2020). A leader's innovation expectation is projected to encourage an employee's innovation behaviour by conveying organizational information of encouragement, support, and trust (Jiang & Gu, 2017). Especially when they are encouraged, supported and trusted by a leader, employees feel more confident about their innovation activities, reducing innovation risks and uncertainties (Erkutlu & Chafra, 2015). When the head nurses or other leaders exhibit innovation expectation, it is easier to create an innovation atmosphere in the organization and encourage nurses' innovation behaviour in conjunction with artificial intelligence technology. Hence, we hypothesize:

H1. A leader's innovation expectation is positively related to a nurse's innovation behaviour.

2.2 | The mediating role of creative self-efficacy

Self-efficacy is an individual belief or sense of success (Bandura, 2001). Creative self-efficacy sets specific situations and closely combines self-efficacy with innovative activities. It is an individual belief that he/she can attain innovation and the self-confidence perception of their innovation ability (Tierney & Farmer, 2002). Herein, nurses believe that they are innovative and can provide valuable suggestions for improving medical AI. The Pygmalion effect highlights that extrinsic expectation is self-fulfilling prophecies (Carmeli & Schaubroeck, 2007). The stronger the leaders' innovation expectation and the more resources provided, the more employees can feel the leader's support for their innovation behaviour, which augments the employee's confidence in innovation behaviour (Qu et al., 2015). Creative self-efficacy plays an increasingly vital role in promoting an employee's innovation behaviour (Chuang et al., 2013). Yan et al. (2020) confirmed that higher psychological capital can promote a nurse's innovation behaviour. One of the dimensions of psychological capital is self-efficacy. Adil et al. (2018) reported that creative self-efficacy mediated the positive relationship between a leader's innovation expectation and an employee's creativity. Moreover, Jiang and Gu (2017) found the mediating effect of creative self-efficacy between a leader's innovation expectation and an employee's innovation behaviour. Our study postulates that the head nurses or other leaders expect nurses to think positively about medical AI through clinical practice, posit new ideas to improve and enhance the application value. Leaders' innovation expectation will enhance nurses creative self-efficacy, thereby motivating nurses to actively participate in the innovation of medical AI. Hence, we hypothesize:

> **H2.** Creative self-efficacy mediates the relationship between a leader's innovation expectation and a nurse's innovation behaviour.

2.3 | The mediating role of job control

Job control denotes an individual's cognition and assessment of the effect of internal factors, such as his own ability and effort in work, that is, a sense of control experienced by individuals in work. It is an individual's perception of the coping ability and influence of his/her jobs and work environment (Ngo & Murphy, 2005). In the context of medical AI, job control indicates that nurses use medical AI to complete nursing tasks smoothly. The leader's innovation expectation conveys two messages to nurses. One message is that the application of medical AI puts forward high requirements for the knowledge and skills of nurses. The other is that leaders encourage nurses' innovation behaviour and nurses face a high level of innovation demand. According to the Job Demand-Control-Support model, when employees face high job demand, job control can relieve tension and contribute to problem-solving, which may enhance individual skill development (Van Yperen & Hagedoorn, 2003). The support and resources that employees receive from the organization can increase their control over their work. Van Doorn et al. (2016) surveyed 210 Nigerian nurses and reported that a leader's support is positively associated with job control. In the application scenarios of medical AI, a nurse's skill and experience will be enhanced through clinical practice and active learning. Nurses will promote technological innovation by providing feedback on medical needs and design concepts for medical AI products. Thus, facing high leaders' innovation expectation, nurses can improve their technical level of using medical AI and promote innovation behaviour by enhancing job control. We hypothesize:

> **H3.** Job control mediates the relationship between a leader's innovation expectation and a nurse's innovation behaviour.

2.4 | The chain mediation role of creative self-efficacy and job control

Self-efficacy is a positive psychological character (Luthans & Youssef, 2004). Job control is an individual's overall perception of a task, which is related to the employee's psychological capital and creativity (Du et al., 2018; Yan et al., 2020). Zhang et al. (2014) believed that job control can increase an employee's innovation behaviour by increasing the employee's perceptions of environmental change and decision-making authority. According to the Pygmalion effect, positive external expectation leads to higher performance (Carmeli & Schaubroeck, 2007). Employees perceive the leaders' innovation expectation and exhibit the behaviour expected by the leader in the innovation process to increase the employee's motivation and confidence. Motivation and confidence increase employee control over their work (Du et al., 2018; Yan et al., 2020), and job control can be beneficial only to those who believe they can use it effectively (Häusser et al., 2010; Karasek, 1979). Besides, the uncertainty and risk of innovation activities might make employees unable to execute innovation activities in high job demands and high work pressure states. Thus, employees must have strong self-confidence and increase their sense of control over their work, which are the key factors to transitioning from the negative state to the positive state (Binnewies & Gromer, 2012). As stated by the Job Demand-Control-Support model, employees with high job demands are more likely to engage in positive behaviour (Daniels et al., 2011; Häusser et al., 2010). In the scenarios of medical AI, the leader's expectation for the nurse's innovation behaviour displays the support for innovative activities, enhancing the self-efficacy of a nurse to execute innovative activities. In addition, the nurses sense of control over their work is enhanced by increased self-confidence, which eventually motivates them to engage in innovative activities. Hence, we hypothesize:

> **H4.** Creative self-efficacy and job control play a chain mediation role between a leader's innovation expectation and a nurse's innovation behaviour.

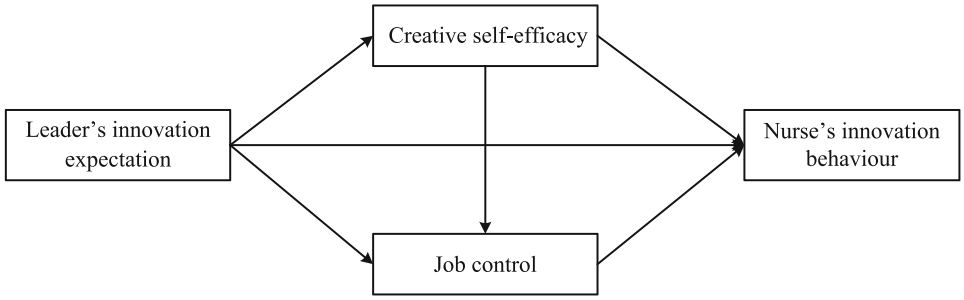

FIGURE 1 Theoretical model of nurses' innovation behaviour

Overall, Figure 1 presents the theoretical model of this study.

3 | METHODS

3.1 | Study design and sample

This study first empirically tested the association of leaders' innovation expectation, creative self-efficacy, and job control on nurses' innovation behaviour. In addition, we discuss the mediating role of creative self-efficacy and job control between leaders' innovation expectation and nurses' innovation behaviour respectively. Finally, we analysed the possible chain mediation role of creative self-efficacy and job control between leaders' innovation expectation and nurses' innovation behaviour.

The cross-sectional survey was conducted among nurses from tertiary hospitals and secondary hospitals in Hefei, Anhui province from July to September 2021. The inclusion criteria were as follows: (i) Acquiring a nurse's qualification certificate and a nurse's practice certificate; (ii) understanding the purpose of the survey, agree, and participate voluntarily; (iii) using medical AI in the department; (iv) working in the department for >3 months. In order to reduce common method bias (Podsakoff et al., 2003), we adopted a research design with two stages and the time lag between stages was 2 months. Matching codes were used to link the two-wave questionnaires. The last four digits of the telephone number were used as matching code. Participants who completed the first phase questionnaire received the next questionnaires 2 months later. Specifically, we asked the participants to return the coded envelope with an informed consent form in the first stage, otherwise they would not receive the second stage questionnaires.

The sample size was determined according to the *N*:*q* rule proposed by Jackson (2003), where *N* denotes the appropriate sample size, and *q* is the number of questions. According to the *N*:*q* rule, the rational ratio of the parameter (*N*:*q*) is between 10 and 20 (Kline, 2011). This study had 24 questions (leaders' innovation expectation, 4; creative self-efficacy, 4; job control, 6; nurses' innovation behaviour, 10); thus, the appropriate sample size was between 240 and 480. A total of 400 questionnaires were distributed, of which 307 were collected, with a recovery rate of 76.8%. After screening the incomplete and visibly unqualified questionnaires, the total number of valid questionnaires was 263, which belongs to the appropriate sample size.

3.2 | Measurements

In this study, measurements were based on the reliable mature scales developed abroad. To ensure their scientific nature, the selected measurements were originally English written; however, to avoid misinterpretation and translation deviation due to language and cultural differences, we used the translation–back-translation procedure to interpret the relevant scales into Chinese. The questionnaire items were adjusted appropriately per the medical AI application scenarios. We invited two head nurses to examine the questionnaire for its clarity, terminology, logical consistency, and relevance. In addition, 30 nurses were presurveyed before the formal survey. Preliminary research results showed that the questionnaire demonstrated high reliability and validity, fulfilling the study criteria. According to the pre-surveyed results and the feedback from nurses, the questionnaire items were revised to determine the formal questionnaire. All responses were reflected using a 5-point Likert scale, where 1 = *strongly disagree*; 5 = *strongly agree*. A higher mean score on any subscale indicates stronger support and approval for leaders' innovation expectation, creative self-efficacy, job control and nurses' innovation behaviour.

3.2.1 | Leaders' innovation expectation

We adopted four items developed by Carmeli and Schaubroeck (2007). The representative item was "When adopting medical AI, the leader wants me to be creative." In this study, the scale's reliability coefficient was 0.90.

3.2.2 | Creative self-efficacy

We adopted four items developed by Tierney and Farmer (2002). The representative item was "I believe I have the ability to adopt medical AI." In this study, the scale's reliability coefficient was 0.94.

3.2.3 | Job control

We adopted six items developed by Gonzalez-Mulé and Cockburn (2017). The representative item was "To what extent do you agree

that your job allows you to make a lot of decisions on your own?" In this study, the scale's reliability coefficient was 0.81.

3.2.4 | Nurses' innovation behaviour

We adopted 10 items developed by Bao et al. (2012). The three dimensions were idea generation, support obtaining, and idea realization. The representative items were "When working with medical AI, I will find the problems and be willing to solve them." "To improve medical AI, I will seek the recognition, support and participation from colleagues or leaders." "When for improving medical AI, I will implement new ideas in my work." In this study, the scale's reliability coefficient was 0.88.

3.3 | Ethical consideration

No ethical review of the study was needed under Chinese law and institutional guidelines. This study did not involve unethical behaviour and strictly abided by institutional requirements and ethical standards in the process of data collection and processing. During the investigation, nurses were clearly informed that this study was only used for academic purposes and participated voluntarily. The study was conducted anonymously to ensure that the privacy of nurses was not disclosed.

3.4 | Data analysis

The data were analysed using IBM SPSS v22.0 and Amos 23.0. First, descriptive statistical analysis was used to describe the basic characteristics of nurses. Second, the Harman's single-factor test and a single-factor approach were used to test the common method bias and confirmatory factor analysis (CFA) was used to test the measurement model. Then, the Pearson's correlation coefficient was used to analyse the correlation among leaders' innovation expectation, creative self-efficacy, job control, and nurses' innovation behaviour. A structural equation model based on the hypothesis was established. Finally, we used SPSS PROCESS macro 3.5 (MODEL 6) to test the chain mediation role of creative self-efficacy and job control. The bootstrapping method produced 95% confidence intervals (CI) of these effects from 5000 bootstrap samples (Hayes, 2017).

4 | RESULTS

4.1 | Demographic characteristics

Table 1 presents the demographic characteristics of nurses. The effective sample size was 263. Most participants were female (74.5%) with 92.8% aged <41 years. Approximately a quarter were university graduates (25.5%), with an additional 6.1% having a post-graduate degree.

TABLE 1 Nurse's characteristics ($n = 263$)

Variables	Frequency(f)	Percentage(%)
Gender		
Male	67	25.5
Female	196	74.5
Age		
≤20	57	21.7
21–30	135	51.3
31–40	52	19.8
41–50	17	6.5
≥ 50	2	0.8
Highest education level		
High school	33	12.5
Junior college	147	55.9
University	67	25.5
Master and above	16	6.1
Clinical experience		
≤1	83	31.6
1–5	86	32.7
6–10	51	19.4
11–15	19	7.2
16–20	14	5.3
≥20	10	3.8
Work department		
Imaging	83	31.6
Laboratory	89	33.8
Operation theatre	46	17.5
Medical-surgical	29	11.0
Other	16	6.1
Rank of hospital		
Tertiary	181	68.8
Secondary	82	31.2

Note: In China, there are three hospital levels (the rank of hospitals). The best hospital level is level three (tertiary hospitals). Hospitals in this level can provide more beds, departments, professional nurses, professional doctors, and good service for patients. The higher the rank of hospital, the greater the use of AI. AI is just can provide some basic medical services and rarely used in level one hospitals.

The majority of participants had <5 years of work experience (64.3%) and worked in tertiary hospital (68.8%). Moreover, 31.6% of respondents worked in imaging and 33.8% in laboratory.

4.2 | Common method bias and confirmatory factor analysis

In this study, the influence of common method bias was minimized via anonymous filling, concealing variable names, and item mismatches. However, it was still necessary to test the likely homologous variance.

The Harman's single-factor test showed that the unrotated first factor explained 36.26% of the variance, which was <40%, indicating that no serious common method bias existed in this study. According to Table 2, the fitting indices of the univariate confirmatory factor analysis (CFA) were poor (χ^2/df = 13.334, GFI = 0.466, RFI = 0.636, NFI = 0.676, CFI = 0.692, RMSEA = 0.217), suggesting that the common method bias in this study received better control.

In addition, the CFA was performed to evaluate the measurement model. As shown in Table 2, the four-factor model (χ^2/df = 1.884, GFI = 0.907, RFI = 0.948, NFI = 0.958, CFI = 0.980, RMSEA = 0.058) fitted the data better than alternative models, including a three-factor model, a two-factor model, and a one-factor model. Hence, the results supported the distinctiveness of the four constructs in this study.

4.3 | Correlation study

Table 3 provided the means, standard deviations, and correlations among the variables. The results showed that a leader's innovation expectation was positively correlated with creative self-efficacy ($r = 0.549$, $p < 0.01$), job control ($r = 0.487$, $p < 0.01$), and a nurse's innovation behaviour ($r = 0.541$, $p < 0.01$). Creative self-efficacy was positively correlated with job control ($r = 0.402$, $p < 0.01$) and a nurse's innovation behaviour ($r = 0.609$, $p < 0.01$). Job control was positively correlated with a nurse's innovation behaviour ($r = 0.629$, $p < 0.01$).

4.4 | The structural equation model

For testing the hypothesized model, the indices of fit in the model were as follows: χ^2/df = 1.936, GFI = 0.903, RFI = 0.947, NFI = 0.957, CFI = 0.978, RMSEA = 0.060, and within the acceptable range recommended by Byrne (2016). As shown in Figure 2, a leader's innovation expectation had a positive impact on a nurse's innovation behaviour ($b = 0.12$, $p < 0.01$), which supported H1. A leader's innovation expectation had a positive impact on creative self-efficacy ($b = 0.53$, $p < 0.001$) and job control ($b = 0.44$, $p < 0.001$). Creative self-efficacy had a positive impact on job control ($b = 0.38$, $p < 0.001$) and a nurse's innovation behaviour ($b = 0.31$, $p < 0.001$). Job control positively influenced the nurse's innovation behaviour ($b = 0.50$, $p < 0.001$).

Using the bootstrap method, we tested the single mediating role and chain mediation role of creative self-efficacy and job control. Table 4 shows that the total effect of a leader's innovation expectation and a nurse's innovation behaviour was 0.611. The total effect was significant at 95% CI [0.510, 0.702], excluding 0. The total indirect effect of a leader's innovation expectation and a nurse's innovation behaviour was 0.445. The total indirect effect was significant at 95% CI [0.342, 0.550], excluding 0.

In addition, indirect effect 1 was a leader's innovation expectation → creative self-efficacy → a nurse's innovation behaviour, which tested the mediating effect of creative self-efficacy between a leader's innovation expectation and a nurse's innovation behaviour. The value of indirect effect 1 was 0.207, with 95% CI [0.121, 0.309], excluding 0. The mediating effect of creative self-efficacy was significant. Hence, H2 was supported. Indirect effect 2 was a leader's innovation expectation → job control → a nurse's innovation behaviour, which tested the mediating effect of job control between a leader's innovation expectation and a nurse's innovation behaviour. The value of indirect effect 2 was 0.144, with 95% CI [0.075, 0.225], excluding 0. Furthermore, the mediating effect of job control was significant. Hence, H3 was supported.

Indirect effect 3 was a leader's innovation expectation → creative self-efficacy → job control → a nurse's innovation behaviour, which

TABLE 2 Results of confirmatory factor analysis (CFA)

Model	Variables	χ^2/df	GFI	RFI	NFI	CFI	RMSEA
Four-model	LIE, CSE, JC, NIB	1.884	0.907	0.948	0.958	0.980	0.058
Three-model	LIE, CSE + JC, NIB	6.011	0.724	0.836	0.859	0.879	0.138
Two-model	LIE + CSE + JC, NIB	9.515	0.565	0.740	0.770	0.789	0.180
One-model	LIE + CSE + JC + NIB	13.334	0.466	0.636	0.676	0.692	0.217

Note: LIE = leaders' innovation expectation; CSE = creative self-efficacy; JC = job control; NIB = nurses' innovation behaviour; χ^2/df = cmin/df; GFI = goodness of fit index; RFI = relative fit index; NFI = normed fit index; CFI = comparative fit index; RMSEA = root mean square error of approximation.

TABLE 3 Means, standard deviations, and correlations among variables ($n = 263$)

Variables	M	SD	1	2	3	4
1. A leader's innovation expectation	3.96	0.75	1			
2. Creative self-efficacy	3.67	0.72	0.549**	1		
3. Job control	3.66	0.59	0.487**	0.402**	1	
4. A nurse's innovation behaviour	3.70	0.72	0.541**	0.609**	0.629**	1

Note: M = mean; SD = standard deviation.
**$p < 0.01$.

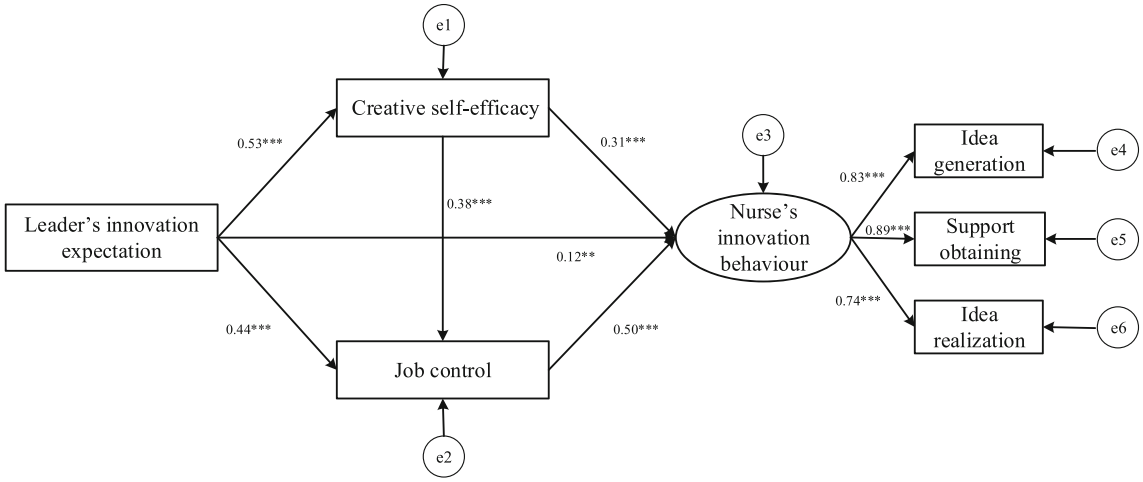

FIGURE 2 Structural equation model

TABLE 4 Direct and indirect effects

	Product of coefficients		Bootstrapping 95% CI	
Effect	**Point estimate**	**Boot *SE***	**Lower**	**Upper**
Total effect of LIE on NIB	0.611	0.050	0.510	0.702
Total indirect effect of LIE on NIB	0.445	0.054	0.342	0.550
Indirect 1: LIE → CSE → NIB	0.207	0.049	0.121	0.309
Indirect 2: LIE → JC → NIB	0.144	0.038	0.075	0.225
Indirect 3: LIE → CSE → JC → NIB	0.094	0.024	0.051	0.143

Note: LIE = leaders' innovation expectation; CSE = creative self-efficacy; JC = job control; NIB = nurses' innovation behaviour; CI = confidence interval.

tested the chain mediation effect of creative self-efficacy and job control between a leader's innovation expectation and nurse's innovation behaviour. The value of indirect effect 3 was 0.094, with 95% CI [0.051, 0.143], excluding 0. The chain mediation effect of creative self-efficacy and job control was significant. Hence, H4 was supported.

5 | DISCUSSION

This study investigated the association of leaders' innovation expectation on nurses' innovation behaviour in China, along with the single mediating role and chain mediating role of creative self-efficacy and job control. Nurses are the core users of medical AI and they can provide new ideas for improving, adjusting, and extending this technique. In this study, nurses' innovation behaviour was in the middle level (3.703 ± 0.719), which was lower than that of Pakistani nurses (3.95 ± 0.35; Masood & Afsar, 2017) but higher than that of Chinese nurses surveyed by other scholars (3.06 ± 0.660; Yan et al., 2020). The different results could be because this study focused on the innovation behaviour of nurses adopting medical AI, which involved high job demands and high risk (Fernández-Llamas et al., 2018), encouraging nurses to innovate. In addition, the result also indicated that the innovation of Chinese nurses for medical AI warrants improvement. Previous studies on the antecedents of nurses' innovation behaviour focused on the leadership style (Salas-Vallina et al., 2018; Wang et al., 2019; Yang et al., 2019), disregarding the importance of leaders' innovation expectation for nurses' innovation behaviour. Thus, this study investigated how leader's innovation expectation influenced nurses' innovation behaviour.

First, this study showed that leaders' innovation expectation was positively associated with nurses' innovation behaviour in China, which was aligned with previous studies (Jiang & Gu, 2017) and confirmed the validity of the Pygmalion effect. The results were also a response to Tierney and Farmer (2004) appeal for "future tests of the Pygmalion process for creativity within different settings." In this way, this study expanded the innovative behaviour of nurses in medical AI application scenarios. Since the outbreak of the COVID-19 pandemic, the Chinese government encourages technological breakthroughs in detection technology, drug vaccines, and medical devices, which has accelerated the innovation of medical AI. As the core users of medical AI, nurses could better understand the real needs of health care staff and patients for medical AI (Martikainen et al., 2020). Thus, nurses' innovation behaviour can promote the development of medical AI. Innovation activities involve high risk and uncertainty. Leaders' innovation expectation is projected to convey the organizational trust

and support. When nurses receive external support and trust, especially from leaders' encouragement, support and recognition, nurses' belief in innovation is heightened, and their uncertainty perception of innovation activities is decreased (Erkutlu & Chafra, 2015).

Second, this study confirmed that leaders' innovation expectation influenced nurses' innovation behaviour through the mediation of creative self-efficacy and job control respectively. While adopting medical AI, nurses perceived that the leader's expectation for their improved medical AI would augment their belief in executing innovative activities, and then displayed higher innovation behaviour. The results corroborated previous conclusions (Adil & Ab Hamid, 2019; Adil et al., 2018; Jiang & Gu, 2017) and were more in line with the current application scenarios of medical AI. The WTO report of 2021 highlighted that more than 160 million confirmed COVID-19 cases and 3.3 million deaths were caused by severe shortage of medical resources. AI imaging, AI electrocardiogram machine, and other medical AI played an essential role during the pandemic, which could not only complete massive data processing, disease marker screening, and treatment plan simulation but also improve the efficiency and accuracy of diagnosis, and decrease the workload and work intensity of medical staff in laboratory, pathology, and imaging departments. In this context, leaders expected nurses to use and improve medical AI, promote the rapid development of medical AI, enhance nursing service level, and solve the shortage of medical resources. Hence, leaders' innovation expectation should be internalized into nurses' own recognition of medical AI innovation, which can enhance nurses' creative self-efficacy and investment in innovation behaviour.

As a concrete manifestation of social support, leaders' innovation expectation conveys the organization's attitude towards innovation behaviour (Adil & Ab Hamid, 2019; Adil et al., 2018; Jiang & Gu, 2017) and provides incentives to encourage employees' innovation behaviour. In the medical AI application scenario, nurses face the dual job demands of new AI technologies application and technological innovation. Nurses actively learn and enhance job control to better perform tasks and fulfil leaders' innovation expectation. The COVID-19 outbreak had fast-tracked the spread and application of remote diagnosis and online consultation. During the pandemic, JD Health received 100,000 online consultations per day, while Ali Health received nearly 3000 consultations per hour (China Healthcare Consulting, 2021). Hospital leaders expected nurses to present valuable suggestions on improving medical AI to satisfy patients' consultation needs. Job control provides nurses with access to resources and information, promoting nurses' technical improvement and experience accumulation, which is a crucial means to promote nurses' innovation behaviour (Yan et al., 2020). From the perspective of the Job Demand-Control-Support model, this study provides a new perspective for improving nurses' innovation behaviour.

Third, this study demonstrated that creative self-efficacy and job control played a chain mediation role between leaders' innovation expectation and nurses' innovation behaviour. Regarding medical AI adopted by nurses, leaders' innovation expectation conveys their support for innovation, enhances the nurses' creative self-efficacy and job control and then improves the employee's enthusiasm for innovation. When a leaders innovation expectation is internalized into a nurses innovation goals, nurses will seek more resources to support innovation activities. The more committed nurses are to innovating, the more time and effort they will spend learning about medical AI. As nurses' understanding of medical AI increases, they will be able to use it to complete nursing tasks faster and are more likely to gain control over their work. Job control can enhance nurses' innovation behaviour by increasing an employee's perceptions of environmental change and decision-making authority (Zhang et al., 2014). Our study showed that nurses' creative self-efficacy was positively related to job control, which confirmed the validity of the Job Demand-Control-Support model and supported the previous research (Du et al., 2018; Yan et al., 2020). Although Yan et al. (2020) demonstrated the relationships among Chinese nurses' psychological capital (including creative self-efficacy), job control and innovation behaviour, the role of leaders' innovation expectation on nurses' innovation behaviour is not considered. We extend their research to the relationship between leaders' innovation expectation and nurses' innovation behaviour. This study enriches the research on the application scenario and influencing factors of nurses' innovation behaviour in medical AI.

6 | CONCLUSIONS

6.1 | Study limitations

First, this is a cross-sectional study, which may not elucidate the causal relationship between variables. Thus, longitudinal research could help to further explain the causal relationship among leaders' innovation expectation, creative self-efficacy, job control, and innovation behaviour. Second, all the items in this study were self-reported by nurses. Future studies could be considered to interview nurses and collect data from multiple sources, such as head nurses and hospital managers. Finally, this study was based on the innovation behaviour of nurses adopting medical AI in Hefei, Anhui Province, and the applicability of the findings in other contexts remains debatable. Hence, the scope and contexts of research could be expanded and widened, refining universality.

7 | IMPLICATIONS FOR NURSING MANAGEMENT

This study established that leaders' innovation expectation, creative self-efficacy, and job control are closely related to nurses' innovation behaviour.

First, leaders should convey the organization's support for innovative behaviour so that nurses can perceive the innovation expectation, which is conducive to nurses' medical AI innovation activities. Leaders should also pay attention to the new ideas that stem from nurses and listen carefully to nurses' suggestions for refining AI technology and feedback. Nurses are crucial practitioners of medical AI and have a

better understanding of the requirements for medical AI (Martikainen et al., 2020).

Second, leaders should focus on promoting nurses' creative self-efficacy. Leaders could increase nurses' creative self-efficacy by offering highly focused micro-interventions and training courses. On the one hand, leaders could divide complex AI-related work into simple and easy-to-implement innovation tasks, which will increase nurses' confidence and sense of accomplishment in completing innovation tasks. The successful experience from previous innovative work can improve nurses' creative self-efficacy. Of note, the psychological capital intervention (PCI) model is an effective short-term intervention (Dello Russo & Stoykova, 2015). Creative self-efficacy is the core element of psychological capital. On the other hand, leaders should increase the support for nurses to perform medical AI innovation activities, convey to nurses the expectation of improving medical AI innovation, and create a good organizational innovation atmosphere. For example, nurses are provided with short-term training and learning opportunities in medical AI technology. The mastery of medical AI skills helps nurses to enhance creative self-efficacy and implement innovation behaviour, which is conducive to the career development of nurses in the future.

Third, leaders should strengthen nurses' sense of control over their work. Nurses are not only important practitioners of medical AI but also participants in technological innovation. The application of AI technology has led to changes in the scope of health care work and decision-making. Leaders empower nurses to improve their nurse's job autonomy, and their perception of control over work (Laschinger & Finegan, 2005). Job crafting is a common method. Nurses redesign their work through task reengineering, relationship reengineering, and cognitive reengineering to attain high job control (Wrzesniewski & Dutton, 2001). Leaders should focus on the physiological, psychological, and career development needs of nurses, provide targeted guidance, and develop nurses' diverse work skills, such as information capability, to handle the rapid spread of medical AI to improve nurse's job control.

Finally, leaders should focus on the relationship between creative self-efficacy and job control. Creative self-efficacy is not only the principal intermediary role between leaders' innovation expectation and innovation behaviour of nurses but also a crucial factor that affects their job control. Creative self-efficacy is a positive psychological factor, which has a positive impact on job control. Thus, in the career development of nurses, hospital managers or leaders should focus on the psychological state of nurses and implement positive psychological intervention. Leaders should help nurses recognize their dual roles as users of technology and participants in innovation, which is contribute to advance the application and innovation of medical AI.

ACKNOWLEDGEMENTS

We thank the Anhui Education Humanities and Social Science Research Major Program (SK2020ZD18), the Anhui University of Science and Technology Innovation Fund Program (2021CX2133), and University Students Science Popularization Innovation and Scientific Research Education Demonstration Program (KYX202126).

CONFLICT OF INTEREST

The author claims that there is no conflict of interest.

ETHICS STATEMENT

Because this study did not involve unethical behaviour, human clinical trials or animal experiments, according to institutional guidelines and national laws and regulations, this study was exempt from further approval by the ethics committee.

DATA AVAILABILITY STATEMENT

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

ORCID

Xianmiao Li https://orcid.org/0000-0001-7189-1136
Mengting Cheng https://orcid.org/0000-0002-2922-7319
Jicheng Xu https://orcid.org/0000-0002-1626-3337

REFERENCES

Adil, M. S., & Ab Hamid, K. B. (2019). The relationships between leader creativity expectations, intrinsic motivation, and creative performance. *Science Journal of Management*, *2*(2), 58–68. https://doi.org/10.33215/sjom.v2i2.123

Adil, M. S., Khan, M. N., Khan, I., & Qureshi, M. A. (2018). Impact of leader creativity expectations on employee creativity: Assessing the mediating and moderating role of creative self-efficacy. *International Journal of Management Practice*, *11*(2), 171–189. https://doi.org/10.1504/IJMP.2018.10010565

Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, *52*(1), 1–26. https://doi.org/10.1146/annurev.psych.52.1.1

Bao, L., Wang, L., & Zhang, Y. Q. (2012). Development and analysis of reliability and validity of nurse innovative behavior scale. *Journal of Shanghai Jiaotong University (Medical Science)*, *32*(8), 1079–1082. https://doi.org/10.3969/j.issn.1674-8115.2012.08.025

Binnewies, C., & Gromer, M. (2012). Creativity and innovation at work: The role of work characteristics and personal initiative. *Psicothema*, *24*(1), 100–105. http://hdl.handle.net/11162/4165

Byrne, B. M. (2016). *Structural equation modeling with AMOS: Basic concepts, applications, and programming*. Routledge. https://doi.org/10.4324/9781315757421

Carmeli, A., & Schaubroeck, J. (2007). The influence of leaders' and other referents' normative expectations on individual involvement in creative work. *Leadership Quarterly*, *18*(1), 35–48. https://doi.org/10.1016/j.leaqua.2006.11.001

China Business Intelligence Network. (2021). 2021 China's AI medical device industry market size and market segment forecast analysis. https://t.cj.sina.com.cn/articles/view/1245286342/4a398fc6001011ur8

China Healthcare Consulting. (2021). The epidemic has escalated the importance of medical devices across the board, taking stock of the opportunities for growth after the epidemic. https://www.sohu.com/a/392157160_100000405

China Net Medical Channel. (2021). The "2021 Medical AI Report" is released. Where is the commercialization of medical AI in the IPO? https://med.china.com.cn/content/pid/296225/tid/1026

Chuang, A., Hsu, R. S., Wang, A. C., & Judge, T. A. (2013). Does west "fit" with east? In search of a Chinese model of person-environment fit. *Academy of Management Journal*, *58*(2), 480–510. https://doi.org/10.5465/amj.2012.1076

Daniels, K., Wimalasiri, V., Cheyne, A., & Story, V. (2011). Linking the demands-control-support model to innovation: The moderating role of personal initiative on the generation and implementation of ideas. *Journal of Occupational and Organizational Psychology*, *84*(3), 581–598. https://doi.org/10.1348/096317910X494269

Dello Russo, S., & Stoykova, P. (2015). Psychological capital intervention (PCI): A replication and extension. *Human Resource Development Quarterly*, *26*(3), 329–347. https://doi.org/10.1002/hrdq.21212

Du, Y., Li, P., & Zhang, L. (2018). Linking job control to employee creativity: The roles of creative self-efficacy and regulatory focus. *Asian Journal of Social Psychology*, *21*(3), 187–197. https://doi.org/10.1111/ajsp.12219

Erkutlu, H., & Chafra, J. (2015). The effects of empowerment role identity and creative role identity on servant leadership and employees' innovation implementation behavior. *Procedia-Social and Behavior Sciences*, *181*(12), 3–11. https://doi.org/10.1016/j.sbspro.2015.04.860

Fernández-Llamas, C., Conde, M. A., Rodríguez-Lera, F. J., Rodríguez-Sedano, F. J., & García, F. (2018). May I teach you? Students' behavior when lectured by robotic vs. human teachers. *Computers in Human Behavior*, *80*, 460–469. https://doi.org/10.1016/j.chb.2017.09.028

Gonzalez-Mulé, E., & Cockburn, B. (2017). Worked to death: The relationships of job demands and job control with mortality. *Personnel Psychology*, *70*(1), 73–112. https://doi.org/10.1111/peps.12206

Griffin, P. M., Nembhard, H. B., Deflitch, C. J., Bastian, N. D., Kang, H., & Muñoz, D. A. (2016). Health analysis. In *Healthcare Systems Engineering* (pp. 245–296). John Wiley & Sons. https://doi.org/10.1002/9781119174639.ch9

Häusser, J. A., Mojzisch, A., Niesel, M., & Schulz-Hardt, S. (2010). Ten years on: A review of recent research on the Job Demand–Control (-Support) model and psychological well-being. *Work & Stress*, *24*(1), 1–35. https://doi.org/10.1080/02678371003683747

Hayes, A. F. (2017). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. Guilford Publications.

He, J., Baxter, S. L., Xu, J., Xu, J. M., Zhou, X., & Zhang, K. (2019). The practical implementation of artificial intelligence technologies in medicine. *Nature Medicine*, *25*(1), 30–36. https://doi.org/10.1038/s41591-018-0307-0

Jackson, D. L. (2003). Revisiting sample size and number of parameter estimates: Some support for the N:Q hypothesis. *Structural Equation Modeling*, *10*(1), 128–141. https://doi.org/10.1207/S15328007SEM1001_6

Jiang, W., & Gu, Q. (2017). Leader creativity expectations motivate employee creativity: A moderated mediation examination. *The International Journal of Human Resource Management*, *28*(5), 724–749. https://doi.org/10.1080/09585192.2015.1109535

Karasek, R. A. Jr. (1979). Job demands, job decision latitude, and mental strain: Implications for job redesign. *Administrative Science Quarterly*, *24*, 285–308. https://doi.org/10.2307/2392498

Kline, R. B. (2011). *Principles and practice of structural equation modeling* (3rd ed.). Guilford Publications.

Kuo, M. C., Chang, P., Feng, R. C., Ball, M., & Westra, B. (2012). From passion to excellence: National nursing informatics movement in Taiwan. *CIN. Computers, Informatics, Nursing*, *30*(5), 234–236. https://doi.org/10.1097/nxn.0b013e318259e596

Labrague, L. J., al Sabei, S. D., AbuAlRub, R., Burney, I. A., & al Rawajfah, O. (2021). Authentic leadership, nurse-assessed adverse patient events, and quality of care: The mediating role of nurses' safety actions. *Journal of Nursing Management*, *29*(7), 2152–2162. https://doi.org/10.1111/jonm.13356

Laschinger, H. S., & Finegan, J. (2005). Empowering nurses for work engagement and health in hospital settings. *Journal of Nursing Administration*, *35*(10), 439–449. https://doi.org/10.1097/00005110-200510000-00005

Longoni, C., Bonezzi, A., & Morewedge, C. K. (2019). Resistance to medical artificial intelligence. *Journal of Consumer Research*, *46*(4), 629–650. https://doi.org/10.1093/jcr/ucz013

Luthans, F., & Youssef, C. M. (2004). Human, social, and now positive psychological capital management: Investing in people for competitive advantage. *Organizational Dynamics*, *33*(2), 143–160. https://doi.org/10.1016/j.orgdyn.2004.01.003

Martikainen, S., Kaipio, J., & Lääveri, T. (2020). End-user participation in health information systems (HIS) development: Physicians' and nurses' experiences. *International Journal of Medical Informatics*, *137*, 104117. https://doi.org/10.1016/j.ijmedinf.2020.104117

Masood, M., & Afsar, B. (2017). Transformational leadership and innovative work behavior among nursing staff. *Nursing Inquiry*, *24*(4), e12188. https://doi.org/10.1111/nin.12188

Ngo, A., & Murphy, S. (2005). A theory-based intervention to improve nurses' knowledge, self-efficacy, and skills to reduce PICC occlusion. *Journal of Infusion Nursing*, *28*(3), 173–181. https://doi.org/10.1097/00129804-200505000-00005

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Qin, Y., Zhou, R., Wu, Q., Huang, X., Cheng, X., Wang, W., Wang, X., Xu, H., Zheng, J., Qian, S., Bai, C., & Yu, P. (2017). The effect of nursing participation in the design of a critical care information system: A case study in a Chinese hospital. *BMC Medical Informatics and Decision Making*, *17*(1), 1–12. https://doi.org/10.1186/s12911-017-0569-3

Qu, R., Janssen, O., & Shi, K. (2015). Transformational leadership and follower creativity: The mediating role of follower relational identification and the moderating role of leader creativity expectations. *Leadership Quarterly*, *26*(2), 286–299. https://doi.org/10.1016/j.leaqua.2014.12.004

Raso, R., Fitzpatrick, J. J., & Masick, K. (2020). Clinical nurses' perceptions of authentic nurse leadership and healthy work environment. *The Journal of Nursing Administration*, *50*(9), 489–494. https://doi.org/10.1097/NNA.0000000000000921

Rosenthal, R. (2002). Covert communication in classrooms, clinics, courtrooms, and cubicles. *American Psychologist*, *57*(11), 839–849. https://doi.org/10.1037/0003-066X.57.11.839

Salas-Vallina, A., Ferrer-Franco, A., & Fernandez Guerrero, R. (2018). Altruistic leadership and affiliative humor's role on service innovation: Lessons from Spanish public hospitals. *The International Journal of Health Planning and Management*, *33*(3), 861–872. https://doi.org/10.1002/hpm.2549

Tierney, P., & Farmer, S. M. (2002). Creative self-efficacy: Its potential antecedents and relationship to creative performance. *Academy of Management Journal*, *45*(6), 1137–1148. https://doi.org/10.2307/3069429

Tierney, P., & Farmer, S. M. (2004). The Pygmalion process and employee creativity. *Journal of Management*, *30*(3), 413–432. https://doi.org/10.1016/j.jm.2002.12.001

Van Doorn, Y., Van Ruysseveldt, J., Van Dam, K., Mistiaen, W., & Nikolova, I. (2016). Understanding well-being and learning of Nigerian nurses: A job demand control support model approach. *Journal of Nursing Management*, *24*(7), 915–922. https://doi.org/10.1111/jonm.12397

Van Yperen, N. W., & Hagedoorn, M. (2003). Do high job demands increase intrinsic motivation or fatigue or both? The role of job control and job social support. *Academy of Management Journal*, *46*(3), 339–348. https://doi.org/10.2307/30040627

Vockley, M. (2017). Game-changing technologies: 10 promising innovations for healthcare. *Biomedical Instrumentation & Technology*, *51*(2), 96–108. https://doi.org/10.2345/0899-8205-51.2.96

Wang, Y. X., Yang, Y. J., Wang, Y., Su, D., Li, S. W., Zhang, T., & Li, H. P. (2019). The mediating role of inclusive leadership: Work engagement and innovative behaviour among Chinese head nurses. *Journal of Nursing Management*, *27*(4), 688–696. https://doi.org/10.1111/jonm.12754

Wrzesniewski, A., & Dutton, J. E. (2001). Crafting a job: Revisioning employees as active crafters of their work. *Academy of Management Review*, *26*(2), 179–201. https://doi.org/10.2307/259118

Yan, D., Wen, F., Li, X., & Zhang, Y. (2020). The relationship between psychological capital and innovation behaviour in Chinese nurses. *Journal of Nursing Management*, *28*(3), 471–479. https://doi.org/10.1111/jonm.12926

Yang, K., Zhou, L., Wang, Z., Lin, C., & Luo, Z. (2019). Humble leadership and innovative behaviour among Chinese nurses: The mediating role of work engagement. *Journal of Nursing Management*, *27*(8), 1801–1808. https://doi.org/10.1111/jonm.12879

Zhang, L., Bu, Q., & Wee, S. (2014). Impact of job control on employee creativity: The moderating effect of cognitive irritation. In *2014 International Conference on Management Science & Engineering 21th Annual Conference Proceedings* (pp. 873–878). IEEE. https://doi.org/10.1109/ICMSE.2014.6930319

How to cite this article: Li, X., Cheng, M., & Xu, J. (2022). Leaders' innovation expectation and nurses' innovation behaviour in conjunction with artificial intelligence: The chain mediation of job control and creative self-efficacy. *Journal of Nursing Management*, *30*(8), 3806–3816. https://doi.org/10.1111/jonm.13749