

RESEARCH ARTICLE

Impact of knowledge, attitudes and self-reported practices of nurses on early mobilization of mechanically ventilated patients in the ICU

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Abstract

Background: Many ICUs worldwide are striving to integrate early mobilization as part of critical care rehabilitation. However, ICU nurses, who are essential contributors to the early mobilization of critically ill patients, still lack comprehensive surveys assessing their knowledge, beliefs, and practices regarding the early mobilization of mechanically ventilated patients.

Aim: To analyse the knowledge, attitudes, and practices of intensive care unit (ICU) nurses regarding the early mobilization of mechanically ventilated patients and to explore the effects of these practices.

Study Design: A multicentre cross-sectional study. ICU nurses in five tertiary hospitals in Zhejiang Province, China, were selected by convenience sampling and invited to complete an online questionnaire between 1 June 2021 and 15 June 2021. Socio-demographic data and the knowledge, attitudes, and practices of ICU nurses regarding early mobilization.

Results: A total of 296 valid questionnaires were collected, for a response rate of approximately 77.5%. The average scores for knowledge, attitudes, and practices of ICU nurses regarding the early mobilization of mechanically ventilated patients were 42.7 ± 7.4 , 34.3 ± 6.5 , and 47.1 ± 6.5 , respectively, which were good scores. Quantile regressions showed that at the 25% and 50% quartiles, increases in knowledge and attitude scores resulted in increases in practice scores ($p < .001$); however, at the 75% quartile, increases in knowledge scores did not result in practice score increases ($t = 0.000$, $p = .999$); moreover, there was still a 0.5-point increase in practice scores per 1-point increase in attitude scores ($t = 0.500$, $p < .001$).

Conclusions: The knowledge, attitudes, and self-reported practices of ICU nurses were good, although there is room for improvement. Considering that the influence of attitudes on practice improvement is more important than knowledge, ICU managers should promote knowledge transformation, strengthen attitudes, and adopt comprehensive measures to promote the early mobilization of mechanically ventilated patients in the ICU.

Relevance to Clinical Practice: To optimize the early mobilization of mechanically ventilated patients in the ICU, introducing multipronged support strategies based on the knowledge and attitudes of ICU nurses is recommended to promote the implementation of such practices.

KEYWORDS

cross-sectional study, early mobilization, intensive care unit, knowledge–attitude–practice, mechanical ventilation

1 | INTRODUCTION

Mechanical ventilation (MV) involves the use of devices to restore effective ventilation and improve oxygenation when the patient's natural ventilation and/or oxygenation function is impaired.¹ To some extent, the demand for MV has been exacerbated by the aging population, and the number of patients on MV in intensive care units (ICUs) has increased considerably in recent years.² To facilitate early rehabilitation of patients with MV, an increasing number of ICUs are promoting the delivery of early mobility services. Early mobilization (EM) refers to the implementation of specific physical interventions, including active and passive exercises, that are appropriate for patients in the ICU environment.³ Considering the proven short- and long-term benefits of early mobilization for patients, this approach is endorsed by clinical guidelines and expert consensus recommendations to promote patient rehabilitation.^{4–8} Although the content and implementation details of early mobilization strategies for mechanically ventilated patients in the ICU are clear, implementation of these strategies is limited in clinical practice. A study of 42 ICUs in the United States showed that the early mobilization rate of patients who underwent endotracheal intubation was approximately 32%.⁹ In a large-sample study in China, the implementation rate of early mobilization among patients with MV was as low as 19.15%.¹⁰ Inadequate clinical experience with early mobilization limits our ability to fully understand the importance of early mobilization in the ICU and to conduct further research.

Exploring the influencing factors in the practice process is crucial. In the ICU, early mobilization typically involves interdisciplinary collaboration; therefore, clinical practice can be affected by the competence of medical staff.¹¹ ICU nurses generally play an important role in understanding care coordination needs, aggregating and disseminating information, employing resources, promoting team cohesion, and engaging in situation-based practices throughout the course of early mobilization.¹² However, they face several difficulties. Interviews with nurses have identified elements that obstruct early mobilization in the ICU, including attitudes and lack of knowledge; analgesic-sedative practices; patient pain, discomfort, and hemodynamic instability; lack of physician referrals; safety concerns regarding tubes, catheters, and wires; personnel and equipment resources; the clinical value ascribed to mobilization and its prioritization¹³; and nurses' concerns for patient safety (e.g., falls and harm).¹⁴ This shows that knowledge and beliefs are considered influencing factors that should be prioritized. However, more rigorous scientific research designs and statistical methods are needed to confirm the influence of knowledge and attitudes on clinical practice. Extensive research has focused on understanding the influencing factors of early mobilization implementation among ICU nurses, including some quality improvement projects focused on enhancing knowledge and attitudes.^{15–17} Interventions appear to have a positive impact on early mobilization practices,

What is known about the topic

- Enhancing early mobilization practices in ICUs can lead to the prevention or reduction of complications in mechanically ventilated patients, as well as various other potential benefits. There is a growing emphasis on the importance of early mobilization in health care.
- Nurses play a crucial role as major contributors to early activities within the ICU, and their pivotal role lies in advancing the implementation of early mobilization for patients undergoing mechanical ventilation.

What this paper adds

- Knowledge-based training of ICU nurses in the development of early mobilization programs for mechanically ventilated patients should be enhanced.
- Building upon this foundation, more attention should be given to the attitudes of ICU nurses to overcome mental health barriers and promote positive attitudes, which can be transformed into positive practices.
- Multipronged organizational culture support strategies based on the knowledge and attitudes of ICU nurses to promote the implementation of practices are recommended.

although it is not clear whether the impact persists linearly as knowledge and attitudes intensify and whether these continue to effectively influence participants' practices or patient outcomes.¹⁸

To gain a more comprehensive and scientific understanding of the early mobilization of mechanically ventilated patients in the Chinese context, this study investigated the knowledge, attitudes, and practices of ICU nurses in five tertiary hospitals in China in relation to the early mobilization of mechanically ventilated patients. Specifically, we analysed the diverse effects of knowledge and attitudes on early mobilization practices to improve current practices.

1.1 | Conceptual framework

This was an empirical investigation based on knowledge, attitude and practice theory (KAPT). The theory comprises three aspects: knowledge, belief, and behaviour. The theory suggests that after a rational and systematic examination of acquired knowledge, attitudes gradually form, transforming knowledge into beliefs that then govern human behaviour. Changes in human behaviour involve three consecutive processes: acquiring knowledge, developing beliefs or attitudes, and

forming behaviour.¹⁹ In this context, “knowledge” refers to understanding and comprehending relevant subjects, “attitude/belief” pertains to attitudes or opinions, and “practice” denotes actions or behaviours. This theory summarizes the progressive relationship between knowledge, attitude, and behaviour, with knowledge serving as the foundation for behaviour change, while belief and attitude provide the driving force.^{20,21} A positive attitude can be nurtured only through continuous learning, active contemplation, and a strong sense of responsibility. Only when knowledge evolves into an attitude or belief is it possible to adopt a positive attitude towards changing behaviour.

In this study, knowledge refers to the process by which ICU nurses receive knowledge, mainly referring to the relevant knowledge of early mobilization, such as concepts, related indications, assessments, and activity plans. This is the basis of action. Attitudes, such as attitudes towards theory, practice, and emotions, mainly refer to the attitudes of ICU nurses towards the knowledge and value of early mobilization in mechanically ventilated patients. Finally, practice mainly refers to the medical care practice for mechanically ventilated patients, such as personal practice, management practice, and adverse event handling practices, generated in the context of early mobilization knowledge and attitudes of ICU nurses and the ICU working environment. ICU nurses can better apply theoretical knowledge about early mobilization in clinical practice by understanding and endorsing this knowledge. Currently, the KAPT model is applied in disease prevention and management, nursing management, nursing education, and other fields, demonstrating its feasibility and effectiveness.

2 | METHODS

2.1 | Objectives

The purpose of this study was to investigate the knowledge, attitudes, and practices of ICU nurses regarding the early mobilization of patients on MV in a sample of Chinese nurses and to explore the specific influence of knowledge and attitudes on these practices. We anticipate that the results of this study will make two contributions. First, these findings will clarify the influence of knowledge and attitudes on the early mobilization practices of mechanically ventilated patients. Second, nursing managers can use these findings to effectively integrate knowledge education and attitude cultivation regarding early mobilization into clinical practice to improve the efficiency and effectiveness of early activities.

2.2 | Design

A quantitative cross-sectional survey was performed in this study using convenience sampling. This study received ethical approval from the Institutional Review Board (IRB) of the Zhejiang University School of Medicine Sir Run Run Shaw Hospital (approval reference number: KY20190520-153). All research procedures involving human subjects were conducted in accordance with the ethical standards outlined by the institution.

2.3 | Setting and participants

Data were collected from nurses working in the ICUs of five tertiary hospitals (two in Hangzhou city, 1 in Jiaxing city, 1 in Jinhua city and 1 in Huzhou city) in Zhejiang Province, China, between 1st June 2021 and 15th June 2021. ICU nurses working in the ICU during the study period were asked to participate. The inclusion criteria were as follows: (1) nurses who had obtained their nurse practice qualification certificate in the People's Republic of China, (2) were aged ≥ 18 years, (3) had worked in the ICU for more than 1 year, and (4) provided informed consent to participate in this study. The following exclusion criteria were applied: (1) student nurses, trainee nurses, or nurses rotating from other hospitals or other nursing departments; (2) nurses on personal leave, maternity leave, sick leave, or study leave during the duration of this study; and (3) nurses who did not fulfil a clinical role, such as the nursing secretary in the ICU. During the year leading up to the investigation, ICU nurses from all the research units received education on early mobilization. This education included literature reviews and morning meetings for knowledge sharing. However, they received no specific skill training. There were accessible early mobilization protocols in place for early mobilization in the abovementioned ICUs. Early mobilization was promoted within the ICU, for example, as an essential component of the ABCDEF (Assess · prevent · and manage Pain, Both spontaneous awakening Trials and spontaneous breathing trials, Choice of analgesia and sedation, Delirium: assess · prevent · and manage, Early mobility, Family engagement, and empowerment) bundle. Early mobilization in the ICU is gradually becoming a routine focus of health care for both doctors and nurses. The attending physician and bedside nurses decide during handovers or rounds, based on their own judgement, whether to implement early mobilization. In the ICU, the implementation of early mobilization may involve collaboration between nurses and physical therapists; in some cases, other health care professionals, such as nutritionists, may also be involved. Generally, nurses may have received advanced rehabilitation training and, following assessments, may spontaneously assist patients with early mobilization. Alternatively, patients or their families may express a desire for early mobilization; alternatively, during rounds, physicians may encourage nurses to assist patients with early mobilization in appropriate cases. Physicians may also issue medical prescriptions requesting physical therapists and nurses to carry out early mobilization, highlighting the crucial role of nurses in such situations, requiring coordinated attention and cooperation with physical therapists.

2.4 | Sampling

It is generally believed that the sample size for unconditional logistic regression analysis should be 5–10 times the number of independent variables. In this study, there were a total of 10 independent variables, so the sample size had to be between 50 and 100. Considering the 10–20% invalid questionnaires, a sample size of 55–120 valid questionnaires was required. Finally, 296 valid questionnaires met the statistical requirements.²²

2.5 | Variables and measurements

This study collected sociodemographic data and data on knowledge, attitudes, and practices among ICU nursing staff regarding the early mobilization of patients through a questionnaire.

Participants were given instructions about the purpose and importance of the survey and how to complete the questionnaire. The sociodemographic data included participant age, sex, ICU classification, education, nursing level, professional title, job title, working time in clinical practice (years), working time in the ICU (years), and the number of beds in the ICU. The levels of knowledge, attitudes, and perceived practices of ICU nursing staff towards early mobilization were collected using a scale developed by Wang et al.²³ The scale consists of three domains, knowledge, attitudes, and practices, with a total of 31 items. The item options used a 5-point Likert scale ranging from 1 to 5, from strongly disagree to strongly agree. This applied to all the items except for Item 31, for which the reverse scoring method was used. The total score on this scale was 155 points, including 55 points in the knowledge domain, 45 points in the attitude domain, and 55 points in the practice domain. A higher score on the scale indicated higher levels of knowledge, attitudes, or practices of medical staff regarding early mobilization.

2.6 | Data collection

Before the investigation, the researcher contacted the head nurses of the ICU units under investigation to explain the purpose and requirements of the questionnaire survey with unified guidance. After obtaining consent, the two-dimensional code of the online questionnaire was issued, and the nurses answered the questionnaire online. The online questionnaire was considered to be submitted successfully only when all the questions were completed. Those who completed the questionnaire received a 5 RMB coupon. Therefore, there were no missing data. Each participant was associated with an IP address and could submit the questionnaire only once, preventing multiple answers from the same person. The e-questionnaire platform was open for 2 weeks. The researchers closed the questionnaire submission track at 17:00 on 15 June 2021. There were 296 valid questionnaires. The questionnaire was deemed invalid and was deleted if any of the following occurred: the total answer time was less than 1 min (a total of four questionnaires), there were contradictions after logical review (a total of five questionnaires), or all the choices marked were the same, that is, only the middle option for all items was selected (a total of five questionnaires). Finally, the completed valid questionnaires were imported into a Microsoft[®] Excel 2021 spreadsheet.

2.7 | Statistical analysis

The measurement data are presented as the means \pm standard deviations or the medians (quartile spacing), and the categorical data are

presented as frequencies (percentages). Independent sample *t* tests, one-way analysis of variance, and Kruskal–Wallis rank-sum tests were used to analyse the differences between the groups. In pairwise comparisons, those variables with homogeneous variances were compared with the least significant difference (LSD) in this study, and those with unequal variances were compared using Dunnett's pairwise comparison. Pearson's correlation analysis was used to measure the degree of correlation between the quantitative variables. Quantile regression analyses were used to explore the influencing effects of sociodemographic data, knowledge, and attitudes of ICU nurses on the practice of early mobilization of mechanically ventilated patients. All the statistical analyses were performed using R version 3.6.1, with a two-sided significance level of $\alpha = 0.05$.

3 | RESULTS

3.1 | Sociodemographic characteristics

In this survey, 400 questionnaires were distributed, and a total of 310 questionnaires were collected, for a response rate of 77.5%. Among them, 14 questionnaire items were missing more than 50% of the data and were excluded. Therefore, the total number of valid questionnaires was 296. The 296 ICU nurses who participated in this study worked in five tertiary hospitals in four cities in Zhejiang Province; almost half (40.5%) of the nurses were from Hangzhou city, followed by Jinhua city (26.4%), Huzhou city (19.9%), and Jiaxing city (13.2%). Over half (66.2%) of the nurses worked in a general ICU (2.03%), followed by a surgical ICU (14.2%), a medical ICU (12.8%), a respiratory ICU (4.7%), and an emergency ICU (2.0%). The majority (87.5%) of the nurses were female. The age distribution of the participants was as follows: 18–30 years, 51.4%; 31–40 years, 41.6%; and 41–55 years, 7.1%. The majority (88.2%) of ICU nurses had a bachelor's degree, followed by an associate's degree (10.1%), and only 1.69% had a master's degree. In terms of professional title, 52.0% were intermediate registered nurses, 88.2% were nurses in charge, 12.5% were primary registered nurses, 4.39% were associate chief superintendent nurses, and 1.69% were chief superintendent nurses.

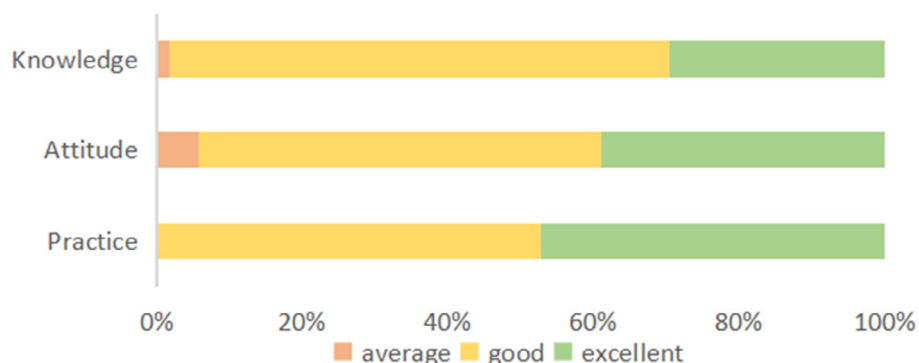
The median number of beds in the ICU was 28, with a quartile range of 24.0 to 42.0. The median number of years of clinical service for nurses was eight, and the quartile range was 5.00 to 11.0. The median number of years of ICU service for nurses was 6, and the quartile range was 2.00 to 10.0.

3.2 | Knowledge, attitudes, and practice status

3.2.1 | The knowledge, attitudes, and practice status of ICU nurses regarding the early mobilization of mechanically ventilated patients

In the knowledge domain, the mean \pm standard deviation of the total score was 42.7 ± 7.4 , and those of the subdomains from high to low

FIGURE 1 The knowledge, attitudes, and practices of ICU nurses regarding the early mobilization of mechanically ventilated patients ($n = 296$). **Knowledge/Practice Score:** poor:1–15; average: 16–30; good: 31–45; excellent: 46–55; **Attitude Score:** poor: 1–15; average: 16–25; good: 26–35; excellent: 36–45.



scores were adverse events (4.4 ± 0.7), outcome evaluations (4.3 ± 0.8), start-up timing and process assessments (4.1 ± 0.8), indications (3.7 ± 1.1), conceptual theory (3.7 ± 0.8), and developing early mobilization programs (3.6 ± 0.9); in the attitude domain, the mean \pm standard deviation of the total score was 34.3 ± 6.5 , and the subdomain scores from high to low were attitudes towards knowledge (4.1 ± 0.8), attitudes about emotions (3.7 ± 1.0), and attitudes towards practice (3.7 ± 0.8); in the practice domain, the mean \pm standard deviation of the total score was 47.1 ± 6.5 , and the subdomain scores from high to low were adverse events (4.3 ± 0.8), organizational support (4.3 ± 0.6), and personal practices (4.3 ± 0.6).

In addition, in the knowledge domain of the scale, only 1.7% of the nurses were at an average level, more than half (68.6%) of the ICU nurses were at a good level, and nearly one-third (29.7%) were at an excellent level; in the attitude domain, approximately 5.7% were at an average level, approximately half (55.4%) were at a good level, and more than one-third (38.9%) were at an excellent level; in the practice domain, approximately half (52.7%) were at a good level, and the others (47.3%) were at an excellent level (see Figure 1).

3.3 | Univariate analysis of ICU nurses' knowledge, attitudes, and practices regarding the early mobilization of mechanically ventilated patients

Single-factor analysis revealed that the differences in the general data were not statistically significant in the knowledge, attitude, or practice domain ($p < .05$), as shown in Table 1.

3.4 | Correlation analysis of the relationships between knowledge, attitudes, and practices of ICU nurses and the early mobilization of mechanically ventilated patients

For the quantitative variables in this study, such as the number of ICU beds, duration of clinical service (years), and ICU service time (years), the correlation coefficient matrix showed that there was no linear correlation between the above variables and the knowledge, attitudes, or practice scores of ICU nurses regarding the early mobilization of

mechanically ventilated patients (Figure 2). The relationships among knowledge, attitudes, and practices were significant; knowledge and attitudes ($r = 0.81$, $p < .001$), knowledge and practices ($r = 0.69$, $p < .001$), and attitudes and practices ($r = 0.72$, $p < .001$) were significantly correlated (Figure 2).

3.5 | Multivariate analysis of the knowledge, attitudes, and practices of ICU nurses in the early mobilization of mechanically ventilated patients

Multiple linear regression with demographic variables, knowledge, and attitudes as the independent variables and practice scores as the dependent variable showed that the regression equation was valid ($F = 15.11$, $p < .001$). The influence of knowledge and attitude on practice was statistically significant ($p < .05$), and practice scores increased with increasing knowledge and attitude scores (Table 2). Knowledge and attitude did not have severe collinearity, with variance inflation factors (VIFs) of 3.08 and 3.04, respectively, although the residual did not satisfy variance homogeneity ($\chi^2 = 29.359$, $p < .001$).

Quantile regression can solve the problems of nonnormally distributed data, outliers, and heteroscedasticity and can describe the influence of independent variables on different parts of the dependent variables more comprehensively. This study used quantile regression to analyse the effects of knowledge and attitude scores on practice scores in early ICU mobilization (Table 3).

The results of the quantile regression (Table 3) showed that for knowledge, at the 25% quantile, for every 1-point increase in the knowledge score, the practice score increased by 0.333 points; at the 50% quantile, for every 1-point increase in the knowledge score, the practice score increased by 0.300 points; however, at the 75% quantile, the increase in knowledge score did not lead to an increase in the practice score, and its coefficient was not significant ($t = 0.000$, $p = 0.999$). Conversely, for attitude, at the 25% quantile, a 1-point increase in the attitude score was associated with a 0.667-point increase in the practice score; at the 50% quantile, a 1-point increase in the attitude score was associated with a 0.431-point increase in the practice score; and at the 75% quantile, a 1-point increase in the attitude score was associated with a

TABLE 1 Univariate analysis of ICU nurses' knowledge, attitudes and practices regarding the early mobilization of mechanically ventilated patients ($n = 296$, points, $\bar{x} \pm S$).

Item	Case number (%)	Knowledge			Attitudes			Practices		
		Score (mean \pm SD)	Statistics ($\chi^2/t/F$)	p value	Score (mean \pm SD)	statistics ($\chi^2/t/F$)	p value	Score (mean \pm sd)	Statistics ($\chi^2/t/F$)	p value
Location			0.922 ^a	.551		1.160 ^a	.250		6.269 ^a	.099
Hangzhou	120 (40.5)	41.7 \pm 6.5			33.3 \pm 5.7			46.8 \pm 6.2		
Jiaxing	39 (13.2)	40.2 \pm 6.1			32.8 \pm 5.7			45.4 \pm 6.8		
Huzhou	59 (19.9)	43.0 \pm 8.4			35.2 \pm 7.0			47.3 \pm 7.3		
Jinhua	78 (26.4)	45.4 \pm 8.0			35.9 \pm 7.4			48.2 \pm 7.4		
ICU classification			2.314 ^c	.058		0.966 ^c	.426		0.442 ^c	.778
Comprehensive ICU	196 (66.2)	42.1 \pm 7.1			34.0 \pm 6.2			46.8 \pm 6.6		
Surgical ICU	42 (14.2)	44.3 \pm 7.3			35.1 \pm 6.6			48.0 \pm 7.0		
Medical ICU	38 (12.8)	45.3 \pm 8.2			35.7 \pm 7.8			47.8 \pm 7.5		
Respiratory ICU	14 (4.7)	41.7 \pm 8.3			32.4 \pm 7.1			46.5 \pm 7.7		
Emergency ICU	6 (2.03)	39.5 \pm 10.1			34.0 \pm 6.0			48.0 \pm 8.5		
Sex			-0.021 ^b	.984		0.409 ^b	.683		0.333 ^b	.740
Male	37 (12.5)	42.7 \pm 7.5			34.7 \pm 6.3			47.4 \pm 6.7		
Female	259 (87.5)	42.8 \pm 7.5			34.2 \pm 6.6			47.0 \pm 6.9		
Age			1.272 ^a	.530		0.149 ^a	.928		1.130 ^a	.568
20-30	152 (51.4)	42.5 \pm 8.0			34.3 \pm 6.8			46.7 \pm 7.3		
31-40	123 (41.6)	43.0 \pm 7.0			34.5 \pm 6.6			47.3 \pm 6.8		
41-55	21 (7.09)	43.4 \pm 5.4			33.6 \pm 4.5			48.5 \pm 3.9		
Education			3.200 ^a	.202		3.824 ^a	.148		3.784 ^a	.151
Associate's degree	30 (10.1)	42.2 \pm 9.9			33.7 \pm 8.3			48.1 \pm 6.6		
Bachelor's degree	261 (88.2)	42.7 \pm 7.1			34.3 \pm 6.3			46.9 \pm 6.9		
Master's degree	5 (1.69)	48.2 \pm 6.5			39.6 \pm 5.7			52.6 \pm 2.3		
Professional title			4.023 ^a	.403		2.025 ^a	.731		8.157 ^a	.086
Registered nurse	37 (12.5)	43.2 \pm 8.5			35.2 \pm 7.5			48.6 \pm 7.0		
Senior nurse	154 (52.0)	42.4 \pm 7.8			34.1 \pm 6.8			46.1 \pm 7.3		
Nurse in charge	87 (29.4)	43.0 \pm 6.8			34.4 \pm 6.2			47.8 \pm 6.2		
Associate chief superintendent nurse	13 (4.39)	42.5 \pm 5			32.8 \pm 3.7			47.9 \pm 3.6		
Chief superintendent nurse	5 (1.69)	47.6 \pm 4.7			36.4 \pm 5.0			51.4 \pm 4.5		
Job title			0.590 ^b	.560		0.028 ^b	.978	0.978	1.426 ^b	.164
Head nurse	12 (4.05)	34.3 \pm 4.6				34.3 \pm 4.6		48.5 \pm 4.5		
Clinical nurse	284 (95.95)	34.3 \pm 6.7				34.3 \pm 6.7		47.0 \pm 7.0		

^a χ^2 .

^b t .

^c F .

0.5-point increase in the practice score. That is, knowledge and attitude had a significant effect on practice when practice scores were in the lower range, although practice scores did not increase with knowledge and attitude scores. The overall effect of knowledge on practice tended to decrease, with the effect of knowledge being almost zero when behaviour scores were high. However, after the 50% quantile, an increase in attitude scores still led to an increase in practice scores.

4 | DISCUSSION

4.1 | Status quo of knowledge, attitudes, and behaviours of ICU nurses on the early mobilization of mechanically ventilated patients

The total score of the main questionnaire was 155 points, and the average score was 114.1 ± 19.0 ; these results were good and

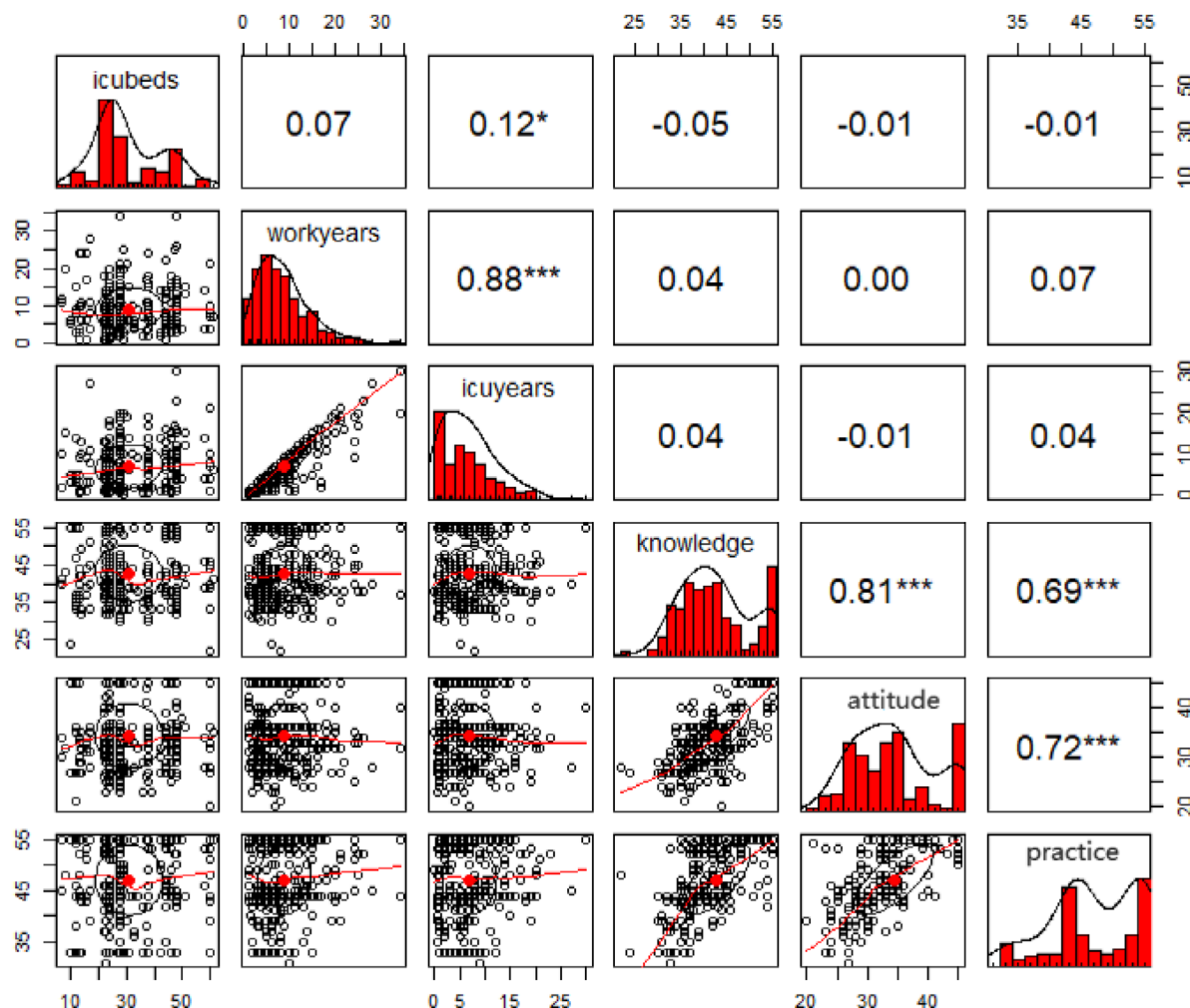


FIGURE 2 The quantitative correlation coefficient matrix between the independent variables and dependent variables.

TABLE 2 Multivariate analysis of the knowledge, attitudes and practices of ICU nurses regarding the early mobilization of mechanically ventilated patients ($n = 296$).

Explanatory variables	Regression coefficient	Standard error	T value	p value
Constant	17.473	2.674	6.534	<.001
Knowledge	0.286	0.063	4.514	<.001
Attitudes	0.501	0.072	6.971	<.001

TABLE 3 Regression coefficients and test results for different quantiles of early mobilization practices among ICU nurses for mechanically ventilated patients ($n = 296$).

Explanatory variables	P25		P50		P75	
	Regression coefficient	p value	Regression coefficient	p value	Regression coefficient	p value
Constant	6.667	.002*	19.115	<.001	32.500	<.001**
Knowledge	0.333	<.001**	0.300	<.001	0.000	.999
Attitudes	0.667	<.001**	0.431	<.001	0.500	<.001**

Note: P25 refers to the quantile level at 0.25; P50 refers to the quantile level at 0.50; P75 refers to the quantile level at 0.75.

* $p < .05$; ** $p < .001$.

slightly better than the results reported by Wang et al.²³ This means that ICU nurses in tertiary general hospitals in Zhejiang have relatively good knowledge, attitudes, and practices related to

the early mobilization of mechanically ventilated patients. The reason may be that Zhejiang Province is located in the developed eastern coastal area of China, which is technologically developed;

therefore, local medical institutions may have an advanced understanding of the value of early rehabilitation for critical illness, which provides a fertile environment for ICU nurses to have a more than average level of knowledge, attitudes, and practice.²⁴ However, the minimum score of 84.0 should not be overlooked, and there is clearly considerable scope for progress in knowledge, attitudes, and practices, which should be the focus of future research.

Specifically, in terms of the knowledge domain, the ICU nurses in this study had above-average scores. This finding is consistent with the results of Zhang et al.²⁵ and Zha et al.²⁶ However, many ICU nurses reported the lowest knowledge scores related to developing early mobilization programs for mechanically ventilated patients, similar to those reported by Liew et al.²⁷ This reflects that the knowledge of guidelines and expert consensus on the early mobilization program of mechanically ventilated patients and their application in clinical practice remains inadequate.²⁸

A well-established early mobilization program is essential. An effective program integrates standard activity policies; sets clear, achievable, and patient-oriented goals for each patient; and facilitates effective communication between nurses and other health care professionals involved in patient care. In general, the following approaches are used for patients who are unconscious or unable to cooperate actively: postural management (e.g., regular turning, passive sitting in bed, passive bed-chair transfer)^{5,24}; passive limb activities (e.g., passive limb and trunk joint mobility maintenance and passive joint muscle stretching)^{4,29}; and physiotherapy (e.g., neuromuscular electrical stimulation).³⁰ For conscious patients who are able to cooperate, when muscle strength has a score <3, active assisted activities in bed, assisted upright sitting, assisted bicycle training and muscle strength training can be added.^{5,24} When the upper arm strength is has a score ≥ 3 , active activities in bed can be added, from assisted sitting up to independent sitting up, until the patient is able to sit independently on the edge of the bed, as well as active/assisted limb activities, resistance training, and assistance with activities of daily living.^{4,30,31} When leg strength has a score of ≥ 3 , active out-of-bed movement is increased, and walking with/without a walker is gradually achieved.^{5,30} Based on this knowledge, ICU nurses also need to be aware of patient preferences, hospital facilities, and patient conditions to flexibly adapt the content of early activity programs.³² Therefore, nursing managers should reinforce the training of ICU nurses in early activity and promote a proper understanding of an early activity program through the “four Es” approach—engage, educate, execute and evaluate—following a low-dose, high-frequency approach.³³ After taking into account the patient's medical situation and dynamically updating evidence-based knowledge, ICU nurses can then set clear, achievable, and patient-oriented goals for each patient and tailor corresponding and standardized early mobilization programs.

This study revealed that ICU nurses' attitudes towards early mobilization activities for mechanically ventilated patients were generally good. However, there was still a lack of attitudinal commitment in terms of personal emotions and practices, which is consistent with the findings in Brazil.³⁴ This may be because early mobilization is

labour intensive, and each session may take up to 45 min, particularly in mechanically ventilated patients with multiple invasive catheters for intravascular access.³⁵ Limited time, safety concerns, and patient resistance are common reasons for low attitudinal commitment.³⁶ Only one-third of nurses reported prioritizing early mobilization activities.³⁷ A lack of multidisciplinary cooperation resources will further reduce the disposition of nurses towards early mobilization.¹² In addition, some clinicians are ambivalent about the potential benefits of early mobilization activity.³⁸ Therefore, managers should appropriately allocate human and facility resources to avoid adding to the workloads of bedside nurses. ICU nurses should also be provided with clear guidance regarding patient safety during activities, such as a “traffic light” system with specific criteria covering respiratory,³⁹ hemodynamic, neurological, and other body systems. This strategy could be used to assess the potential risks of early ICU activities effectively and reduce nurses' concerns about safety. The provision of information about positive health outcomes after early mobilization (e.g., earlier extubation, withdrawal, or shorter ICU stays) should be used to encourage nurses to engage with early activity programs for mechanically ventilated patients. Patient improvement as a result of early activity confers a sense of personal achievement upon nurses, promoting positive attitudes.

Finally, in this study, ICU nurses implemented early mobilization activities for mechanically ventilated patients at a good level, although there is room for further improvement in adverse event practices, organizational support, and personal practice. For adverse events, it is recommended that nursing managers establish standardized protocols or guidelines for handling and reporting procedures for early mobilization-related special conditions to reduce nurses' fear and confusion about unknown outcomes. Furthermore, care should be taken when deciding to mobilize mechanically ventilated patients in the ICU, which is a multifaceted, individualized decision made by nurses, and numerous patient-, nurse-, and organization-related factors influence that practice. The ICU should establish a reasonable and effective incentive mechanism at the organizational level to increase ICU nurses' motivation to participate in early activities for mechanically ventilated patients,³⁹ particularly over the weekend, when personnel allocation is relatively low, to support interprofessional communication and practice. To ensure maximum mobilization, an interprofessional team and protocol-driven program are recommended.

4.2 | Factors influencing ICU nurses' practice of early mobilization of mechanically ventilated patients

This study revealed that when the level of early activity practice was relatively poor, knowledge and attitudes had a significant impact on practice; however, practice did not improve linearly with increasing knowledge and attitude scores. The overall impact of knowledge on practice tended to weaken in the later period. When early activity practices were at a relatively good level but required further improvement, the positive influence of knowledge was small. However, attitude reinforcement can improve the level of early activity practices.

This finding is consistent with the findings of other studies showing that attitudes are good predictors of behaviour, regardless of complexity, at high behavioural correlations, while the amount of knowledge has no consistent effect on behaviour.⁴⁰ Other studies have shown that addressing staff attitudinal barriers should be a high priority when implementing early mobilization activities.⁴¹ The reason may be that many deficiencies in knowledge or skills can be easily overcome through several iterations of education and training. However, while nurses' attitudes towards early activity theory improve with increased education, their attitudes towards practice and emotional issues may be overlooked. For example, nurses perceive that initiating early mobilization means taking greater responsibility for the patient, including the management of unexpected situations and the acquisition of additional resources. Furthermore, nurses take on more psychological and intellectual resources during early mobilization. Therefore, a greater focus on the attitudes of nurses towards early mobilization is required, and it may be unrealistic to expect that a consistent improvement in ICU nurses' attitudes can be achieved through simple training. Thus, we suggest that, while emphasizing knowledge education, improvement items should be prioritized, such as developing a positive attitude through effective knowledge transformation, based on available evidence, while identifying potential attitude problems in early mobilization and establishing reliable comprehensive and long-term solutions.

Many interventions have been proposed to overcome these difficulties based on hypotheses or clinical experience.⁴² This study implemented bundle-based interventions as previously described.¹⁶ The initial strategy focused on educating and improving the knowledge skills of nurses, and subsequent strategies focused on positive reinforcement to achieve a shift in culture, ultimately facilitating nurse-led early mobilization of ICU patients. The results showed that the active early mobilization rate remained low during the initial phase. However, the rate increased significantly among mechanically ventilated patients (9.7% vs. 34.8%; $P = 0.0003$) during the subsequent phases. These findings should alert nursing managers to avoid strategies based on single interventions, such as educational sessions, which improve only knowledge or skills, in favour of multifaceted approaches and integrated interventions that have been identified as having a greater impact.^{43,44} In addition to facilitating knowledge, attitudes, and practices, managers should work to create an organizational culture for early mobilization interventions in the ICU. Members of staff who focus on safety and demonstrate practical skills and positive attitudes should be supported to increase the confidence and competence of the team. These early mobilization champions can use leadership and communication skills to contribute to a change in culture and educate, train, coordinate, and promote early mobilization in mechanically ventilated patients.⁴⁵

4.3 | Limitations

This study has several limitations. First, the data were cross-sectional, thereby limiting the ability to establish causality. We anticipate that

the theoretical framework provided here may enhance confidence in the directionality of the relationships presented in our model. Second, this study investigated ICUs in only five tertiary general hospitals in Zhejiang Province; therefore, caution should be applied when generalizing these results to different geographical regions. Finally, this study investigated only the knowledge, attitudes, and practices regarding early mobilization for mechanically ventilated patients of ICU nurses; however, ICU physicians, respiratory therapists, rehabilitation staff, dieticians, and family members also play important roles in the early mobilization process. Future studies should investigate these different roles to gain a more comprehensive understanding of the factors influencing the early mobilization of mechanically ventilated patients in the ICU.

5 | CONCLUSION

Early mobilization of mechanically ventilated patients in the ICU is clinically beneficial and is recommended. However, the knowledge, attitudes, and practices of ICU nurses related to early mobilization need to be further enhanced. Based on the findings of this study, it is important for ICU managers to actively improve systematic knowledge training for staff, promote knowledge transformation, and strengthen attitudes to promote early mobilization of patients on MV. Furthermore, a multidisciplinary team should be established, a structured early mobilization program and adverse event handling process should be developed, a supportive organizational culture in the ICU should be created, and a comprehensive approach should be adopted to promote the effective implementation of early mobilization in ICUs so that more patients can benefit from this approach.

AUTHOR CONTRIBUTIONS

SWJ: Conceptualization, methodology, software, writing-original draft, writing-reviewing and editing; ZYY: Conception, resources, supervision, project administration, and writing-review and editing; GXY: Investigation, data curation, writing-original draft and editing.

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CONFLICT OF INTEREST STATEMENT

All the authors declare that there are no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT

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

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