

# Association Between Self-Efficacy and Knowledge, Attitudes, and Practices Regarding pulmonary rehabilitation Among Clinical Nurses: A Cross-Sectional Study

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## Article

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# Abstract

Pulmonary rehabilitation (PR) was recommended as the standard treatment for patients with moderate-to-severe Chronic Obstructive Pulmonary Disease (COPD). Despite the robust evidence supporting PR as a highly effective intervention, its capacity has not kept pace with global demand, and its utilization remains underutilized. In addition, the association between self-efficacy and the knowledge, attitudes, and practices (KAP) related to PR among clinical nurses has not been extensively explored. This study aims to assess the association between self-efficacy and KAP to PR among clinical nurses using a cross-sectional design. A total of 679 clinical nurses were included. The mean KAP score was  $73.71 \pm 14.36$ , and the mean self-efficacy score was  $27.62 \pm 6.75$ . Nurses who received PR training had higher KAP scores ( $\beta = 12.358$ ,  $p < 0.001$ ). Self-efficacy was positively associated with KAP scores ( $\beta = 0.9$ ,  $p < 0.001$ ) even after adjusting for multiple factors. This study demonstrated that targeted training programs and interventions to improve self-efficacy could significantly enhance nurses' KAP regarding PR, ultimately improving the quality of care for COPD patients.

## Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a major global health concern, with a rising prevalence and increasing disease burden. Recent studies estimate the global prevalence of COPD in 2021 to be approximately 384 million cases<sup>1</sup>. Within China, the prevalence of COPD among adults aged 20 and above is 8.6%, rising to 13.7% within the population aged over 40 years<sup>2</sup>. The World Health Organization has estimated the costs of COPD to be in excess of 100 billion dollars per year on a global scale. In China, it is the fourth leading cause of death<sup>3</sup>. The significant economic burden and considerable harm to individuals have prompted health providers to dedicate efforts to mitigating the impact and enhancing the quality of life for those affected by COPD.

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) recommends pulmonary rehabilitation (PR) as the standard treatment for patients with moderate-to-severe COPD. The scope of PR encompasses educational initiatives, exercise training, and behavioral modification. Its primary function is to promote long-term adherence to health-enhancing behaviors, ultimately leading to enhanced physical and psychological well-being. A preceding study has demonstrated that PR has the capacity to enhance exercise capacity, quality of life, and dyspnea in patients with COPD<sup>4,5</sup>. Furthermore, it is a safe intervention for patients with COPD during acute exacerbation<sup>6</sup>.

Despite the robust evidence supporting PR as a highly effective intervention, its capacity has not kept pace with global demand, and its utilization remains underutilized. Specifically, a previous study revealed that only 0.4% of Canadians with COPD have access to PR<sup>7</sup>. A further study revealed that approximately 24% of centers in Sweden stated that their COPD patients had no access to PR<sup>8</sup>. Only 29% of physicians in Saudi Arabia had referred COPD patients to a PR program<sup>9</sup>. A similar situation was reported in a study of hospitals in China, where only 27.4% had implemented PR for patients<sup>10</sup>. The paucity of PR awareness

or knowledge has been identified as a primary factor contributing to the suboptimal referral rates<sup>11</sup>. A further study identified a lack of professional knowledge and confidence as a contributing factor to the establishment and delivery of PR programs<sup>12</sup>.

Self-efficacy, which is defined as an individual's conviction in their capacity to execute specific tasks, significantly impacts behavioral choices, effort, and persistence. Within the context of health behaviors, self-efficacy is recognized as a pivotal element in predicting and modifying actions<sup>13</sup>. Empirical evidence suggests that elevated levels of self-efficacy are associated with improved self-management of chronic conditions, including enhanced treatment adherence and quality of life among patients with coronary heart disease<sup>14</sup>. Nevertheless, the association between self-efficacy and the knowledge, attitudes, and practices (KAP) related to PR among clinical nurses has not been extensively explored.

Some researchers were interested in the topic of medical staff's knowledge, beliefs, and practice on PR. Specifically, a study of healthcare providers' attitudes, beliefs and barriers to PR for patients with COPD in Saudi Arabia found that about half of them believed that PR was an effective management strategy for patients with COPD<sup>15</sup>. Another study analyzing the implementation and understanding of PR in doctors at all levels of medical institutions in China revealed that the lower the level of the hospital, the poorer knowledge, attitude, and practice of PR<sup>10</sup>. Additionally, a study exploring Chinese respiratory physicians' awareness and referral of PR found that most of them had heard about PR, and many had knowledge of PR practice, but relatively few had referred patients to PR<sup>16</sup>. However, the majority of existing research has predominantly centered on physicians. A prior study highlighted the inconsistent understanding of PR among doctors, nurses, and therapists, noting that nurses generally possess less knowledge about COPD compared to their physician counterparts<sup>17</sup>. Additionally, nurses from different clinical units demonstrate varying levels of knowledge regarding PR, with those in chest medicine and general internal medicine wards particularly lacking in both knowledge and skills related to PR<sup>18</sup>.

As mentioned above, current research on KAP to PR among clinical nurses is limited, with existing studies primarily focusing on patient perspectives. Nurses, as key implementers of PR, directly influence rehabilitation outcomes through their knowledge, attitudes, and practices. Concurrently, nurses' self-efficacy may be a crucial factor affecting their acquisition and implementation of PR knowledge. Nevertheless, the association between these two factors has not been systematically investigated, revealing a significant knowledge gap.

Given this context, our study aims to assess the association between self-efficacy and KAP to PR among clinical nurses using a cross-sectional design. The uniqueness of this research lies in its focus on the nursing population, exploring the impact of self-efficacy on KAP to PR. The findings will provide valuable insights for enhancing nurses' PR practices, potentially improving the quality of care for COPD patients. Furthermore, this study will offer a theoretical foundation for developing targeted nurse training strategies, contributing significantly to the effective implementation of PR in clinical practice.

# Methods

## Design

A cross-sectional study design was used to explore nurses' KAP toward PR. This study was undertaken in accordance with the STROBE checklist for observational studies.

## Ethics approval and consent to participate

The study protocol was approved by the Institutional Review Board of Fuzhou University Affiliated Provincial Hospital (approval number: K2021-09-033). The requirement for written informed consent was waived because this was an anonymous cross-sectional questionnaire survey involving minimal risk. No identifiable personal information was collected, and participation was entirely voluntary. Participants were informed about the purpose of the study, and completion and submission of the questionnaire indicated their willingness to participate. Written informed consent was obtained from all participants. All procedures were conducted in accordance with the Declaration of Helsinki.

## Participants

The participants were nurses from public hospitals. The inclusion criteria were: 1) with a nurse practicing qualification certificate; 2) willing to participate; 3) being working as a nurse for more than 3 months. The exclusion criterion was being absent from their positions for more than 1 year.

## Measures

**KAP Questionnaire on PR:** Nurses' KAP toward promoting PR for patients with the chronic obstructive pulmonary disease was measured by Knowledge, Attitude, and Practice (KAP) Questionnaire on PR in the Patients with COPD. It was developed by Gao<sup>19</sup>. It consists of three domains. The first one is the knowledge domain which consists of 21 items. The answers were divided into "very familiar" (5 points), "relatively familiar" (4 points), uncertain (3), Not very familiar (2 points), and "Completely unknown" (1 point). The second is the attitude domain which consists of 7 items. The last domain is the practice domain which consists of 14 items. The items were rated on a Likert scale (5= strongly agree, 4=agree, 3=neutral, 2=disagree, 1 point=strongly disagree). The total score of the KAP ranges from 40-200. The Cronbach's  $\alpha$  was 0.976 in this study.

**Self-efficacy:** The General Self-Efficacy Scale was used to assess nurses' confidence levels (self-efficacy) in encouraging COPD patients to participate in the PR program.

This is a 10-item scale with a four-point Likert scale (1 "not at all true" to 4 "exactly true")<sup>20</sup>. The total score ranges from 10~40, with higher scores indicating greater self-efficacy. The Cronbach's  $\alpha$  was 0.959 in this study.

## Data collection

Study data were collected using the online questionnaires created surveys in Sojump Survey. The authors posted an invitation message with the link to the online questionnaire to online groups on WeChat. The questionnaire was disseminated by the registered nurses in the groups.

### **Data Analysis**

Descriptive statistics were used to summarize the characteristics of the study participants. Continuous variables were presented as mean  $\pm$  standard deviation (SD), while categorical variables were expressed as frequencies and percentages. To examine factors associated with KAP scores among clinical nurses, we conducted univariate and multivariate analyses. Univariate analysis was performed using simple linear regression, with results presented as beta coefficients ( $\beta$ ) and 95% confidence intervals (CI). The association between self-efficacy and KAP scores was further investigated using multiple linear regression models. Three models were employed:

1. Non-adjusted model: No covariates included
2. Adjust I model: Adjusted for age, sex, and marital status
3. Adjust II model: Fully adjusted for PR training experience, clinical teacher, self-reported PR knowledge, head nurse, technical titles, education, rotating nurse status, hospital grade, working department, years of working experience, marital status, sex, and age. Results from these models were presented as beta coefficients  $\beta$  with 95% confidence intervals CI and corresponding p-values. The beta coefficient represents the change in KAP score for each one-point increase in self-efficacy score. All statistical analyses were performed using Empower. A two-tailed p-value  $< 0.05$  was considered statistically significant.

## **Results**

### **Participants' characteristics**

The study included 679 clinical nurses. The mean age of participants was  $31.20 \pm 6.69$  years, with an average working experience of  $8.92 \pm 7.05$  years. The majority of participants were female (94.55%) and married (59.21%). Regarding educational background, 56.85% of nurses held a bachelor's degree, while 40.65% had an associate degree. In terms of technical titles, 47.72% were intermediate nurses, 29.90% were senior nurses, and 21.06% were junior nurses. Most participants (89.10%) worked in tertiary hospitals, with 46.98% working in internal medicine departments. 78.20% were not rotating nurses, 95.88% were not head nurses, and 72.75% were not clinical teachers. Regarding self-reported knowledge of PR, 33.14% reported "some understanding," 23.71% "understood," and 22.68% "relatively well understood." However, 77.61% reported not having received PR training. For the main study variables, the mean self-efficacy score was  $27.62 \pm 6.75$ . The mean scores for KAP were  $73.29 \pm 16.43$ ,  $84.64 \pm 12.47$ , and  $68.09 \pm 20.45$ , respectively, with an overall KAP score of  $73.71 \pm 14.36$ . More specific information was shown in Table 1.

## **Univariate Analysis Results**

The univariate analysis revealed several factors significantly associated with KAP scores among clinical nurses regarding PR. Working department was significantly associated with KAP scores. Compared to nurses working in internal medicine [reference group], those in surgery ( $\beta = -6.561$ , 95% CI: -12.587 to -0.535,  $p = 0.033$ ) ICU ( $\beta = -8.569$ , 95% CI: -11.734 to -5.404,  $p < 0.001$ ) and other departments ( $\beta = -12.436$ , 95% CI: -14.631 to -10.242,  $p < 0.001$ ) had significantly lower KAP scores. Head nurses demonstrated significantly higher KAP scores compared to non-head nurses ( $\beta = 6.612$ , 95% CI: 1.197 to 12.027,  $p = 0.017$ ). Interestingly, self-reported knowledge of PR showed a significant negative association with KAP scores. Compared to nurses who reported "Don't know" [reference group], those who reported higher levels of self-reported knowledge had progressively lower KAP scores: "Have heard of it" ( $\beta = -6.852$ , 95% CI: -9.509 to -4.195,  $p < 0.001$ ) "Some understanding" ( $\beta = -14.587$ , 95% CI: -17.020 to -12.153,  $p < 0.001$ ) "Good understanding" ( $\beta = -18.444$ , 95% CI: -21.853 to -15.034,  $p < 0.001$ ) and "Fully understand" ( $\beta = -24.842$ , 95% CI: -28.201 to -21.484,  $p < 0.001$ ). Nurses who received PR training had significantly higher KAP scores compared to those who did not ( $\beta = 12.358$ , 95% CI: 9.937 to 14.779,  $p < 0.001$ ). Self-efficacy scores were positively associated with KAP scores ( $\beta = 1.153$ , 95% CI: 1.018 to 1.288,  $p < 0.001$ ) indicating that nurses with higher self-efficacy tended to have higher KAP scores. Other factors, including age ( $p = 0.416$ ), sex ( $p = 0.245$ ), marital status ( $p > 0.05$ ), hospital grade ( $p = 0.207$ ), working experience ( $p = 0.317$ ), rotating nurse status ( $p = 0.657$ ), education level ( $p > 0.05$ ), and being a clinical teacher ( $p = 0.079$ ), did not show statistically significant associations with KAP scores in this univariate analysis. (see Table 2)

## **Multiple regression analysis**

The association between self-efficacy and KAP scores related to PR among clinical nurses was examined using multiple regression analyses. Three models were employed: a non-adjusted model, a model adjusted for demographic factors [Adjust I], and a fully adjusted model controlling for multiple professional and work-related factors [Adjust II]. In the non-adjusted model, self-efficacy demonstrated a significant positive association with KAP scores ( $\beta = 1.2$ , 95% CI: 1.0 to 1.3,  $p < 0.001$ ). This association remained consistent after adjusting for age, sex, and marital status in the Adjust I model ( $\beta = 1.2$ , 95% CI: 1.0 to 1.3,  $p < 0.001$ ), suggesting that these demographic factors had minimal influence on the relationship between self-efficacy and KAP scores. In the fully adjusted model (Adjust II), which controlled for an extensive set of factors including PR training, clinical teacher, self-reported knowledge, head nurse, technical title, education, rotating nurse status, hospital grade, working department, working experience, and demographic variables, the positive association between self-efficacy and KAP scores persisted, albeit with a slightly reduced effect size ( $\beta = 0.9$ , 95% CI: 0.7 to 1.0,  $p < 0.001$ ). These findings indicate that self-efficacy is independently associated with higher KAP scores related to PR among clinical nurses. Specifically, for every one-point increase in self-efficacy score, there was a corresponding increase of 0.9 points in KAP scores, even after controlling for multiple potential confounding factors. This robust relationship underscores the potential importance of enhancing nurses' self-efficacy as a strategy to improve their KAP regarding PR.

The slight reduction in effect size from the non-adjusted  $\beta = 1.2$  to the fully adjusted model  $\beta = 0.9$  suggests that while other factors such as training, knowledge level, and work-related characteristics also contribute to KAP scores, self-efficacy maintains a significant and independent association. This finding highlights the complex interplay of factors influencing nurses' competence in PR and emphasizes the potential value of interventions aimed at boosting self-efficacy in nursing education and professional development programs. (Table 3).

## Discussion

To our best knowledge, most studies on the knowledge of PR were among respiratory physicians and primary care physicians. This study investigated the KAP of clinical nurses regarding PR, as well as the factors associated with their KAP scores, with a particular focus on the role of self-efficacy. It will provide a reference for promoting PR in clinical practice. Previous studies had revealed that physicians' awareness of PR and referral to PR was not sufficient<sup>16,21</sup>. Similarly, nurses had low KAP status on PR in this study.

Although a previous study found no differences in PR knowledge between nurses working in internal medicine and general medicine<sup>18</sup>, this study found significant differences in KAP scores based on working departments, with nurses in department of thoracic surgery, ICU, and other departments showing lower scores compared to those in internal medicine. This is similar to a previous study that revealed that internal medicine physicians had a higher level of knowledge of PR than other clinicians<sup>22</sup>. This may be due to their experience with caring for patients with respiratory system disease in clinical practice. As that PR was usually implemented among patients with COPD, lung cancer<sup>23</sup>, pulmonary fibrosis<sup>24</sup>, and lung transplants<sup>25</sup>, nurses in the related units have more access to the knowledge of PR than other units. As a previous study revealed that more years of practice in respiratory care had better awareness of PR<sup>16</sup>. This disparity might reflect differences in exposure to PR practices across various clinical settings and highlights the need for more comprehensive PR training across all departments<sup>26</sup>.

Notably, nurses who received PR training demonstrated significantly higher KAP scores ( $\beta = 12.358$ , 95% CI: 9.937 to 14.779,  $p < 0.001$ ). Attending certain training programs could improve the perception of knowledge, attitude, skill, and confidence level<sup>27</sup>. However, only 22.39% of participants reported receiving such training. This finding emphasizes the critical need for more widespread and accessible PR training programs for clinical nurses<sup>28</sup>.

Head nurses showed higher KAP scores, suggesting that leadership roles might contribute to enhanced knowledge and practices in PR. This could be due to increased exposure to educational opportunities or a greater sense of responsibility in staying updated with best practices<sup>29</sup>. Research and guidelines related to lung rehabilitation are constantly updated, and new knowledge and concepts are generally disseminated through academic conferences. Head nurses have more opportunities to participate in seminars and get new knowledge than clinical nurses. Also, as a leader, head nurses are more active in

acquiring new knowledge, new concepts, and new trends in the discipline. Thus, the knowledge of clinical nurses is relatively lagging behind.

Our findings revealed that self-efficacy is significantly and positively associated with KAP scores related to PR among clinical nurses. This association remained robust even after adjusting for multiple demographic, professional, and work-related factors ( $\beta = 0.9$ , 95% CI: 0.7 to 1.0,  $p < 0.001$ ). This result aligns with previous studies that have demonstrated the importance of self-efficacy in nursing practice and education<sup>30</sup>. The persistent association across all regression models suggests that enhancing nurses' self-efficacy could be a valuable strategy for improving their competence in PR. Self-efficacy is comprised of a person's attitudes, abilities, and cognitive skills. It is an individual's belief in their ability to complete a task or achieve a goal. Self-efficacy can enhance an individual's confidence when facing difficulties, predict their actions and lead to behavior changes<sup>31</sup>. Additionally, self-efficacy positively interacted with learning ability<sup>32</sup>. Thus, nurses with higher self-efficacy usually mean that they have a higher level of knowledge and skill.

Interestingly, our univariate analysis revealed that nurses' self-reported knowledge of PR was negatively associated with their KAP scores. This counterintuitive finding might indicate a Dunning-Kruger effect, where individuals with limited knowledge in a domain overestimate their competence<sup>33</sup>. It underscores the importance of objective assessment and targeted education in PR for nurses.

## Limitations

While our study provides valuable insights, it has some limitations. First, this study used a convenience sample strategy; therefore, the participants may be not representative of the larger population. Also, the cross-sectional design precludes causal inferences, and self-reported measures may be subject to bias. Future longitudinal studies could provide more robust evidence on the causal relationships between self-efficacy, training, and KAP scores in PR.

PR has been recommended as the standard treatment for patients with COPD. It is an effective evidence-based intervention for people with COPD. A lack of professional knowledge and confidence is the main factor hindering the development of PR<sup>10,12</sup>. Thus, medical staff with high level of knowledge and positive attitude to PR is very important, and efforts should be made to improve the knowledge of PR among them. Nurses also work in the PR team and play an important role in the PR section in terms of assessment, patient education, symptom management and disease management<sup>34</sup>. Understanding the status of nurses' KAP toward PR will improve awareness of the importance of PR. Exploring the factors related to the status will help nurse administrators and hospital directors improve nurses' skills and expert knowledge on PR. High level of knowledge on PR will enable nurses provide high standard of person-centered care that is centered around the goals of PR and finally improve the condition of COPD patients. Specifically, it is important to note that pulmonary nurses had more opportunities to contact COPD patients. Developing more targeted training courses to achieve better training results is very important. Thus, nursing administrators should actively organize training related to PR and popularize

the theory and knowledge of PR. They should create more opportunities for clinical nurses to get access to PR. Also, more training efforts may focus on young nurses working in settings with less work experience with respiratory disease. Finally, helping nurses develop self-efficacy may also improve their KAP of PR. Specifically, simulation scenarios and experiential learning via models and practice were suggested to improve self-efficacy<sup>35</sup>.

## Conclusions

In conclusion, our findings highlight the complex interplay of factors influencing nurses' competence in PR, with self-efficacy emerging as a key independent factor. These results suggest that interventions aimed at enhancing self-efficacy, coupled with comprehensive PR training programs, could significantly improve nurses' KAP in PR. Future research should focus on developing and evaluating such interventions to enhance the quality of PR care provided by clinical nurses.

## Declarations

### Data availability

All relevant data and the key findings from this study are included within the published article. For additional information or specific inquiries, interested readers are encouraged to contact the corresponding author

### Author contributions

HMZ and XYL drafted the manuscript; HMZ performed data analysis; LFQ refined the language; BLY critically reviewed the content; XYL supervised the study, provided substantial revisions, and approved the final manuscript.

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### Declarations Competing interests

No conflict of interest has been declared by all authors.

### Ethics approval and consent to participate

This cross-sectional study was reviewed and approved by the Institutional Review Board of Fuzhou University Affiliated Provincial Hospital (approval number: K2021-09-033). Written informed consent was obtained from all participants. The purpose of the research was explained, and the participants were invited to confidentially complete the survey.

**Tables 1-3**

Table 1  
Characteristics of the study population (N = 679)

| Characteristic             | n (%) or Mean $\pm$ SD |
|----------------------------|------------------------|
| Age (years)                | 31.20 $\pm$ 6.69       |
| Working experience (years) | 8.92 $\pm$ 7.05        |
| Gender                     |                        |
| Female                     | 642 (94.55)            |
| Male                       | 37 (5.45)              |
| Marital status             |                        |
| Single                     | 270 (39.76)            |
| Married                    | 402 (59.21)            |
| Other                      | 7 (1.03)               |
| Education level            |                        |
| Associate degree           | 276 (40.65)            |
| Bachelor's degree          | 386 (56.85)            |
| Master's degree or above   | 7 (1.03)               |
| Other                      | 10 (1.47)              |
| Professional title         |                        |
| Junior                     | 143 (21.06)            |
| Intermediate               | 324 (47.72)            |
| Senior                     | 203 (29.90)            |
| Other                      | 9 (1.32)               |
| Position                   |                        |
| Staff nurse                | 651 (95.88)            |
| Head nurse                 | 28 (4.12)              |
| Clinical teacher           |                        |
| Yes                        | 185 (27.25)            |
| No                         | 494 (72.75)            |
| Department                 |                        |

| <b>Characteristic</b>      | <b>n (%) or Mean <math>\pm</math> SD</b> |
|----------------------------|------------------------------------------|
| Internal Medicine          | 248 (36.52)                              |
| Surgery                    | 20 (2.95)                                |
| ICU                        | 92 (13.55)                               |
| Other                      | 319 (46.98)                              |
| Hospital grade             |                                          |
| Tertiary                   | 605 (89.10)                              |
| Secondary                  | 74 (10.90)                               |
| Rotating nurse             |                                          |
| Yes                        | 148 (21.80)                              |
| No                         | 531 (78.20)                              |
| PR training experience     |                                          |
| Yes                        | 152 (22.39)                              |
| No                         | 527 (77.61)                              |
| Self-reported PR knowledge |                                          |
| None                       | 161 (23.71)                              |
| Little                     | 154 (22.68)                              |
| Moderate                   | 225 (33.14)                              |
| Familiar                   | 68 (10.01)                               |
| Very familiar              | 71 (10.46)                               |
| KAP scores                 |                                          |
| Knowledge                  | 73.29 $\pm$ 16.43                        |
| Attitude                   | 84.64 $\pm$ 12.47                        |
| Practice                   | 68.09 $\pm$ 20.45                        |
| Total KAP                  | 73.71 $\pm$ 14.36                        |
| Self-efficacy score        | 27.62 $\pm$ 6.75                         |

Table 2  
Univariate Analysis of Factors Associated with KAP Scores

| Variable                                                                                                        | Category                 | $\beta$ (95% CI)           | P-value |
|-----------------------------------------------------------------------------------------------------------------|--------------------------|----------------------------|---------|
| Age (years)                                                                                                     |                          | -0.067 (-0.229, 0.094)     | 0.416   |
| Sex                                                                                                             | Male                     | Reference                  |         |
|                                                                                                                 | Female                   | 2.828 (-1.931, 7.586)      | 0.245   |
| Marital status                                                                                                  | Single                   | Reference                  |         |
|                                                                                                                 | Married                  | 1.053 (-1.162, 3.269)      | 0.352   |
|                                                                                                                 | Other                    | 5.754 (-5.025, 16.534)     | 0.296   |
| Working department                                                                                              | Internal Medicine        | Reference                  |         |
|                                                                                                                 | Surgery                  | -6.561 (-12.587, -0.535)   | 0.033   |
|                                                                                                                 | ICU                      | -8.569 (-11.734, -5.404)   | < 0.001 |
|                                                                                                                 | Other                    | -12.436 (-14.631, -10.242) | < 0.001 |
| Hospital grade                                                                                                  | Tertiary                 | Reference                  |         |
|                                                                                                                 | Secondary                | -2.235 (-5.700, 1.231)     | 0.207   |
| Working experience (years)                                                                                      |                          | -0.078 (-0.232, 0.075)     | 0.317   |
| Rotating nurse                                                                                                  | No                       | Reference                  |         |
|                                                                                                                 | Yes                      | 0.594 (-2.024, 3.213)      | 0.657   |
| Education level                                                                                                 | Other                    | Reference                  |         |
|                                                                                                                 | Associate degree         | 1.527 (-7.532, 10.586)     | 0.741   |
|                                                                                                                 | Bachelor's degree        | 0.682 (-8.332, 9.696)      | 0.882   |
|                                                                                                                 | Master's degree or above | 10.257 (-3.612, 24.126)    | 0.148   |
| Technical title                                                                                                 | Staff nurse              | Reference                  |         |
|                                                                                                                 | Junior nurse             | -2.451 (-5.276, 0.373)     | 0.089   |
|                                                                                                                 | Intermediate nurse       | -1.564 (-4.635, 1.507)     | 0.319   |
|                                                                                                                 | Senior nurse             | 3.303 (-6.365, 12.971)     | 0.503   |
| Head nurse                                                                                                      | No                       | Reference                  |         |
| Abbreviations: PR, pulmonary rehabilitation; KAP, Knowledge, Attitudes, and Practices; CI, Confidence Interval. |                          |                            |         |

| Variable                                                                                                        | Category           | $\beta$ (95% CI)           | P-value |
|-----------------------------------------------------------------------------------------------------------------|--------------------|----------------------------|---------|
| Clinical teacher                                                                                                | Yes                | 6.612 (1.197, 12.027)      | 0.017   |
|                                                                                                                 | No                 | Reference                  |         |
| Self-assessed knowledge on PR                                                                                   | Yes                | -2.178 (-4.601, 0.245)     | 0.079   |
|                                                                                                                 | Don't know         | Reference                  |         |
|                                                                                                                 | Have heard of it   | -6.852 (-9.509, -4.195)    | < 0.001 |
|                                                                                                                 | Some understanding | -14.587 (-17.020, -12.153) | < 0.001 |
|                                                                                                                 | Good understanding | -18.444 (-21.853, -15.034) | < 0.001 |
|                                                                                                                 | Fully understand   | -24.842 (-28.201, -21.484) | < 0.001 |
| Received PR training                                                                                            | No                 | Reference                  |         |
|                                                                                                                 | Yes                | 12.358 (9.937, 14.779)     | < 0.001 |
| Self-efficacy score                                                                                             |                    | 1.153 (1.018, 1.288)       | < 0.001 |
| Abbreviations: PR, pulmonary rehabilitation; KAP, Knowledge, Attitudes, and Practices; CI, Confidence Interval. |                    |                            |         |

Table 3  
Association between Self-Efficacy and KAP Scores in Multiple Regression Models

| Exposure Variable                                                                                                                                                                                                                                                                                                  | Non-adjusted Model | Adjust I Model | Adjust II Model |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|----------------|-----------------|
| Self-Efficacy                                                                                                                                                                                                                                                                                                      | 1.2 (1.0, 1.3)     | 1.2 (1.0, 1.3) | 0.9 (0.7, 1.0)  |
|                                                                                                                                                                                                                                                                                                                    | p < 0.001          | p < 0.001      | p < 0.001       |
| Data are presented as $\beta$ (95% CI) and p-value.                                                                                                                                                                                                                                                                |                    |                |                 |
| Non-adjusted model: No adjustments                                                                                                                                                                                                                                                                                 |                    |                |                 |
| Adjust I model: Adjusted for age, sex, and marital status                                                                                                                                                                                                                                                          |                    |                |                 |
| Adjust II model: Adjusted for pulmonary rehabilitation training, clinical teacher status, self-assessed knowledge on pulmonary rehabilitation, head nurse status, technical title, education, rotating nurse status, hospital grade, working department, years of working experience, marital status, sex, and age |                    |                |                 |
| $\beta$ represents the change in KAP score for each one-point increase in self-efficacy score.                                                                                                                                                                                                                     |                    |                |                 |

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