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ARTICLE

Knowledge, Attitude, and Practice Levels of Nurses in Primary Hospitals Regarding Elderly Subsyndromal Delirium: Assessment and Development of a Network-Based Tiered Training Program

Xiaping Shu[1], Fang Wang[1], Jinqiu He[1], Fang Huang[1,*]

[1]Department of Rehabilitation Medicine, Shengzhou People's Hospital (Shengzhou Branch of the First Affiliated Hospital of Zhejiang University School of Medicine, The Shengzhou Hospital of Shaoxing University), Shengzhou, Zhejiang, China

*Correspondence: Szrmyysjnk2008@126.com (Fang Huang)

Abstract

Aims/Background Subsyndromal delirium (SSD) in elderly patients can lead to prolonged hospital stays, reduced quality of life, and cognitive decline. Evidence suggests that nursing interventions play a key role in mitigating SSD risk by facilitating early identification as well as timely and effective interventions. This study aimed to assess the knowledge, attitude, and practice (KAP) levels of nurses in primary hospitals regarding elderly SSD, identify factors influencing these levels, and construct a network-based tiered training program.

Methods A literature review and Delphi expert consultation method, based on the KAP theory, were utilized to develop a questionnaire to assess the KAP levels of nurses regarding elderly SSD in primary hospitals. A pilot study was conducted to determine the reliability and validity of the questionnaire. From January 2024 to June 2024, a stratified cluster sampling method was employed to survey nurses from six secondary or higher-level primary hospitals in Shaoxing, China. The self-developed questionnaire was used to evaluate the KAP levels of primary hospital nurses regarding elderly SSD assessment and analyze factors influencing their scores. Based on the findings, a network-based tiered training program was constructed.

Results A total of 615 questionnaires were distributed, of which 600 were valid, with an effective response rate of 97.56%. The mean total KAP score for nurses in primary hospitals regarding elderly SSD assessment was 98.11 ± 12.23, with an overall scoring rate of 61.32%. The mean scoring rates for KAP were 48.35%, 81.29%, and 68.84% respectively. Significant differences in KAP scores regarding elderly SSD for nurses in primary hospitals with different characteristics were observed based on age, educational level, years of experience, and professional title ($p < 0.001$). Multiple linear regression analysis showed that years of experience and professional title (nurse in charge or deputy senior nurse practitioner and above) were significant predictors of total KAP scores ($p < 0.05$).

Conclusion The overall KAP level of primary hospital nurses regarding elderly SSD assessment was suboptimal. While attitudes towards SSD were generally positive, knowledge and practice levels required considerable improvement. A network-based tiered training program was developed to enhance the capacity of primary hospital nurses for timely and accurate identification of SSD risks in elderly patients.

Key words: primary hospital; nurses; elderly; subsyndromal delirium; knowledge; attitude; practice; network-based; training

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Introduction

Delirium is a prevalent clinical syndrome characterized by disturbances in consciousness, cognitive function, and perception, with an acute onset and fluctuating course (Wilson et al, 2020). A systematic review reported that delirium affects approximately 50% of hospitalized elderly patients (age ≥65 years) (Inouye et al, 2014). Delirium significantly affects the quality of life of patients, with some individuals experiencing long-term cognitive impairment, and in severe cases, it can even lead to mortality. Additionally, delirium imposes a significant economic burden on families and society due to increased medical costs (Shin et al, 2023; Zazzara et al, 2021). With increasing research on delirium, it has been observed that some hospitalized patients exhibit clinical manifestations of delirium without meeting the full diagnostic criteria. This condition, which adversely affects patient prognosis, is referred to as subsyndromal delirium (SSD) (Cole et al, 2013).

As frontline caregivers, nurses spend most of their working hours providing direct care to patients. Compared to physicians, they have more frequent interactions with patients, allowing them to promptly detect changes in patients' consciousness and effectively identify, report, and manage SSD (Xing et al, 2022; Xing et al, 2019). A study has highlighted the critical role of nursing in reducing the risk of SSD occurrence through early identification of high-risk patients and providing timely and effective interventions (Denny and Such, 2018). However, a cross-sectional survey conducted in intensive care units (ICUs) across seven hospitals in Southwest China revealed suboptimal SSD assessments in the ICU, with major obstacles including inadequate knowledge and skills among nurses, poor organizational management, and the complexity of patient conditions (Gao et al, 2022). Additionally, a systematic review showed that hypoactive delirium, a subtype of SSD, was missed in two-thirds of adult ICU patients (Krewulak et al, 2020). Another cross-sectional survey involving 1521 ICU patients across 47 countries reported that only 42% of healthcare providers correctly utilized delirium detection tools (Morandi et al, 2017). These findings highlight the urgent need to improve clinical nurses' ability to assess and manage SSD effectively.

The Centers for Disease Control and Prevention have recognized the knowledge, attitude, and practice (KAP) theory as one of the four most influential behavioural intervention models (Alzghoul and Abdullah, 2015). According to this framework, KAP interacts dynamically, which influences individual behaviour change (Tariq et al, 2022). The KAP models are widely used in healthcare and nursing research to assess the knowledge, beliefs, and behaviours of individuals on particular health-related topics (Nair et al, 2021). As primary caregivers for elderly inpatients, nurses need to apply their knowledge of delirium to accurately identify its subtypes and implement appropriate management strategies, to improve the diagnosis and treatment of SSD (Zhou et al, 2024). The effectiveness of SSD management is directly influenced by nurse's KAP levels, and training has been shown to enhance their knowledge, attitude and skills (Xing et al, 2022).

With the accelerating global ageing trend, primary comprehensive hospitals are gaining increasing attention. However, the KAP levels of primary hospital nurses

regarding elderly SSD remain unclear (Aoki et al, 2023; Durlach et al, 2023). This study aimed to investigate the KAP levels of primary hospital nurses regarding elderly SSD and identify factors influencing their KAP. Furthermore, it constructed a network-based tiered training program to enhance the competencies of nurses in SSD assessment and management. The ultimate goal was to provide novel insights that enhance the precision of clinical SSD diagnosis in elderly patients and provide evidence-based support for clinical decision-making.

Methods

Participants

From January 2024 to June 2024, nurses from 6 secondary or higher-level primary hospitals in Shaoxing, China, were recruited for this study using stratified cluster sampling. Hospitals were selected based on region, size, and service population characteristics to ensure sample representativeness and efficiency, capturing homogeneity and heterogeneity. This sampling approach ensures that the data are consistent with the population, scalable, and representative of a wide range of primary hospitals.

The inclusion criteria were as follows: (1) Possession of a valid nurse practice certificate issued by China; (2) A minimum of one year of work experience in secondary or higher-level primary hospitals; (3) Awareness of the study objectives and provision of signed informed consent.

The exclusion criteria were: (1) Nurses who were interns or undergoing further education; (2) Those with less than one year of nursing experience or those who had been on leave for more than three months; (3) Nurses who withdrew from the study before completion; (4) Nurses who were absent (on leave) during the questionnaire administration period.

This study was approved by the Shengzhou People's Hospital Ethics Review Committee (Approval No. [2022] No. 019) and strictly adhered to the ethical guidelines outlined in the Declaration of Helsinki.

Questionnaire Construction, Tools and Data Collection of KAP Level Survey

Construction of a Questionnaire on the KAP Level

The KAP questionnaire was developed to assess nurses' understanding, perceptions, and clinical practices related to elderly SSD. The development process consisted of the following key steps: (1) Preliminary establishment of the research theoretical framework and item pool: ① A conceptual structure was formulated based on a comprehensive literature review and consensus from expert panel discussions; ② An item pool was created to represent each theoretical dimension of the KAP model; ③ A panel of subject-matter experts reviewed and assessed the relevance and clarity of each item; ④ Feedback from practicing nurses was incorporated based on expert recommendations. The questionnaire was structured into 3 dimensions: personal information, knowledge about elderly SSD, attitude towards and practice in managing elderly SSD. Based on this theoretical structure, the "Ques-

tionnaire on the KAP Level of Primary Hospital Nurses regarding Elderly SSD" was developed, establishing the item pool for further refinement.

(2) Delphi expert consultation: To ensure the validity and reliability of the questionnaire, the Delphi method was employed, involving experts from clinical nursing, nursing management, and nursing education. Experts were selected based on the principles of "reasonable knowledge structure and professional complementarity" using the following criteria: ① At least 10 years of professional experience; ② Bachelor's degree or higher; ③ Deputy senior nurse practitioner or above; ④ Specialization in clinical nursing (geriatric-related departments); ⑤ Have signed informed consent for participation.

A total of 15 experts from Zhejiang Province were selected to participate in the Delphi consultation and validation. Two rounds of the Delphi consultation were conducted to refine the "Questionnaire on the KAP Level of Primary Hospital Nurses regarding Elderly SSD". Experts, leveraging their clinical experience and professional knowledge in primary hospitals, evaluated each item of the questionnaire, analyzed its significance, conducted screening and demonstration, and provided constructive feedback for modification, addition, or removal.

The Delphi expert consultation questionnaire consisted of three main components: (1) The questionnaire description, which included research background, objectives, and significance; (2) Expert demographic information including age, educational background, professional title, nursing education and management experience, familiarity with the evaluation indicators, and the rationale for their judgment; (3) Main body of the questionnaire including the content of each evaluation index and the scoring system for rating the importance of each item.

Experts were asked to rate the importance of each item on a 5-point Likert scale (1 = not important, 5 = very important) (Joshi et al, 2015) and provide comments or suggestions for other items. The first round of consensus questionnaires was distributed via email or the online platform "WenJuanXing" (https://www.wjx.cn/), a free and widely used survey platform. The questionnaire content remained consistent across both formats to accommodate experts' preferences.

After the first round of consultations, the research team summarized and analyzed expert feedback, revised the questionnaire accordingly, and redistributed it for the second round of assessment. The interval between the two rounds of questionnaire consultation was four weeks. The criteria for further revision in the second round were: (1) Items with an average significance or rationality score <4; (2) Items with a coefficient of variation (CV) $\geq 25\%$; (3) Items that experts suggested modifying, adding, or removing.

The response rates of the experts reflected their positive attitude towards the "Questionnaire on the KAP Level of Primary Hospital Nurses regarding Elderly SSD". The response rates for the two rounds of experts were 84.7% and 100%, respectively. The mean significance scores for each item ranged from 4.40–5.00 (CV: 0.00–0.15), and the mean rationality score ranged from 4.60–5.00 (CV: 0.00–0.16). These results indicated strong expert consensus regarding the validity and significance of the "Questionnaire on the KAP Level of Primary Hospital Nurses regarding Elderly SSD". Following focus group discussions and final expert reviews,

Table 1. Reliability and validity assessment of the questionnaire on KAP levels of primary hospital nurses regarding elderly SSD.

Item	Knowledge	Attitude	Practice	Total score
Cronbach's α coefficient	0.965	0.920	0.911	0.955
Test-retest reliability	0.829	0.901	0.962	0.979

Note: KAP, knowledge, attitude, and practice; SSD, subsyndromal delirium.

the final version of the KAP questionnaire was established. The high response rate and strong consensus indicate that the "Questionnaire on the KAP Level of Primary Hospital Nurses regarding Elderly SSD" is a valid and reliable instrument for assessing nurses' knowledge, attitudes, and practices regarding elderly SSD in primary hospital settings.

After 2 rounds of expert consultations, the most influential expert recommendations were as follows: In the first round of expert consultations, experts suggested removing the option in the knowledge dimension that asked, "Do you know how to promptly assess subtypes of elderly patients with high-risk delirium and provide targeted preventive treatments for different subtypes?". Additionally, they proposed adding the option—"Are you aware that the identification and management of elderly SSD require a multidisciplinary team approach?" in the knowledge dimension. In the second round, it was agreed to include the option—"Do you think it is necessary for nurses in primary hospitals to be knowledgeable about elderly SSD during their clinical practice?" in the attitude dimension.

(3) Reliability and validity analysis of the questionnaire: To assess the reliability and validity of the final questionnaire, a pilot study was conducted using SPSS 25.0 software (IBM Corp., Armonk, NY, USA). The principal researcher conducted the pre-test among 30 nurses from locations outside the main study site. The observational results of the pilot study indicated that all items were clear, relevant, and appropriate. The questionnaire was completed within the first 30 minutes of the pilot test, and data analysis of the scale was performed to determine its reliability. Cronbach's α coefficient was calculated to evaluate the internal consistency of the questionnaire. A Cronbach's α coefficient value >0.7 indicated good reliability, with values closer to 1 reflecting higher reliability of the scale (Taber, 2018). To examine the stability of the questionnaire over different time points, the questionnaire was administered twice to the same group of participants at different time points. The test-retest reliability coefficient was determined via correlation analysis in SPSS 25.0 (IBM Corp., Armonk, NY, USA). We calculated the correlation between the results of the two tests, that is, the Test-retest reliability coefficient was obtained. A Test-retest reliability coefficient >0.7, suggesting high stability and consistency of the scale over time (Li et al, 2022).

The final results confirmed that our questionnaire has good reliability and validity, making it a robust tool for assessing KAP levels among nurses in primary hospital settings (Table 1).

Investigative Tools

A self-developed questionnaire was used to assess the KAP levels of primary hospital nurses regarding elderly SSD. The questionnaire comprised four sections: (1) Personal information of primary hospital nurses, including gender, age, years of work experience, educational level, professional title, hospital level, and marital status; (2) Knowledge of elderly SSD among primary hospital nurses; (3) Attitude of primary hospital nurses towards elderly SSD; and (4) Practice of primary hospital nurses regarding elderly SSD. The questionnaire contained a total of 32 items.

A Likert 5-point scale was employed for scoring (Joshi et al, 2015), with each item rated from 1 to 5 points. The total score ranged from 32 to 160 points, where higher scores indicated a higher KAP level of the research participants.

Data Collection

Before data collection, the research team established contact with primary hospital departments to obtain their support and cooperation. The questionnaire was uploaded onto the "WenJuanXing" online survey platform (https://www.wjx.cn/) and distributed to the research subjects by sending the questionnaire link via WeChat and using a standardized instruction guide. Participants were required to complete the questionnaire independently within 30 minutes. Throughout the data collection process, informed consent was obtained, and the privacy rights of all participants were strictly upheld.

Statistical Analysis

Statistical analysis was performed using SPSS 25.0 software (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as frequency and percentage [n (%)] and compared between groups using the chi-square (χ^2) test. The Shapiro-Wilk test was used to check the normality of continuous variables. Normally distributed variables were expressed as mean ± standard deviation ($\bar{x} \pm s$), with comparisons between the two groups conducted using an independent samples *t*-test. Comparisons among multiple groups were conducted using one-way analysis of variance (ANOVA), followed by Tukey's post hoc test for pairwise comparisons. KAP scores of nurses in primary hospitals were treated as continuous variables, and multiple linear regression analysis was conducted to identify factors influencing nurses' KAP scores. A p-value < 0.05 was considered statistically significant.

Results

Baseline Characteristics

A total of 615 questionnaires were distributed, of which 600 were valid, with an effective response rate of 97.56%. The baseline characteristics of the 600 nurses in primary hospitals are summarized in Table 2 and Fig. 1. Among the participants, 115 (19.17%) were males and 485 (80.83%) were females. The average ages of the nurses ranged from 23 to 48 years, with a mean age of 33.15 ± 7.23 years. In terms of educational background, 120 nurses (20.00%) held a college degree, while 480 nurses (80.00%) had a bachelor's degree or higher. Regarding marital status,

Table 2. Baseline characteristics of nurses in primary hospitals (n = 600).

Characteristic	Category	n (%)
Age (years)	≤30	310 (51.67%)
	31–40	190 (31.67%)
	≥41	100 (16.67%)
Gender	Male	115 (19.17%)
	Female	485 (80.83%)
Educational level	College	120 (20.00%)
	Bachelor's degree or higher	480 (80.00%)
Marital status	Unmarried	275 (45.83%)
	Married	325 (54.17%)
Years of work experience (years)	≤2	220 (36.67%)
	3–10	265 (44.17%)
	≥11	115 (19.17%)
Professional title	Nurse	155 (25.83%)
	Nurse practitioner	280 (46.67%)
	Nurse in charge	130 (21.67%)
	Deputy senior nurse practitioner or higher	35 (5.83%)
Hospital level	Grade A secondary hospital	185 (30.83%)
	Grade B secondary hospital	415 (69.17%)

275 nurses (45.83%) were unmarried, whereas 325 nurses (54.17%) were married. Participants' working experience ranged from 1 to 25 years, with an average of 5.93 ± 4.38 years. Based on professional titles, there were 155 nurses (25.83%), 280 nurse practitioners (46.67%), 130 nurses in charge (21.67%), and 35 deputy senior nurse practitioners or above (5.83%). In terms of hospital classification, 185 nurses (30.83%) worked in grade A secondary hospitals, while 415 nurses (69.17%) worked in grade B secondary hospitals.

KAP Levels of Primary Hospital Nurses Regarding Elderly SSD Assessment

The mean knowledge dimension score for nurses in primary hospitals regarding elderly SSD assessment was 38.68 ± 9.37, with a scoring rate of 48.35%. The mean attitude dimension score was 28.45 ± 5.94, corresponding to a scoring rate of 81.29%. The mean nursing practice dimension score was 30.98 ± 7.36, with a scoring rate of 68.84%. The overall score had a mean value of 98.11 ± 12.23, with a total scoring rate of 61.32% (Table 3).

Univariate Analysis of the Total KAP Scores Regarding Elderly SSD Assessment Among Nurses in Primary Hospitals

A comparison of total KAP scores among nurses from primary hospitals regarding elderly SSD with different characteristics showed statistically significant differences in age, educational level, years of work experience, and professional title ($p < 0.001$) (Table 4).

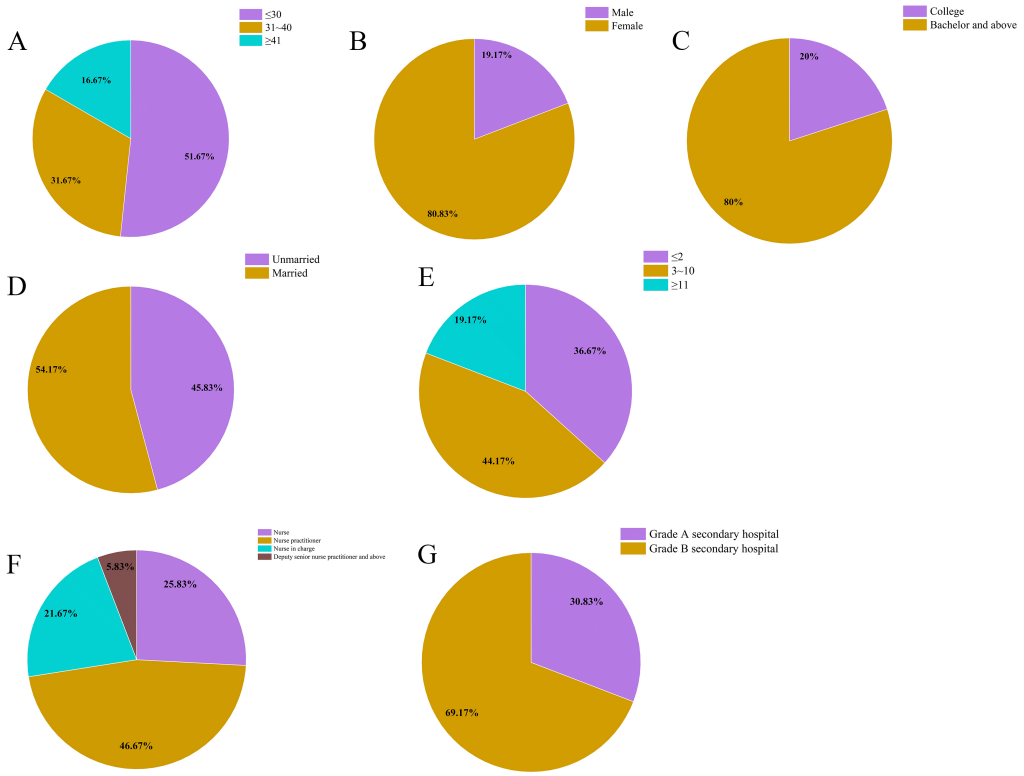

Fig. 1. Baseline characteristics of nurses in primary hospitals. (A) Age distribution (years). (B) Gender. (C) Educational level. (D) Marital status. (E) Years of work experience. (F) Professional title. (G) Hospital level.

Table 3. KAP dimension scores of primary hospital nurses.

Dimension	Rating range	Average score	Score rate (%)
Knowledge	16–80	38.68 ± 9.37	48.35
Attitude	7–35	28.45 ± 5.94	81.29
Practice	9–45	30.98 ± 7.36	68.84
Total score	32–160	98.11 ± 12.23	61.32

Note: KAP, knowledge, attitude, and practice.

Multiple Linear Regression Analysis of Risk Factors Influencing Total KAP Scores Regarding Elderly SSD Assessment for Nurses in Primary Hospitals

A multiple linear regression model was used to identify factors influencing the KAP scores among primary hospital nurses. The total scores of the KAP questionnaire by nurses in primary hospitals were considered the dependent variable, while statistically significant variables from the univariate analysis were included as the independent variables. The self-variable assignment details are shown in Table 5. The multilinear regression analysis showed that years of working experience, nurse in charge, and deputy senior nurse practitioner or higher were significant predictors of KAP scores in nurses from primary hospitals ($p < 0.05$, Table 6). The regression equation had an F-value of 23.041, with an adjusted R^2 of 0.183, explaining 18.3% of the variance in KAP scores.

Table 4. Univariate analysis of total KAP scores ($\bar{x} \pm s$).

Item	n	Total KAP score	F/t	p-value
Age (years)			93.451	<0.001
≤30	310	88.17 ± 17.77		
31–40	190	110.69 ± 19.66		
≥41	100	105.00 ± 19.72		
Gender			0.422	0.673
Male	115	97.43 ± 18.24		
Female	485	98.27 ± 19.15		
Educational level			7.230	<0.001
College	120	88.17 ± 15.11		
Bachelor's degree or higher	480	100.59 ± 22.47		
Marital status			1.302	0.193
Unmarried	275	97.06 ± 18.18		
Married	325	98.99 ± 17.99		
Years of work experience (years)			80.562	<0.001
≤2	220	87.79 ± 17.69		
3–10	265	99.65 ± 18.91		
≥11	115	114.30 ± 18.25		
Professional title			24.858	<0.001
Nurse	155	91.30 ± 17.13		
Practitioner nurse	280	95.75 ± 20.33		
Nurse in charge	130	107.55 ± 18.23		
Deputy senior nurse practitioner or higher	35	111.97 ± 19.44		
Hospital level			1.088	0.277
Grade A secondary hospital	185	97.24 ± 12.57		
Grade B secondary hospital	415	98.49 ± 13.16		

Note: KAP, knowledge, attitude, and practice.

Discussion

Nurses, as primary caregivers for elderly patients, play a crucial role in the monitoring and prevention of SSD in this population (Denny and Such, 2018). A comprehensive understanding of SSD is essential for the accurate identification and assessment of affected patients (Xing et al, 2022). Unlike previous studies on delirium and its subtypes that primarily focused on nurses in tertiary hospitals (Xing et al, 2022; Xing et al, 2017; Zhou et al, 2023), this study targeted nurses in primary hospitals to assess their KAP levels regarding SSD in elderly patients. Given the significance of early detection and intervention, it is necessary to conduct survey research on SSD assessment among nurses in primary hospitals. To address this gap, a KAP questionnaire for SSD assessment among primary hospital nurses was meticulously developed and validated, demonstrating good reliability and validity. The survey results indicated that the score rates of primary hospital nurses in the KAP dimensions were 48.35%, 81.29%, and 68.84%, respectively.

Table 5. Categorical variable assignments.

Characteristic	Assigned value
Educational level	College = 0, Bachelor's degree or higher = 1
Professional title	Nurse = 0, Practitioner nurse = 1, Nurse in charge = 2, Deputy senior nurse practitioner or higher = 3

Table 6. Multiple linear regression analysis of total KAP scores.

Variable	B	SE	β	t	p-value	R^2	F
Constant	76.190	5.486		13.887	<0.001	0.183	23.041[a]
Age (years)	0.374	0.196	0.131	1.911	0.056		
Years of work experience (years)	0.673	0.327	0.143	2.058	0.040		
Educational level							
Bachelor's degree or higher	0.264	3.584	0.005	0.074	0.941		
College (Ref.)							
Professional title							
Practitioner nurse	4.932	3.542	0.119	1.393	0.164		
Nurse in charge	10.433	4.587	0.208	2.274	0.023		
Deputy senior nurse practitioner or higher	12.757	5.812	0.145	2.195	0.029		
Nurse (Ref.)							

Note: KAP, knowledge, attitude and practice; [a]$p < 0.001$.

Knowledge is typically assessed in relation to its alignment with biomedical concepts (Tannahill, 2008), while attitudes are defined as "acquired tendencies to think, feel, and act in a particular way towards a given object or class of objects" (Yoder, 1997). In KAP surveys, practices usually refer to the implementation of preventive measures and different healthcare choices. A previous study conducted across ten tertiary hospitals in three Chinese provinces revealed that nurses achieved score rates of 58.55% in knowledge, 83.94% in attitude, and 51.70% in practice regarding delirium and its subtypes (Zhou et al, 2023). Comparatively, the knowledge score rate in this study was only 48.35%.

Further analysis of the scores of each item in the knowledge dimension revealed that many ICU nurses are unaware of the actual SSD incidence, related risk factors, and its differential diagnosis from ICU delirium (Xing et al, 2022). These findings indicate that some nurses lack basic knowledge about SSD, which may hinder their ability to make accurate clinical judgements. In contrast, the attitude scores in this study indicate that primary hospital nurses maintain a positive attitude towards elderly SSD assessment, with findings comparable to those by Zhou et al (2023), who reported an 83.94% attitude score rate among clinical nurses' KAP of delirium and subtypes in ten hospitals in three provinces in China. This positive attitude towards SSD assessment supports the development of targeted training programs to enhance SSD management. However, the practice scores suggest that nurses' practical application of SSD remains suboptimal, which may be related to high work intensity and time constraints. For example, a study of 325 ICU nurses

in Beijing, China, found that only 52.9% regularly conducted delirium screening (Yang et al, 2020). Several factors contribute to this limitation, including workplace conditions, staff organization, and resource coordination and allocation in primary hospital nurses, which significantly impact the effective SSD assessment (Li et al, 2017; Liu et al, 2018). Among these factors, the availability and adequacy of educational resources directly determine nurses' ability to acquire and apply knowledge in clinical practice (Olson, 2022). In the Chinese healthcare context, the majority of delirium assessment tools originate from English-language sources, and despite efforts to culturally adapt these tools, the language barrier persists, leading to reduced confidence among nurses in their assessments due to this unfamiliarity (Zhou et al, 2023). To address this challenge, there is a need for further research to enhance the cultural adaptability of these tools and improve language interpretation to facilitate nurses' understanding. Additionally, targeted training programs are necessary to ensure proper utilization of these tools, improving the accuracy of delirium and SSD diagnoses.

Through multiple linear regression analysis, we found that years of work experience and professional titles significantly influenced the total KAP scores of nurses in primary hospitals regarding elderly SSD. Since the onset of SSD is often subtle and most nurses lack a clear understanding of its concept, it is frequently overlooked in clinical practice. However, with increasing work experience, nurses are exposed to a wider and more complex range of diseases, which enhances their judgment and understanding of SSD (Kanno et al, 2021; Siddiqi et al, 2016; Zhou et al, 2023). These findings are consistent with the results of Al-Qadheeb et al (2016), which also demonstrated a positive correlation between clinical experience and SSD assessment proficiency.

Similarly, nurses with higher professional titles and advanced educational backgrounds exhibit greater initiative in learning, and have a broader scope of medical knowledge. Their training includes multiple professional examinations, significantly improving their theoretical foundation and clinical competency (Ramoo et al, 2016; Ramoo et al, 2018). Moreover, most high-level titled nurses often serve as key members of their departments, making them more attuned to new medical knowledge (Xue et al, 2024). These nurses are proactive in acquiring new information, resulting in higher KAP scores in SSD assessment.

Training is a critical and effective strategy to improve ICU nurses' KAP levels regarding delirium assessment (Zhang et al, 2024). Although nurses frequently care for patients with delirium, many report limited formal education on the condition and a lack of access to assessment tools or standardized manuals (Lee and Roh, 2023). A previous study demonstrated that structured nurse training led to a 54.29% reduction in ICU delirium incidence (Speed, 2015). These findings underscore the necessity to develop targeted education and training programs that address the specific gaps identified in this study, thereby equipping primary hospital nurses with the knowledge, attitudes, and skills needed to assess delirium in elderly patients with SSD.

To effectively enhance the competency of nurses in primary hospitals, it is essential to adopt a hybrid teaching model that integrates traditional training methods

and modern information technology. With the ongoing development of China's healthcare sector, the demands on nursing professionals are increasing. Clinical nurses are now required to possess strong theoretical knowledge and advanced practical skills (Chen et al, 2024). Relying solely on traditional teaching approaches makes it insufficient to foster comprehensive clinical proficiency among primary hospital nurses (Macedo et al, 2016).

In recent years, information technology advancements have driven a shift away from traditional teaching methods, as they no longer fully meet the evolving needs of education and professional training. The hybrid teaching model, which combines online and offline training, has gained popularity in medical education. As a novel clinical teaching model, it enhances learning outcomes, and stimulates the learning passion of medical staff (Chen et al, 2024). This approach allows nurses to better grasp and understand key concepts, apply them in practice, and develop stronger problem-solving abilities. Furthermore, it promotes team collaboration, self-directed learning, and professional growth, thereby enhancing the overall effectiveness of training programs (Jia et al, 2019).

To address the need for enhanced nurse education and training in the management of elderly SSD, this study developed a networked, tiered training program comprising the following components: (1) Training Model: The model was designed based on an analysis of survey results assessing nurses' KAP regarding elderly SSD. Expert panel discussions were conducted to formulate a structured training program that integrates scenario-based simulation teaching as the primary method, supplemented by online self-directed learning. The program follows a blended approach, combining online and offline components. Offline learning involves in-person, collective training sessions where expert instructors explain KAP assessment methodologies for elderly SSD using clinical case simulations. Online learning, delivered through the WeChat platform, enables autonomous learning through multimedia formats such as audio, video, and text-based resources. Online learning is structured into three aspects: pre-class preparation, where nurses review learning materials; interactive communication, where participants engage in discussions and seek clarifications; and continuous learning, ensuring knowledge retention and reinforcement.

(2) Education and knowledge management for elderly SSD: Education and management of knowledge on elderly SSD involves evidence-based methodologies, including systematic literature review and project-based research, to ensure alignment with clinical nursing practices. Constructive strategies are developed to enhance nursing techniques for managing elderly SSD, ensuring they align with clinical practice. Standardized clinical scenarios are designed to facilitate practical learning, and Scenario-based simulation scripts are written to reinforce theoretical knowledge of elderly SSD. The training process integrates scenario-based simulations, interactive question-and-answer sessions, and structured discussions to enhance nurses' knowledge and ability to identify SSD cases effectively. Head nurses oversee the daily training of all nursing staff on elderly SSD, ensuring adherence to established management protocols during the training period. Monthly quantitative assessments are conducted to evaluate each nurse's participation, including atten-

dance and total learning hours. Nurses who fail to meet the required participation criteria undergo additional supervision, and their performance is incorporated into their annual professional evaluations to ensure accountability and continuous skill development.

(3) Curriculum Design: The structured training curriculum for elderly SSD consists of 15 instructional hours, including 10 hours of theoretical online learning and 5 hours of practical offline training. Each session is limited to 40 minutes and incorporates interactive components to maximize engagement and retention. The training will use flipped classrooms and brainstorming, with groups of three analyzing and integrating content. A tiered training model has been adopted to tailor educational content to nurses at different levels of expertise. First, specific training requirements and plans are developed and disseminated for each level to nurses, with interventions tailored according to their professional level and submitted to the Nursing Department for filing. Second, a tiered nursing training group is established, led by experienced educators, head nurses, and senior nursing staff. Training content is customized based on each member's speciality, with junior nurses focusing on theoretical knowledge, intermediate nurses emphasizing hands-on clinical skills, and senior nurses developing nursing management and leadership competencies. Third, various educational methods are employed, including centralized classroom teaching, online training modules, self-study via a mobile application, and joint discussions within designated teaching areas. Case analysis and expert-led tutoring sessions are incorporated to address common challenges, allowing participants to engage in in-depth discussions and reach a consensus on best practices. To enhance skill acquisition, the recording of procedural demonstration videos is recommended. Fourth, monthly case-based ward rounds for elderly SSD are conducted, during which nurses select and analyze SSD cases, contributing to the development of a case study library for KAP teaching. Knowledge assessments are integrated into morning ward rounds, where nurses are randomly questioned to reinforce key learning points. The Nursing Department regularly reviews training outcomes and monitors progress to optimize the effectiveness of the program.

(4) Continuous Learning: To ensure professional development, nurses were assigned continuous learning tasks following each centralized training session. Academic records logs are maintained to track progress and encourage sustained engagement with the material.

As with many self-reported questionnaire-based studies, the accuracy of the responses may be affected by participants' misinterpretation of survey questions or recall bias. Additionally, while the questionnaire utilized in this study underwent expert review, it lacks validation against established psychometric criteria, which may limit its reliability. Another limitation is sample selection, as the study was conducted in six secondary-level or higher hospitals in Shaoxing City, China. These hospitals were strategically chosen, taking into account their geographical distributions, institutional scale, and patient demographics to ensure a broad representation of the urban population. However, the unique healthcare characteristics of Shaoxing may limit the generalizability of our findings to primary-care hospitals in other regions with different healthcare systems and patient demographics.

Future studies should use larger samples from diverse provinces and cities to address these challenges and enhance external validity. Additionally, further research should focus on validating the psychometric properties of the employed questionnaire to ensure its reliability and applicability across different healthcare systems.

Conclusion

Nurses in primary hospitals have a low level of knowledge regarding the assessment of elderly SSD patients, but they have positive nursing attitudes towards nursing care, indicating potential for improvement in clinical practice. Among the factors influencing the KAP levels of primary hospital nurses, years of work experience and professional titles play significant roles. Therefore, it is necessary to enhance the knowledge of primary hospital nurses about SSD and targeted educational interventions. To address this gap, we developed a networked, tiered training program to improve nurses' ability to accurately and timely identify potential risks associated with elderly SSD.

Key Points

- This study developed an effective questionnaire to assess the KAP levels of nurses in primary hospitals regarding SSD.
- While primary hospital nurses exhibit positive attitudes toward SSD assessment, they lack sufficient knowledge and practical skills in this area.
- Work experience and professional title are significant factors influencing the overall KAP scores of nurses in primary hospitals regarding elderly SSD.
- A network-based hierarchical training scheme was developed to improve the KAP levels of nurses in primary hospitals, equipping them with the necessary skills to improve SSD assessment and management in elderly patients.

Availability of Data and Materials

All data included in this study are available from the corresponding author upon reasonable request.

Author Contributions

XPS and FH designed the research study and wrote the first draft. FW and JQH performed the research. FW and JQH analyzed the data. All authors contributed to the important editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

This study was approved by the Shengzhou People's Hospital Ethics Review Committee (Approval No. [2022] No. 019) and strictly adhered to the ethical guidelines outlined in the Declaration of Helsinki. All participants gave informed consent.

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Conflict of Interest

The authors declare no conflict of interest.

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