

Development of an Emergency Nursing Care Competency Scale for School Nurses

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Research Article

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Abstract

Background The school nurse is a vital component of the school emergency services. Assessing School nurses' emergency nursing care competency is essential to be sure safety and quality of care. The purpose of the study was to develop a scale for measuring school nurses' competency.

Methods This was an instrument development and validation study. The study was conducted according to the revised DeVellis scale development process coupled with the application of the International Council of Nurses' Nursing Care Continuum Competencies Framework. Eight experts who specialize in school health and emergency care evaluated the validity of the content, while 386 school nurses evaluated the scale. The validity evaluation comprised factor analysis, analysis of control group validity according to school nurse experience differences, and analysis of criterion validity. Scale reliability was analyzed using Cronbach's α value.

Results The final scale comprises a self-reported 5-point Likert scale with 30 items, based on three factors and three sub-factors. The convergent validity of the items by factor and control group validity were both confirmed. The criterion validity was also found to be positively correlated with the Triage Competency Scale.

Conclusion The scale may be used to identify factors influencing school nurses' competency in emergency nursing care and contribute to research in competency-based education programs.

Introduction

Students experience both medical emergencies precipitated by accidents and health problems while they are at school as a result of the sizable amount of time spent there for learning and various educational activities (Elgie, Sapien, Fullerton, & Moore, 2010; Mobarak, Afifi, & Qulali, 2015). The incidence of sudden cardiac arrest has been reported to be 0.17–4.4 per 100,000 students per year in the US (Smith & Colquhoun, 2015) and 0.4 per 100,000 students per year in Japan (Kiyohara et al., 2018). Further, the number of students suffering from rare and chronic illnesses and the number of student accidents have been rising, increasing the likelihood of school medical emergencies (Evans & Ficca, 2012; Murphy, 2014; Schoessler & White, 2013; Yoon & Lee, 2017). In Korea, school accidents increased from 116,684 in 2017 to 122,570 in 2018 (School Safety and Insurance Federation, 2019), while the number of students with health disabilities increased from 1,626 in 2017 to 1,758 in 2018 (Ministry of Education, 2019).

The school nurse, who is the only qualified medical professional position in a school, is a vital component of the school emergency services (Boudreax & Broussard, 2012; Lee, 2011; Lineberry, Whitney, & Noland, 2018); thus, school nurses' emergency nursing care competency has an important impact on safety and quality of care. In particular, school nurses need a high level of emergency nursing care competency because they are required to make clinical decisions independently (Nilsson, Johansson, Nordström, & Wilde-Larsson, 2020). Maintaining and improving competency is essential not only for the safety and positive experience of the patient but also for the school nurses' professional growth and confidence (Wilkinson, 2013).

Assessing nursing competencies is essential to develop nursing practice (Dellai, Mortari, & Meretoja, 2009), and its use contributes to improving practice, promoting continuing education, and increasing job satisfaction (Jeon, Meretoja, Vahlberg, & Leino-Kilpi, 2019). Competency evaluation itself constitutes a critical aspect of maintaining competencies and establishing improvement plans (Resha, 2009). Research has shown that competency scales are a valid way to assess nursing competencies, suggesting that competency scales could be used to develop competency-based educational programs and test effectiveness (Jeon et al., 2019; Marin, Hutton, & Witt, 2020). An emergency-nursing-care competency scale can be used to analyze the effects of various interventions and related factors to improve the quality of school emergency nursing care. Studies (Delaney, Friedman, Dolansky, & Fitzpatrick, 2015; Mirbagher Ajorpaz, Zagheri Tafreshi, Mohtashami, Zayeri, & Rahemi, 2016) have used assessed nursing competency as a key proxy for the effectiveness of educational programs.

However, a scale to measure the emergency nursing care competency of school nurses has not been developed. Research has examined the overall competencies of school nurses (Connecticut State Department of Education, 2014; Park & Bea, 2012) but has invariably suffered from limitations in identifying the content and level of emergency nursing care competency. Furthermore, a valid and reliable scale to assess emergency-nursing-care competency in school nurses has not been developed to date. Therefore, the purpose of this study was to develop and validate a scale to measure the emergency nursing care competency of school nurses.

Methods

Procedures

This was an instrument development and validation study. The study was conducted according to the revised DeVellis (2017) scale development process. The development process described by DeVellis (2017) was primarily theoretical and has been modified for data collection and analysis. DeVellis's (2017) eight-phase scale development process has been re-classified into scale development, scale evaluation, and final scale steps with six separate phases.

Scale Development

Phase 1: Clarification of concept. The concept of emergency nursing care competency was analyzed and developed in detail using the Nursing Care Continuum Competencies Framework (NCCCF; International Council of Nurses [ICN], 2008). The NCCCF (ICN, 2008) consists of 3 factors, 17 sub-factors, competencies, and behavioral indicators. Some of the processes used by Elo and Kyngas (2008) for qualitative content analysis that included the preparation, organizing, and reporting steps were applied to clarify and derive school nurses' emergency nursing care competency and behavioral indicators.

In the preparation phase of the content analysis, I reviewed the dictionary meaning for each competency listed in the NCCCF (ICN, 2008) and conducted a review of conceptual analysis studies (Abdolrahimi, Ghiyasvandian, Zakerimoghadam, & Ebadi, 2017; Chivima, 2014; Yun & Lee, 2014) and previous studies (Connecticut State Department of Education, 2014; Dunn et al., 2000; Moon & Park, 2018; Park & Bea, 2012; Wihlborg, Edgren, Johansson, & Sivberg, 2014; Yoon & Lee, 2017) related to school nurse competencies or emergency nursing care competencies. The review results were added to the competency and behavioral indicators in the NCCCF (ICN, 2008).

In the organizational phase, the content from the preparation stage was coded and categorized to derive the attributes and behavioral indicators of competency. The descriptive aspects of nursing competency along with the behavioral indicators were incorporated into the school nurse's emergency nursing care competency and behavioral indicators with consideration to the specific characteristics of the school environment.

Phase 2: Development of initial items and scale format. Initial items were developed based on the school nurse's emergency nursing care competency and behavioral indicators derived during Phase 1. Data from the School Safety Insurance Federation from 2015 to 2016 were analyzed for specific items on major school emergency nursing care. Existing literature on school emergencies was also reviewed. The 5-point Likert scale was developed using easy-to-use self-reporting forms and revised by one nursing professor.

Phase 3: Content validity of initial items (expert panel review). The expert panel comprised nine members: one emergency nurse, one emergency head nurse, one professor of nursing with an experience in school nursing, one professor of nursing with an experience as an emergency nurse, one professor of community nursing, one supervisor for school health, and three school nurses enrolled in a doctoral nursing program.

A total of 18 emergency nursing care competencies, 65 emergency nursing competency indicators, and 165 items were reviewed for suitability. The modified nine items, which did not fit the school context, on the Triage Competency Scale (TCS) for emergency nurses (Moon & Park, 2018) were also reviewed.

Competencies, behavioral indicators, and items with a content validity index (CVI) of less than .80 were deleted. Additional deletions and modifications were made upon further review. The adjusted items were reviewed again by two professors of nursing.

Phase 4: Pilot test. The pilot test was conducted through an online survey of 15 school nurses who had been selected based of their school nursing experience. The survey consisted of 92 items of emergency nursing care competency adjusted through the expert panel review, 30 items from the TCS (Moon, & Park, 2018) modified for the school context to assess criteria validity, 10 related to sociodemographic characteristics, and 2 items concerning the evaluation of the scale (time required and correction).

Scale Evaluation

Phase 5: Main survey.

Participants and settings. The main survey's participants were school nurses in elementary, middle, and high schools in Korea. They were divided into five groups based on length of experience as a school nurse : Novice Beginner (<1 Year), Advanced Beginner (1–3

Years), Competent (3–6 Years), Proficient 1 (6–16 years), and Proficient 2 (≥ 16 years; Yoon & Lee, 2017). The sample size was calculated using factor analysis and a control group validity test. The total number of participants from the factor analysis was 460, five times the 92 items on the initial scale (Kang, 2013a). A dropout rate of approximately 10% was applied to set the desired sample size at 500 participants. The minimum sample size per group for the control group validity test was calculated using the G-power 3.1 program. The minimum number per group was determined to be 40 with an effect size of .25 for Cohen's (2013) medium level.

A total of 372 participants took part in the study. Although the total figure did not reach the targeted sample size of 500, data collection was completed with more than 300 cases in the factor analysis and more than 40 school nurses for each experience group to test the validity of the control group. Since there was no change to the items after the pilot test, data from the 15 participants who had participated in the pilot test were also added to the main survey. One respondent was excluded from the final analysis for providing the same answer to all the items, leaving a final analytic sample of 386 participants.

Data collection. Data were collected from an online survey from November 26 to December 31, 2018, and consisted of 92 items regarding emergency nursing care competency, 30 items from the TCS (Moon, & Park, 2018), and 10 items related to sociodemographic characteristics. The local representative of the Korean School Nurses Association was asked to send an e-mail and text message regarding the recruitment of study participants to school nurses who were local members.

Data analysis. The data were analyzed using IBM SPSS 25.0 (Armonk, NY; IBM Corp.) and AMOS 25.0 (Chicago, IL; IBM SPSS Statistical Programs). The mean, standard deviation, skewness, and kurtosis of each items were analyzed. Items with an absolute value of 2 or more for skewness and kurtosis were dropped due to the assumption of normality violation (Bea, 2012). In addition, items with a correlation that was less than .30 were dropped after the correlation analysis of the items by factor. The convergent validity of the items for each sub-factor was verified through the following criteria: Standardized Factor Loading ($FL \geq 0.50$), Critical Ratio ($C.R. \geq 1.96$), p -value ($p < .05$), Average Variance Extracted ($AVE \geq 0.50$), Construct Reliability ($CR \geq .70$), and Squared Multiple Correlation ($SMC \geq .40$; Song, 2011; Woo, 2017). The Kaiser–Meyer–Olkin (KMO) sample fit scale and Bartlett's test of sphericity was performed with a KMO value $\geq .50$ and a p -value for Bartlett's test $< .05$ (Kang, 2013a) to examine the appropriateness of the factor analysis.

Factor analysis was conducted using principal axis factoring and oblique rotation using SPSS to select items that fit the factors in the research framework and to reduce the number of items on the scale. The criteria for deleting items were a cumulative value of .40 or less and a factor loading value of .30 or less (Kim, 2016). In light of the research framework factors and the importance of the items, scale items were deleted until the number of factors with an eigenvalue of 1 was equal to the factors of the research framework.

The convergent validity and model fit of the adjusted scale was analyzed using confirmatory factor analysis. Convergent validity was analyzed under the same criteria as the sub-factor analysis. The criteria used for the fit indices included Normed χ^2 ($CMIN/df \leq 3$), Comparative Fit Index ($CFI \geq .90$), Turker Lewis Index ($TLI \geq .90$), Root Mean Square Error of Approximation ($RMSEA \leq .08$, and Standardized Root Mean-square Residual ($SRMR \leq .05$ (Bae, 2017; Woo, 2017).

The validity test of the control group was based on school nurse experience as differences in competency were reported by length of experience in previous studies (Roh, Issenberg, Chung, Kim, & Lim, 2013; Salonen, Kaunonen, Meretoja, & Tarkka, 2007). Covariance analysis (ANCOVA) was conducted by assigning covariates to the variables that have confirmed differences using a chi-square test (χ^2 test) or one-way ANOVA.

The TCS (Moon & Park, 2018) was modified to be appropriate for the school context and was used as the criterion validity test. Triage is one of the main features of emergency nursing and a major challenge for school nurses (Yoon & Lee, 2017). The TCS (Moon & Park, 2018) has a number of similarities to the sub-attributes of the competencies derived in this study. Correlations between the scale and the TCS were analyzed using Pearson's correlation, and when the value was range of $r = .40$ to $.80$, it was deemed acceptable (Lee et al., 2009). The reliability of the whole scale and each factor was deemed to be acceptable if the Cronbach's $\alpha > .65$ (DeVellis, 2017).

Final Scale

Phase 6: Final scale. The scale was finalized with items derived from the scale evaluation process. The final items were reviewed with five professors of nursing to improve the items' readability and comprehensibility, and the mean, the standard deviation, and the 100-point conversion scores of the school nurse's emergency nursing care competency were analyzed.

Results

Scale Development

Clarification of Concept

The school nurse's emergency nursing care competencies and behavioral indicators were developed with 4 factors, 14 sub-factors, 18 competencies, and 68 behavioral indicators following a review of the NCCCF (ICN, 2008) and related literature.

Development of the Initial Items and Scale Format

The initial items were developed based on the established school nurses' behavioral indicators. In addition, a total of 23,985 accidents from School Safety Insurance Federation for the years 2015 and 2016 were analyzed to develop specific items of major school emergency nursing care. The analysis showed that musculoskeletal injury was the most common accident and followed by skin damage requiring suture. Based on the School Safety Insurance Federation's data and literature on school emergencies (Amanullah, Heneghan, Steele, Mello, & Linakis, 2014; Yoon & Lee, 2017), school emergencies were classified into injuries, sudden symptoms, and deterioration of diseases. Twenty major school emergencies were identified (Table 1), and a total of 31 items were developed for major emergency nursing care assessments and interventions at the school.

The initial scale included 165 items: 21 on the *Professional, Ethical, and Legal Practice* factor, 94 on the *Care Provision* factor, 33 on the *Leadership and Management* factor, and 17 on the *Professional, Personal, and Quality Development* factor. The scale utilizes a 5-point Likert scale that ranged from 1 to 5 points with the frequency ratings of *Never, Rarely, Sometimes, Often, and Always*.

Table 1 *Classification of School Emergencies*

	Classification (n = 20)	Note
Injury		
Musculoskeletal	Fracture, Sprain, Strain, Dislocation [†]	Frequent Injury (1st)
Face	Eye injury	
	Dental & Oral	
	Nose	
Skin	Skin wound requiring suture	Frequent injury (2nd)
	Burn	
Head	Skull Fracture, Concussion, Scalp Damage	Serious Injury
Other	Choking, Abdominal Injury, Bites, Toxic Exposure, Genital Injury, Rape, Suicide	
Sudden Symptoms		
Neurological	Syncope, Unconsciousness [†]	Serious Symptoms
	Severe headache	
Cardiovascular and Respiratory	Dyspnea, Hyperventilation, Pneumothorax	Serious Symptoms
	Chest Pain, Arrhythmia, Tachycardia, Hypertension	Serious Symptoms
	Heart Arrest	
Gastrointestinal	Severe Abdominal Pain	
Other	Psychiatric Symptoms, Dehydration	
Deterioration of Disease		
Allergy	Allergic Reaction, Anaphylaxis [†]	Specified in Law
Cardiovascular and Respiratory	Asthma	
Endocrine	Hypoglycemia & Hyperglycemia	Specified in Law
Neurological	Seizures	Serious Symptoms
Other	Hemophilia	

Note: [†]Included in the final version scale

Content Validity of Initial Items

The content validity analysis showed that one competency, nine behavioral indicators, and eight items had a CVI of less than .80. All behavior indicators were dropped except for one that moved to another factor. Items belonging to each excluded competency and behavioral indicator were also dropped from the scale. Following the expert reviews of the overlapping factors, additional items were excluded or modified due to ambiguity and other similar reasons. The 165 items initially on the scale were adjusted to 92 items as a result of content validity analysis. The revised scale consists of 4 factors, 13 sub-factors, 14 competencies, and 43 behavioral indicators. Six items were reverse coded. Based on the comments by the expert panel regarding the similarity between factors, the *Professional, Ethical, and Legal Practice* factor was renamed the *Ethical and Legal Practice* factor, and the *Professional, Personal, and Quality Development* factor was renamed the *Professionalism and Quality Development* factor.

Pilot Test

The pilot test showed no operational errors related to the online survey. The mean response time of the survey was 14.9 ($SD = 7.59$) minutes, and no items were revised on the emergency nursing care competency scale.

Scale Evaluation

Participant Characteristics

A total of 386 participants were included in this study: 75 in the Novice Group (Group A), 50 in the Advanced Beginner Group (Group B), 56 in the Competent Group (Group C), 105 in Proficient 1 Group (Group D), and 100 in Proficient 2 Group (Group E). The mean duration of the hospital nurses' experiences before appointment as a school nurse was 4.83 years ($SD = 4.38$). A total of 162 (42.2%) participants had experience in caring for severe emergency patients at school, while 88 (22.8%) participants held certifications related to emergency nursing care such as Basic Life Support Provider, Advanced Life Support Instructor, First Aid Rescue, and First Aid Instructor (Table 2).

Table 2 *General Demographic Characteristics of Participants (N=386)*

Characteristics	Total (N = 386)		Group A (n = 75)		Group B (n = 50)		Group C (n = 56)		Group D (n = 105)		Group E (n = 100)	
Gender												
Male, n (%)	2	(0.5)	0	(0.0)	1	(2.0)	1	(1.8)	0	(0.0)	0	(0.0)
Female, n (%)	384	(99.5)	75	(100.0)	49	(98.0)	55	(98.2)	105	(100.0)	100	(100.0)
Age in years, M (SD)	41.09	(10.08)	31.65	(6.15)	32.94	(6.80)	36.54	(8.14)	43.49	(6.42)	52.22	(4.59)
< 30, n (%)	57	(14.8)	28	(37.3)	19	(38.0)	9	(16.1)	1	(1.0)	0	(0.0)
≥ 30 but < 40, n (%)	123	(31.9)	38	(50.7)	23	(46.0)	33	(58.9)	29	(27.6)	0	(0.0)
≥ 40 but < 50, n (%)	107	(27.7)	7	(9.3)	6	(12.0)	9	(16.1)	54	(51.4)	31	(31.0)
≥ 50 but < 60, n (%)	90	(23.3)	2	(2.7)	2	(4.0)	3	(5.4)	21	(20.0)	62	(62.0)
≥ 60, n (%)	9	(2.3)	0	(0.0)	0	(0.0)	2	(3.6)	0	(0.0)	7	(7.0)
Education												
Doctoral Degree, n (%)	4	(1.0)	0	(0.0)	0	(0.0)	0	(0.0)	0	(0.0)	4	(100.0)
Master's Degree, n (%)	73	(18.9)	7	(9.2)	1	(2.0)	4	(7.1)	22	(21.0)	39	(39.0)
Bachelor's Degree, n (%)	292	(75.7)	65	(86.6)	42	(84.0)	48	(85.7)	81	(77.1)	56	(56.0)
Associate Degree, n (%)	17	(4.4)	3	(4.0)	7	(14.0)	4	(7.1)	2	(1.0)	1	(1.0)
Workplace												
Elementary School, n (%)	210	(54.4)	49	(65.3)	28	(56.0)	22	(39.3)	46	(43.8)	65	(65.0)
Middle School, n (%)	105	(27.2)	20	(26.7)	14	(28.0)	21	(37.5)	33	(31.4)	17	(17.0)
High School, n (%)	71	(18.4)	6	(8.0)	8	(16.0)	13	(23.2)	26	(24.8)	18	(18.0)
Length of School Nurse experience in years, M (SD)	10.28	(9.80)	0.88	(0.35)	2.32	(0.56)	4.16	(0.94)	10.37	(3.31)	24.66	(5.74)
Length of Hospital Nurse experience in years, M (SD)	4.83	(4.38)	5.48	(5.69)	5.18	(4.45)	5.13	(3.80)	5.36	(4.55)	3.41	(2.82)
< 1 year, n (%)	51	(13.5)	13	(17.1)	6	(12.0)	7	(12.5)	12	(11.4)	14	(14.1)
≥ 1 but < 3 years, n (%)	89	(23.1)	13	(17.3)	14	(28.0)	10	(17.9)	18	(17.1)	34	(34.3)
≥ 3 but < 6 years, n (%)	124	(32.2)	23	(30.3)	13	(26.0)	20	(35.7)	38	(36.2)	30	(30.3)
≥ 6 years, n (%)	120	(31.2)	26	(34.2)	17	(34.0)	19	(33.9)	37	(35.2)	21	(21.2)
Emergency Experience												

Yes, n (%)	162	(42.2)	14	(18.7)	18	(36.0)	20	(35.7)	48	(45.7)	62	(62.0)
No, n (%)	224	(58.0)	61	(81.3)	32	(64.0)	36	(64.3)	57	(54.3)	38	(38.0)
Certificate Related to Emergency Nursing Care												
Yes, n (%)	88	(22.8)	15	(20.0)	4	(8.0)	13	(23.2)	30	(28.6)	26	(26.0)
No, n (%)	298	(77.2)	60	(80.0)	46	(92.0)	43	(76.8)	75	(71.4)	74	(74.0)

Note. *M*, mean; *SD*, standard deviation; Group A: Novice Group (< 1 year of school nurse experience); Group B: Advanced Beginner Group (≥ 1 but < 3 years of school nurse experience); Group C: Competent Group (≥ 3 but < 6 years of school nurse experience); Group D: Proficient 1 Group (≤ 6 but < 16 years of school nurse experience); Group E: Proficient 2 Group (≥ 16 years of school nurse experience).

Items Analysis

Four items on the *Ethical and Legal Practice* factor and one item on the *Care Provision* factor showed an absolute value of skewness and kurtosis of more than 2. Further, the item-total correlation identified two items on the *Care Provision* factor and one item on the *Leadership and Management* factor with correlation coefficient of $r < .30$. Thus, eight items were dropped, and the scale was reduced to 84 items.

Reliability and Validity Analysis

Convergent validity of the sub-factors. Six items on the *Care Provision* factor, one item in the *Leadership and Management* factor, and two items on the *Professionalism and Quality Development* factor were dropped because of their failure to meet the criteria, reducing the scale to 75 items.

Item refining process. Factor analysis was conducted using SPSS for 75 items. The KMO value was very high at $.97$ ($p < .001$) as was Bartlett's test of sphericity, demonstrating the adequacy of the data for producing a reliable factor solution. The number of items was reduced to 37 through sequential deletion, taking into consideration the factors of the research framework, the importance of the items, and factor loading value. On the 37-scale, four factors were extracted on the basis of eigenvalue =1 that matched the framework factors of the hypothesized model based on the research framework. The total explanatory variance was 61.50%. Item 6 on the *Ethical Practices* sub-factor had a .39 cumulative value and Item 66 on the *Delegation and Supervision* sub-factor had the FL $< .30$ for all the factors, but they were not dropped to maintain the construct of the factors. Five items (51, 38, 43, 62, and 63) loaded onto both the *Care Provision* and the *Leadership and Management* factors, while three items (43, 62, and 63) loaded differently than was theorized by the research framework.

Confirmatory factor analysis. The adjusted scale that included 37 items was analyzed for its convergent validity and model fit using confirmatory factor analysis, with the fit indices for the 37 items being CFI = .85, TLI = .84, RMSEA = .07, and SRMR = .06. A review of the modification indices indicated a high correlation between the *Care Provision* factor and the *Leadership and Management* factor. The model was adjusted with consideration to the modification indices, correlation between the items, the item content, and the research framework. The *Care Provision* factor and the *Leadership and Management* factor, which were highly correlated, were integrated into a factor named *Emergency Care Provision and Management*. Sub-factors were created by dividing *Assessment, Diagnosis, and Planning and Intervention, Evaluation, Therapeutic Communication, and Relationships* because they tended to load differently in the item-refining process. Item 41, which was dropped since it did not meet the sub-factor validity criteria, was added to the final scale, as it was a characteristic intervention that was used in schools. Eight items (22, 24, 25, 37, 76, 78, 75, and 80) were dropped sequentially, as the modification indices were high, and the items were considered less important. The final version of the School Nurse's Emergency Nursing Care Competency Scale (ENCCS_SN) consisted of the 30 remaining items.

Model Fit and Convergent Validity of the Final Scale. The CMIN/df of the final scale using chi-square (χ^2), which is considered to be the most stringent of the goodness-of-fit indices (Kang, 2013b), met the criteria, as did the CFI, TLI, RMSEA, and SRMR. The convergent validity analysis of each of the factors in the final scale had AVE values ranged from .57 to .95 and CR values ranging from .79 to .98,

meeting the criteria. The FL for item 41, the reverse item, was .34, and the SMC = .12, which did not meet the criteria. However, the FL of the other items ranged from .62 to .86 and the SMC from .39 to .74. The convergent validity analysis of the sub-factors for the *Emergency Care Provision and Management* factor showed an AVE of .95 and CR of .98, meeting the criteria. In addition, the FL ranged from .88 to .99 and the SMC from .78 to .98, which also meet the criteria (Table 3).

Table 3 *Result of the Confirmatory Factor Analysis (N=386)*

Domain	Item no.	Item	FL	C.R.	p value	SFL	SMC	AVE	CR
				≥1.96		≥ .50	≥ .40	≥ .50	≥ .70
F1								.57	.79
Ethical Practice	6	I do not break the confidentiality of the patients acquired while delivering emergency nursing care.	1			.65			.42
	7	I keep my emergency nursing care records in a secure location.	1.60	10.51	<.001	.66	.44		
Legal Practice	8	I adhere to laws and regulations related to the school emergency nursing care.	1.51	11.61	<.001	.84	.71		
F2								.95	.98
F2-1			1			.88	.78	.71	.96
Assessment & Diagnosis	20	I can promptly and systematically assess the state of consciousness, the abnormal appearance, and accidents of patients with head injuries.	1.05	21.35	<.001	.84	.71		
	21	I can promptly and systematically assess the mental status, neurological conditions, medical history, and so on, in patients with syncope or who are conscious.	1.06	21.49	<.001	.84	.71		
	23	I can promptly and systematically assess the breathing, skin conditions, and medical history of patients with allergies.	1		<.001	.85	.73		
	18	I can promptly and systematically assess the degree of injury (asymmetry, range of motion, swelling, ecchymosis, neurovascular damage, etc.) in patients with musculoskeletal injuries.	1.00	19.40	<.001	.79	.63		
	14	I can reassess patient at regular intervals and reassign triage.	0.86	17.10	<.001	.73	.54		
	28	I can comprehensively analyze collected data, considering the school emergency patients' characteristics.	0.99	22.22	<.001	.86	.74		
	34	I can promptly determine the necessary hospital referral, transfer, and observation level of emergency patients based on evidence.	0.89	18.55	<.001	.77	.60		
	32	I can promptly assign appropriate diagnoses based on evidence.	0.96	20.15	<.001	.81	.66		
Planning	15	I can establish an emergency nursing care plan based on school and family resources.	0.85	15.70	<.001	.69	.48		
F2-2			0.81	12.46	<.001	.99	.98	.57	.92
Intervention	51	I can dress the affected patients wounds promptly and accurately.	1.16	11.90	<.001	.71	.51		
	38	I can promptly report an emergency situation.	1.21	12.73	<.001	.78	.61		
	41 [†]	I find it difficult to coordinate emergency patient transfers and refer them to the hospital.	0.62	6.32	<.001	.34	.12		
	43	I can do CPR accurately and promptly.	1.31	12.27	<.001	.74	.54		
Evaluation	59	I check if there are any problems or	1.07	11.65	<.001	.69	.48		

		deficiencies in the emergency nursing process.						
	63	I can evaluate the nursing diagnosis and implementation by checking the medical results of the emergency patient.	1.32	13.01	<.001	.80	.64	
Therapeutic Communication & Relationships	69	I provide patients (or caregivers) with detailed information such as emergency patient's condition, follow-up care, and symptoms of deterioration.	1.25	12.42	<.001	.75	.57	
	62	I can accurately and precisely document emergency nursing interventions and a patient's conditions.	1.34	12.92	<.001	.80	.63	
	77	I understand the negative reactions of emergency patients or parents.	1		<.001	.62	.39	
F2-3			0.95	14.98	<.001	.96	.92	.60 .90
Safe Environment	74	I prepare and maintain emergency supplies to be ready for an emergency.	1		<.001	.75	.56	
	79	I am prepared for emergencies that may occur to children with health problems.	1.01	16.65	<.001	.82	.68	
	81	I have established a specific school emergency system that includes patient transfer and reporting, emergency resources, and division of roles and responsibilities.	1.01	14.92	<.001	.75	.56	
Delegation	66	I have established a clear emergency nursing care delegation system in the absence of a school nurse.	1.16	13.82	<.001	.70	.48	
Inter-professional Health Care	85	I try to reasonably resolve conflictual situations related to school emergencies.	1.08	16.35	<.001	.81	.66	
	86	I regularly provide practical first aid training to staff.	1.16	13.22	<.001	.67	.45	
F3								.95 .98
Enhancement of the profession	91	I continuously acquire knowledge through books, research and training related to emergency nursing care	1			.84	.70	
Quality Improvement	92	I actively cooperate with or participate in research to improve emergency nursing care practice.	1.05	16.97	<.001	.80	.63	
	90	I apply and evaluate the latest developments or improvements introduced at seminars, training, and conferences on emergency nursing.	1.14	17.81	<.001	.84	.70	

Note. Overall model fit: CMIN = 1066.73, df = 399, CMIN/df = 2.67, GFI = .84, AGFI = .81, CFI = .92, TLI = .91, RMSEA = .070, SRMR = .05; ^aReverse item.; F1: Ethical and Legal Practice; F2: Emergency Care Provision and Management; F2-1: Clinical Decision Making (Assessment, Diagnosis, Plan); F2-2: Care Provision (Intervention, Evaluation, Therapeutic Communication & Relationships); F2-3: Leadership and Management; F3: Professionalism and Quality Development; FL, factor loading; C.R., critical ratio; SFL, standardized factor loading; SMC, squared multiple correlation; AVE, average variance extracted; CR, construct reliability

Mean Differences between Groups. To analyze the differences in mean between the groups of school nurse experiences, emergency experience ($\chi^2 = 35.43$, $df = 4$, $p < .001$), master's education ($\chi^2 = 54.47$, $df = 4$, $p < .001$), hospital nurse experience ($F = 4.06$, $df = 3$, $p = .007$) were assigned as covariates. In the model test, education beyond master's degrees was excluded from the covariate because of the absence of any significant difference in emergency nursing care competency ($F = 1.42$, $df = 4$, $p = .233$). The results of the ANCOVA

showed homogeneity of variance ($F = 1.59$, $df = 4$, $p = .176$) and a significant difference in the mean of emergency nursing care competency between school nurse experience groups ($F = 3.64$, $df = 4$, $p = .006$). The Novice Group, the Advanced Beginner Group, and the Competent Group each showed a significantly lower mean than Proficient Group 1 and Proficient Group 2. The results indicated that the lower competency of the short-experience groups compared to the long-experience groups demonstrate the control group validity (Table 4).

Table 4 Differences in the Emergency Nursing Care Competency by School Nurse Experience ($N = 385$)

Classification	<i>n</i>	<i>M</i> (<i>SD</i>)	<i>F</i>	<i>df</i>	<i>p</i>	
Group A	75	84.28 (16.73)	3.64	.006		A, B, C < D, E
Group B	50	86.58 (18.23)				
Group C	56	85.84 (19.93)				
Group D	105	93.56 (17.21)				
Group E	99	93.32 (18.94)				

Note: Adjusted by emergency experience; hospital work experience post hoc analysis using LSD; *M*, mean; *SD*, standard deviation; Group A: Novice Group (< 1 year of school nurse experience); Group B: Advanced Beginner Group (≥ 1 but < 3 years of school nurse experience); Group C: Competent Group (≥ 3 but < 6 years of school nurse experience); Group D: Proficient 1 Group (≤ 6 but < 16 years of school nurse experience); Group E: Proficient 2 Group (≥ 16 years of school nurse experience).

Criterion validity. Correlation analyses of the scores measured by the TCS (Moon & Park, 2018) showed the overall correlation coefficient was $r = .86$ ($p < .001$), with $r = .45$ ($p < .001$) for the *Ethical and Legal Practice* factor, $r = .87$ ($p < .001$) for the *Emergency Care Provision and Management* factor, and $r = .55$ ($p < .001$) for the *Professionalism and Quality Development* factor. The correlation coefficients for all factors were higher than .40.

Reliability: Internal consistency. Analyses of the reliability of the final scale found no items increased the Cronbach's α of a factor when deleting items. The Cronbach's α for the whole scale was .96. For each factor, it ranged from .74 to .96, which was higher than the baseline of .65, to ensure reliability.

The Final Scale

The final scale consistent of 30 items loading on three factors: The *Ethical and Legal Practice* factor, the *Emergency Care Provision and Management* factor, and the *Professionalism and Quality Development* factor. The sub-factors under the *Emergency Care Provision and Management* factor were the *Clinical Decision-Making* sub-factor, the *Care Provision* sub-factor, and the *Leadership and Management* sub-factor. The final scale included 13 competencies and 22 behavioral indicators (Table 5). One reverse-scored item was changed to a positive item in the final scale.

Table 5 Competencies, Behavior Indicators in an Emergency Nursing Care Competency Scale for School Nurses

Domain	Competency	Behavior Indicator	Item No.	
			First Version	Final Version
F1				
	Ethical Practice	Adheres to nursing ethics when delivering emergency nursing care.	Maintains the confidentiality of the patient when delivering emergency nursing care.	6, 7 1, 2
	Legal Practice	Adheres to related laws and regulations when delivering emergency nursing care.	Practices in accordance with related laws and regulations.	8 3
F2				
F2-1	Assessment & Diagnosis	Assesses and diagnoses emergency patients promptly and systematically based on evidence.	Collects subjective and objective data of patients promptly and systematically. Analyzes the collected data comprehensively, considering the characteristics of school emergencies. Prioritizes promptly based on evidence. Promptly diagnoses health problems based on evidence.	20, 21, 23, 18, 14 28 34 32 4, 5, 6, 7, 8 9 10 11
	Planning	Has established an evidence-based emergency nursing care plan considering school resources.	Promptly establishes an emergency nursing care plan considering school resources.	15 12
F2-2	Intervention	Promptly provides an evidence-based emergency nursing care interventions.	Promptly provides emergency nursing care interventions using school resources.	51, 38, 41, 43 13, 14, 15, 16
	Evaluation	Evaluates the progress and outcome of emergency nursing care.	Evaluates the progress of emergency nursing care. Evaluates the outcome of emergency nursing care.	59 17 63 18
	Therapeutic Communication & Relationships	Communicates accurately with patients and parents in emergency nursing care.	Provides accurate detailed information to patients and parents. Documents the emergency nursing intervention and the patient's response.	69 19 62 20
		Establishes rapport with patients and parents.	Interacts in a manner that is respectful to patients and parents.	77 21
F2-3	Safe Environment	Maintains a safe environment for school emergencies.	Prepares and maintains emergency supplies in accordance with regulations. Identifies and prepares for emergencies at school. Establishes a school emergency system.	74 22 79 23 81 24
	Delegation & Supervision	Delegates and supervises emergency nursing care in accordance with regulations.	Establishes a delegation system for emergency nursing care in accordance with regulations.	66 25
	Inter-professional	Forms and maintains collaborative relationships with school staff regarding emergencies.	Reasonably resolves conflicts related to school emergencies.	85 26
	Health Care		Makes an effort to enhance the staff's emergency response abilities.	86 27

F3

Enhancement of the profession	Makes an effort to enhance the profession of emergency nursing care.	Continuously engages in education to enhance the profession.	91	28
Quality Improvement	Makes an effort to improve emergency nursing care practice.	Participates in evidence-based research to improve emergency nursing care practice.	92	29
		Identifies and improves problems in practice.	90	30

Note: F1: Ethical and Legal Practice; F2: Emergency Care Provision and Management; F2-1: Clinical Decision Making (Assessment, Diagnosis, Plan); F2-2: Care Provision (Intervention, Evaluation, Therapeutic Communication & Relationships); F2-3: Leadership and Management; F3: Professionalism and Quality Development

The final scale used a self-report format with participants responding on a 5-point rating scale, ranging from 0–4 points for convenience of interpretation (0 = *never*, 1 = *rarely*, 2 = *sometimes*, 3 = *often*, and 4 = *always*). The total score ranges from 0–120. The higher the score, the higher the emergency nursing care competency (Supplementary Material).

The total mean score for emergency nursing care competency on the final scale was 89.67 ($SD = 18.46$) for the sample of 386 school nurses. The mean score on a 100-point scale was 74.73 ($SD = 15.38$).

Discussion

Assessing emergency nursing care competency in school nurses, who are the only individuals with formal medical positions in the schools, is important in practice and research to ensure the safety of students and provide high-quality care (Juntasopeepun et al., 2019). This study develops the first self-report scale designed to measure School Nurse's Emergency Nursing Care Competency (ENCCS_SN). Additionally, the ENCCS_SN showed good reliability, and met the criteria of content validity and construct validity.

The scale validity of the scale was determined by identifying the constructs of the concepts and developing items that effectively measured each construct (DeVellis, 2017; Lee et al., 2009). In this study, the NCCCF (ICN, 2008) was used as a theoretical framework to clarify the scale's composition and to develop well-measured competency, behavioral indicators, and items. Especially, it is meaningful that the ENCCS_SN is consistent with nursing competency by utilizing the NCCCF (ICN, 2008), and the factors, *Ethical and Legal Practice*, *Emergency Care Provision and Management*, and *Professionalism and Quality Development*, in the final version ENCCS_SN are the same as those of the NCCCF (ICN, 2008). In addition, the results of confirmatory factor analysis for the three factors met the criteria. Since nursing competency is the ability to perform common and basic nursing tasks (Emergency Nurses Association, 2011), these results suggest that overall nursing competencies remains the same even when the area of specialization and practice is different.

However, the sub-factors of the *Emergency Care Provision and Management* factor in the ENCCS_SN were constructed differently from the NCCCF (ICN, 2008). In the NCCCF (ICN, 2008), the *Emergency Care Provision and Management* factor comprised the *Care Provision* and *Leadership and Management* sub-factors. In the ENCCS_SN, the *Emergency Care Provision and Management* factor consisted of three sub-factors: *Clinical Decision-Making*, *Care Provision*, and *Leadership and Management*, due to the fact that the mean of the items related to assessment and diagnosis on the factor analysis was lower than the mean of the items related to intervention, evaluation, and therapeutic communication and relationships. This finding suggests that assessment and diagnosis is the most difficult part of emergency nursing care (Choi & Cho, 2008), and school nurses also find it challenging to assess emergency patients in the schools because schools have limited medical resources (Yoon & Lee, 2017).

Since the items were developed based on the results for an analysis of major school medical emergencies and a previous study (Yoon & Lee, 2017) that involved focus group interviews with Korean school nurses, the ENCCS_SN stands out for incorporating items pertaining to school emergency nursing care characteristics and the contents of major school emergency nursing. The confirmatory factor analysis showed that, among the emergency nursing intervention items, Item 41 (*Hospital Referral and Transfer*) had an FL of .34 and an SMC of .12, both of which were lower than the criteria. The standardized FL was .05 in the study, but an FL of .34 was also acceptable according to Tabachnick and Fidell (2013). The low convergent validity of the intervention item was due to its lower average compared to the other intervention-related items, which likely occurred because of school nurses' challenges with transferring

patients (Yoon & Lee, 2017). The intervention item may also have been developed as a reverse-scored item, which confused respondents. Other studies have reported low consistency (DeVellis, 2017); thus, Item 41 was revised as a positive item in the final scale to avoid confusion with the reverse wording. In future studies, Item 41 should be evaluated.

The validity analysis of the control group by experience group showed that the Proficient Group had higher emergency nursing care competency than the low experience group, suggesting the usefulness of the scale in explaining the relationship between experience and competency. The results indicated that the length of experience for school nurses to show a difference in emergency nursing competency was 6 years. This result is longer than was reported in a previous study suggesting that differences in competencies were observed after having a two-year experience as an emergency room nurse (McCarthy, Cornally, Mahoney, White, & Weathers, 2013). One reason that school nurses take a longer time than hospital nurses to increase their competency could be that university curricula have not been able to fully address school emergency nursing care competencies that require extensive knowledge in the limited medical resources of schools (Newell, 2013). In addition, insufficient on-site support for the improvement of emergency nursing care competency has been reported (Kruger, Radjenovic, Toker, & Comeaux, 2009; Lee & Lee, 2014). Given most school nurses work alone, it is necessary to develop a competency-based education program (Seied Davood et al., 2018) that can improve the emergency nursing care competency of school nurses at the beginning of their experience.

Limitations

In this study, the same sample was used for both the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Because of the number of items and factors developed in the study, it was difficult to obtain sufficiently large samples that could be divided. In this study, EFA was applied as a process for refining scales with the limitation that CFA would be repeating relationships that were established through the EFA (Knekta, Runyon, & Eddy, 2019).

The TCS (Moon & Park, 2018) that was used to assess criterion validity in this study is not the gold standard. It has been developed for emergency room nurses, not school nurses. Triage competency is only a component of emergency nursing competency. Nevertheless, the TCS (Moon & Park, 2018) was used because, to date, there is no gold standard for emergency nursing care and triage is an integral component of emergency nursing care. Some of its items that did not fit the school context have been modified and met criteria of content validation.

Conclusions

The results demonstrated that the ENCCS_SN is valid and reliable scale to measuring school nurses' emergency nursing care competency. The scale can be useful to assess the level of school nurses' emergency nursing care competency and to develop a competency-based education program and nursing curriculum for school nurses. Further, the ENCCS_SN could help identify related factors to develop effective interventions or policies as well as evaluate outcome of policies or intervention related to school emergency nursing care.

It is acknowledged that the cut-off value in this study could not be presented due to the lack of gold standard in emergency nursing care competency. Therefore further research should be considered in order to identify what variables can be used to measure the outcomes of school nurses' emergency nursing care competency or to develop a scale that can be used to measure them. In this study, the NCCCF (ICN, 2008) was applied as the research framework to develop a scale that can be used internationally even though each item was developed in the context of Korean school emergency nursing care. The scale was developed in Korean and then translated into English, but the validity of the translated scale was not verified. It should be further noted that, given the international differences in school nursing practices, the scale should be used once the scale's validity has been verified following country-specific modification for school nursing practice.

Abbreviations

NCCCF: Nursing Care Continuum Competencies Framework; ICN: International Council of Nurses; TCS: Triage Competency Scale; CVI: content validity index; FL: Factor Loading; C.R.: Critical Ratio; AVE: Average Variance Extracted; CR: Construct Reliability; SMC: Squared Multiple Correlation; KMO: Kaiser–Meyer–Olkin; CFI: Comparative Fit Index; TLI: Turker Lewis Index; RMSEA: Root Mean Square Error of Approximation; SRMR: Standardized Root Mean-square Residual; ANCOVA: Covariance analysis; ENCCS_SN: School Nurse's Emergency Nursing Care Competency Scale

Declarations

Ethical approval and consent to participate

The study was carried out with the approval of the Institutional Review Board of Seoul National University (IRB No. 1809/003-009). All methods were performed in accordance with regulations of the Institutional Review Board of Seoul National University. Study description and informed consent were provided by email to a panel of experts. The participants of the pilot test and main survey were asked to read the study description and provide informed consent before completing the questionnaire online. Mobile vouchers were given to participants.

Consent for publication

Not applicable.

Availability of data and materials

All data generated or analysed during this study are included in this published article.

Competing interests

The author has no competing interests.

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Authors' contributions

Yoon contributed to the whole process of this study, such as the study design, analysis, drafting of the article, etc.

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Supplementary Files

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