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ORIGINAL ARTICLE

# Factors affecting Korean neonatal nurses' pain care: Psychometric evaluation of three instruments

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## Abstract

**Aim:** The purpose of this study was to evaluate the psychometric properties of the Korean-language versions of Pain Knowledge and Use (PKU-K), Collaboration and Satisfaction About Care Decisions (CSACD-K), and Environmental Complexity Scale (ECS-K).

**Methods:** A cross-sectional design was used with a convenience sample of 159 Korean nurses in seven neonatal intensive care units (NICUs). The data were collected by surveying the nurses with the PKU-K, CSACD-K, and ECS-K. Internal consistency reliability was assessed and Horn's parallel analysis, a confirmatory factor analysis, and a convergent construct validity test were conducted in order to evaluate the psychometric properties of the instruments.

**Results:** The PKU-K, CSACD-K, and ECS-K exhibited strong internal consistency reliability. Horn's parallel analysis showed four factor structures for the PKU-K, one for the CSACD-K, and three for the ECS-K. The confirmatory factor analysis showed a good model fit for the PKU-K and CSACD-K, but the ECS-K model showed a poor fit. Most factor loadings were statistically significant. The CSACD-K's convergent validity was supported by significant correlations for collegial nurse–physician relations with a validated instrument.

**Conclusion:** The findings support the reliability and validity of the PKU-K, CSACD-K, and ECS-K for measuring nurses' knowledge about neonatal pain care, nurse–physician collaboration, and the work environment in NICUs. However, the ECS-K needs further refinement before it is applied to Korean NICU nurses.

**Key words:** factor analysis, infant, pain management, psychometrics.

## INTRODUCTION

On average, 459,800 babies are born in South Korea each year; of these, 5.6% are born prematurely and require admission to a neonatal intensive care unit (NICU) (Statistics Korea, 2015). In one study, 145 Korean neonates in NICUs experienced an average of 105.6 painful procedures per infant during the first 2 weeks of their life, or an average of 7.5 painful procedures per day. These procedures included the heel stick, venipuncture, and suctioning (Jeong, Park, Lee, Choi, & Lee, 2014). Pain, as defined by the International Association for the Study of Pain, is "an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage" (IASP, 2012). Exposure to repeated and untreated painful stimuli can have more harmful consequences for infants than for older children because of

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infants' immature nerve systems and pain pathways (Anand, 2000; Evans, 2001). These consequences include increased cortisol and glucagon levels, which can increase the risk of a depressed immune system, sepsis, and death. Additional negative consequences include more intense responses to painful stimuli, decreased pain sensitivity in childhood, and increased developmental disorders (Anand, 2000; Evans, 2001).

As infants are incapable of self-reporting their pain, it is important that healthcare providers carefully observe behavioral (e.g. crying and body movement) and physiologic (e.g. increased heart rate and decreased oxygen saturation) indicators (American Academy of Pediatrics [AAP], 2016). In order to provide infant pain relief, the AAP (2016) recommended the routine use of standardized, validated, and reliable pain assessment tools (e.g. the Premature Infant Pain Profile [PIPP] or Neonatal Infant Pain Score [NIPS]), as well as effective pharmacological and non-pharmacological interventions. Also, the IASP (2011) issued evidence-based guidelines for acute pain relief in infants that recommended reducing the number of painful procedures by using non-pharmacological interventions (e.g. sucrose) and using pharmacological interventions (e.g. acetaminophen).

As NICU nurses provide key healthcare services for infants, their responsibilities include both anticipating predictably painful experiences and managing infant pain (Halimaa, 2003). However, South Korean investigators found that most nurses did not routinely use standardized assessment tools for infant pain (e.g. PIPP and NIPS) and lacked knowledge about these tools, although they knew that infant pain can be assessed by observing behavioral and physiologic changes (Bae, 2012; Noh, 2010). In addition, investigators found that most nurses did not routinely use effective intervention methods (both pharmacologic and non-pharmacologic), even though they knew the adverse effects of untreated pain on infants (Kim, 2004; Noh, 2010).

The Knowledge Use in Pain Care (KUPC) model that was developed by Latimer, Ritchie, and Johnston (2010) provides a theoretical framework for understanding the factors (e.g. nurses' knowledge, collaborations between physicians and nurses, and the work environment) that influence neonatal pain care. The KUPC model was designed to explain complex environments that were related to the use of nurses' knowledge in practice (Latimer *et al.*). Various factors have been found to affect neonatal pain care in multiple countries. In one Canadian study, the nurses who had the highest mean score for knowledge about neonatal pain care provided a high level of neonatal pain care (Latimer, Johnston, Ritchie, Clarke, & Gilin, 2009). One investigation in the USA found a positive correlation between nurses' perceptions of appropriate pain care and their receiving of adequate training (Cong, Delaney, & Vazquez, 2013). In addition, 45% of nurses perceived that training about neonatal pain care was a useful strategy to improve neonatal pain care (Cong *et al.*). However, in another study in the USA, 28.4% of the nurses reported that they did not receive adequate training about neonatal pain care during orientation (Byrd, Gonzales, & Parsons, 2009).

Additionally, investigations in the USA, Canada, China, and Japan found that neonatal pain care was affected by organizational factors, such as nurse–physician collaboration (Byrd *et al.*, 2009; Cong *et al.*, 2014; Ozawa & Yokoo, 2013), nurses' workload (Byrd *et al.*; Cong *et al.*; Latimer *et al.*, 2009; Ozawa & Yokoo), and a lack of evidence-based pain care guidelines (Byrd *et al.*; Ozawa & Yokoo). In one Canadian study, for example, nurse–physician collaboration and unanticipated changes in nurses' work assignments were identified as significant predictors of evidence-based pain care for infants (Latimer *et al.*).

Despite the fact that considerable research has been conducted on the factors that affect neonatal pain care in various countries, little research on these factors has been done in South Korea. Investigators have reported that nurses' knowledge about infant pain and intervention methods have a significantly positive relationship with neonatal pain care (Noh & Oh, 2011). In other studies, NICU nurses agreed that the barriers to neonatal pain care included insufficient knowledge about neonatal pain care (Kim, 2004; Noh, 2010), a lack of continuing education (Noh), a lack of standardized pain care guidelines (Noh), inadequate collaboration and professional relationships between nurses and physicians (Noh), and a lack of time and an excessive nurse workload (Kim; Noh). Although the Korea Institute for Healthcare Accreditation (2014) has issued a pain care standard for healthcare professionals that addresses matters, such as assessing pain, by using tools and managing pain using pharmacological and non-pharmacological interventions, the country has no national standardized guideline for infant pain relief like the AAP and IASP guidelines.

To investigate the factors that affect neonatal pain care in Korea, such as NICU nurses' knowledge about neonatal pain care, collaboration with physicians, and their work environment, the use of reliable and valid data collection instruments is necessary. For this study, three potentially useful instruments for the Korean

 

NICU nursing context were selected for translation and psychometric evaluation. Pain Knowledge and Use (PKU) is an instrument that was designed to measure NICU nurses' knowledge about neonatal pain care (Latimer *et al.*, 2009). The Collaboration and Satisfaction About Care Decisions (CSACD) was designed to measure collaboration and satisfaction regarding patient care decisions between nurses and physicians in intensive care units (Baggs, 1994). The Environmental Complexity Scale (ECS) was designed to measure nurses' perspectives on how the daily unit work influences their ability to provide patient care (O'Brien-Pallas, Irvine, Peereboom, & Murray, 1997). The reliability and validity of these three instruments has been well established during their use in various populations and clinical practice (Duffield *et al.*, 2011; Latimer *et al.*; Ozawa & Yokoo, 2012; Papathanassoglou *et al.*, 2012). However, these instruments never have been used to examine Korean NICU nurses' knowledge about neonatal pain care, collaboration with physicians, and their work environment.

# METHODS

## Aim

The aim of this study was to evaluate the psychometric properties of the Korean-language versions of the PKU-K, CSACD-K, and ECS-K. Three specific aims were established: (i) to evaluate the item analyses of the PKU-K, CSACD-K, and ECS-K; (ii) to evaluate the reliability of each instrument, based on internal consistency; and (iii) to evaluate each instrument's validity by using an exploratory factor analysis and confirmatory factor analysis, as well as correlations between the CSACD-K and ECS-K instruments and the Korean version of the Practice Environment Scale for the Nursing Work Index (KPES-NWI).

## Design

A cross-sectional, descriptive design was used to accomplish the specific aims of this study. Prior to the study, permission was obtained from the developers of the PKU, CSACD, and ECS to translate and use these instruments.

## Sample

A convenience sample of 159 NICU nurses was recruited from seven university-affiliated general hospitals in Korea. The inclusion criteria comprised registered nurses who had worked full-time for at least 6 months in NICUs. Nurses who did not provide direct care to infants (e.g. head, charge, and educational nurses) were excluded. Regarding the sample size, according to Tabachnick and Fidell (2013), the sample for a study involving a factor analysis should consist of at least five participants per item for an instrument. As multiple instruments were used in this study, the sample size was calculated based on the largest instrument (the KPES-NWI, containing 29 items). Therefore, the total sample size of 159 met the applicable requirements.

## Translation process

The translation process was conducted by using a committee approach that included translation, review, adjudication, pretesting, and documentation (Harkness, 2013). The PKU, CSACD, and ECS first were independently translated from English into Korean by three translators, all of whom were PhD nursing students in the USA and were proficient in both English and Korean. All three versions of the instruments were reviewed and the translators agreed on a single version for final review. This review was carried out by the first authors and two senior reviewers: one was an American native and nursing professor and the other was a Korean American and nursing professor. After the first author and senior reviewers completed their appraisals, a final version of each instrument (the PKU-K, CSACD-K, and ECS-K) was subjected to adjudication and approved for pretesting. During the pretesting, two rounds of expert panel reviews (involving a total of two Korean nursing professors and six Korean NICU nurses) and cognitive interviews (with 12 Korean NICU nurses) were conducted to evaluate the equivalence of the Korean and original English versions of the instruments. In the first expert panel review, the item-content validity index (CVI) score was <0.78 for one of the 25 PKU items, three of the nine CSACD items, and 10 of the 22 ECS items. In the cognitive interviews, one PKU item and three ECS items were found to be unsuitable in the Korean setting; all CSACD items were found to be suitable. Based on the first expert panel review and cognitive interview results, the unsuitable items either were modified or deleted. The final Korean versions of the instruments included 54 items, with a 24-item PKU, nine-item CSACD, and 21-item ECS. The second expert panel review was conducted for these versions of the instruments. The scales' CVI scores were 1.00 for all three instruments. Throughout the translation process, all the identified issues, obtained review comments, and decisions that had been made were documented (Min *et al.*, 2018).

## Instruments

### *Pain Knowledge and Use*

The PKU includes 11 items for knowledge of pain assessment, 10 items for knowledge of pain management (referred to as "pain intervention" in this study), and four items for knowledge of documentation practices, with a six-point Likert-type scale (1 = "strongly disagree" to 6 = "strongly agree"). Higher scores reflect greater knowledge. In a pilot study, the PKU's content validity was supported by nursing expert reviews (Latimer *et al.*, 2009); the CVI score was 0.86 (Latimer *et al.*). The Cronbach's alpha was 0.84 for all items, and the test–retest reliability was 0.68 ($P < 0.01$) (Latimer *et al.*). The construct validity was supported by an exploratory factor analysis, explaining 52% of the total variance for four factors (Latimer *et al.*, 2008). The PKU was translated from English into Korean and the translated instrument (the PKU-K) was validated by pretesting it by using expert panel reviews and cognitive interviews; the scale's CVI was 1.00 (Min *et al.*, 2018).

### *Collaboration and Satisfaction About Care Decisions*

The CSACD includes nine items, with a seven-point Likert-type scale: six items for critical attributes of collaboration (1 = "strongly disagree" to 7 = "strongly agree"), two items for satisfaction (1 = "not satisfied" to 7 = "very satisfied"), and one item for a global measure of collaboration (1 = "no collaboration" to 7 = "complete collaboration"). Higher scores reflect greater nurse–physician collaboration. The CSACD's content validity was supported by a literature review and nursing and medical experts (Baggs, 1994). In a pilot study with nurses and physicians in the NICU, the Cronbach's alpha was 0.93 (Baggs). The construct validity was supported by an exploratory factor analysis of the six critical attribute collaboration items, explaining 75% of the total variance for one factor (Baggs). The CSACD was translated from English into Korean and the translated instrument (the CSACD-K) was validated by pretesting it by using expert panel reviews and cognitive interviews; the scale's CVI was 1.00 (Min *et al.*, 2018).

### *Environmental Complexity Scale*

The ECS includes 22 items in three subscales. The respondents are asked to reflect on the workload they expect before their shift and to identify the influence of each item. The subscales address: (i) unanticipated delays in a response from others; (ii) unanticipated delays due to changes in patients' illness severity; and (iii) care team characteristics and composition. The ECS uses a categorical scale with three options (I = "increase work," D = "decrease work," and S = "same as usual/no change") and a five-point Likert-type scale (1 = "low influence" to 5 = "high influence"). Higher scores reflect a more complex work environment. The Cronbach's alphas of the three subscales were 0.88, 0.87, and 0.77, respectively (O'Brien-Pallas *et al.*, 1997). The construct validity was supported by a factor analysis (O'Brien-Pallas *et al.*). The ECS was translated from English into Korean and the translated instrument (the ECS-K) was validated by pretesting it using expert panel reviews and cognitive interviews; the scale's CVI was 1.00 (Min *et al.*, 2018).

### *Practice Environment Scale for the Nursing Work Index*

The PES-NWI was developed by Lake (2002) to assess the quality of the nursing practice environment. The PES-NWI was translated from English into Korean and was modified by Cho, Choi, Kim, Yoo, and Lee (2011). The Korean version of the PES-NWI was used to examine the correlations with the CSACD-K and ECS-K in order to test the convergent construct validity. The KPES-NWI includes 29 items and five subscales: (i) nurse participation in hospital affairs; (ii) nursing foundations for quality of care; (iii) nurse manager ability, leadership, and support of nurses; (iv) staffing and resource adequacy; and (v) collegial nurse–physician relations. It has a four-point Likert-type scale (1 = "strongly disagree" to 4 = "strongly agree"). Higher scores reflect higher levels of the nursing practice environment. The Cronbach's alpha of the total scale was 0.93 and the construct validity was supported by a confirmatory factor analysis with five factors (Cho *et al.*).

## Data collection procedures

The study was approved by the institutional review boards of one university in the USA and one hospital in Korea, as well as by each nursing division of seven university-affiliated general hospitals in Korea. After the study was approved, NICU nurses were recruited by using information sheets and individual or group meetings in the seven hospital units. During each meeting, the principal investigator (PI) explained the purpose of the study, potential risks and benefits of participation, confidentiality matters, and the participants' right to withdraw from the study at any time. When a nurse expressed interest in participating in the study, the PI obtained written informed consent and then the participant completed five study questionnaires: the demographic information questionnaire, PKU-K, CSACD-K, ECS-K, and KPES-NWI.

### Data analysis

STATA v. 12.0 (StataCorp, College Station, TX, USA) statistical software was used to analyze the study's data. The "not applicable" response option was dealt with as a missing value for further analysis. Each missing value was managed by using the listwise deletion method, which is the most common for handling missing data. If a case has any missing value, listwise deletion excludes all that case's data from the analysis. Descriptive statistics were used to analyze the demographic data and the mean and standard deviation for each instrument item. An independent *t*-test and one-way ANOVA were used to compare the mean scores for each instrument item, according to the demographic information. The item-to-total correlation for each instrument was analyzed in order to determine the extent to which each item correlated with the total instrument score. The Cronbach's alpha was used to determine the internal consistency of the PKU-K, CSACD-K, ECS-K, and KPES-NWI. Bartlett's test of sphericity and the Kaiser–Meyer–Olkin measure were respectively conducted in order to evaluate the appropriateness of the factor model and the sample size for factor analysis. To determine the appropriate number of factors, Horn's parallel analysis was conducted. Based on two analysis results, a confirmatory factor analysis was conducted for each instrument in order to determine how well the underlying structures fit the observed data by using structural equation modeling. The model fit was evaluated by using absolute and incremental fit indices: the root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), and comparative fit index (CFI). A RMSEA value of <0.08, a SRMR value of <0.08, and a CFI value between 0.80 and 0.89 indicate an acceptable model fit (Hu & Bentler, 1999; Knight, Virdin, Ocampo, & Roosa, 1994). To obtain the most parsimonious model, model modification that consisted of Lagrange multiplier tests was carried out. In order to evaluate the convergent construct validity between the CSACD-K and KPES-NWI, as well as between the ECS-K and KPES-NWI, the Pearson's correlation coefficient was used.

## RESULTS

### Demographic information

A total of 159 NICU nurses participated in the study. Most participants (99.4%) were female and the mean age of the participants was 27.76 years (standard deviation [SD] = 3.33). All the participants had completed higher levels of education, with most (84.3%) holding Bachelor's degrees. The participants' mean years of nursing experience was 4.68 years (SD = 3.34) and their mean years of NICU experience was 4.11 years (SD = 2.67). Most participants (66.7%) had not received any training for neonatal pain care in the previous 6 months. Of those who had received such training within this time frame, 76.9% received the training in their NICU. The mean participant scores for each instrument were 4.38 (SD = 0.54) for the PKU-K, 4.18 (SD = 1.06) for the CSACD-K, and 3.43 (SD = 0.79) for the ECS-K. The PKU-K showed statistically significant mean differences for the participants' age, education, and NICU experience ($P < 0.05$) (see Table 1).

### Reliability

The PKU-K's internal consistency was strong, with a Cronbach's alpha of 0.88 for all 24 items (the Cronbach's alpha if an item was deleted = 0.87–0.88). Except for two items, the corrected item-total correlation coefficients of the items were > 0.30 (range: 0.37–0.71). The CSACD-K's internal consistency was strong, with a Cronbach's alpha of 0.94 for the six critical attribute collaboration items (the Cronbach's alpha if an item was deleted = 0.93–0.94). The global collaboration item was strongly correlated with the six critical attribute collaboration items ($r = 0.75$, $P < 0.001$). The correlation between the two satisfaction items was significantly strong ($r = 0.82$, $P < 0.001$). The corrected item-total correlation coefficients of the six critical attribute collaboration items of the CSACD-K were > 0.30 (range: 0.85–0.90). The ECS-K's internal consistency was strong, with a Cronbach's alpha of 0.92 for all 21 items (the Cronbach's alpha if an item was deleted = 0.91–0.92). The Cronbach's alpha values for the three subscales were 0.89 (unanticipated delays in a response from others), 0.77 (unanticipated changes in patients' illness severity), and 0.55 (composition of the care team). Except for two items, the corrected item-total correlation coefficients of the items were>0.30 (range: 0.41–0.67). These two items were negatively related to the ECS-K and thus they were deleted for

 

**Table 1** Descriptive statistics for the Korean versions of the three instruments ($n$ = 159)

| | | PKU-K | | CSACD-K | | ECS-K | |
|---|---|---|---|---|---|---|---|
| Characteristic | N (%) | Mean ± SD | *t* or F (*p*) | Mean ± SD | *t* or F (*p*) | Mean ± SD | *t* or F (*p*) |
| Age (years) | | | −2.37 (0.019) | | 1.05 (0.295) | | −0.14 (0.888) |
| <30 | 121 (76.10) | 4.32 ± 0.51 | | 4.13 ±1.05 | – | 3.42 ± 0.76 | |
| ≥30 | 38 (23.90) | 4.56 ± 0.61 | | 4.34 ± 1.10 | | 3.45 ± 0.90 | |
| Education | | | 4.13 (0.018) | | 0.40 (0.670) | | 1.50 (0.227) |
| Diploma | 20 (12.58) | 4.36 ± 0.61 | | 4.16 ± 1.04 | | 3.57 ± 0.84 | |
| Bachelor degree | 134 (84.28) | 4.36 ± 0.52 | | 4.17 ± 1.05 | | 3.43 ± 0.77 | |
| ≥Master's degree | 5 (3.14) | 5.05 ± 0.40 | | 4.60 ± 1.40 | | 2.89 ± 1.15 | |
| NICU experience (years) | | | 11.13 (0.000) | | 1.33 (0.266) | | 0.02 (0.982) |
| <5 | 115 (72.33) | 4.28 ± 0.51 | | 4.13 ± 1.05 | | 3.43 ± 0.79 | |
| ≤5 ~ <10 | 33 (20.75) | 4.51 ± 0.51 | | 4.19 ± 1.03 | | 3.44 ± 0.86 | |
| ≥10 | 11 (6.92) | 4.99 ± 0.45 | | 4.68 ± 1.18 | | 3.47 ± 0.65 | |

CSACD-K, Collaboration and Satisfaction About Care Decisions-Korean; ECS-K, Environmental Complexity Scale-Korean; NICU, neonatal intensive care unit; PKU-K, Pain Knowledge and Use-Korean; SD, standard deviation.

further analysis. After the two items were deleted, the Cronbach's alpha for the ECS-K was unchanged.

## Validity

### *Factor analysis*

The sample size was appropriate for the factor analysis. The Kaiser–Meyer–Olkin measure of sampling adequacy and Bartlett's test of sphericity were 0.81 and $\chi^2$ (276) = 1688.42 ($P$ < 0.001) for the PKU-K, 0.91 and $\chi^2$ (15) = 863.12 ($P$ < 0.001) for the CSACD-K, and 0.83 and $\chi^2$ (171) = 1097.36 ($P$ < 0.001) for the ECS-K. Horn's parallel analysis showed factor structures for each instrument: four factors for the PKU-K explaining 53.7% of the total variance; one factor for the six critical attribute collaboration items of the CSACD-K explaining 78.6% of the variance; and three factors for the 19 items of the ECS-K explaining 64.7% of the variance.

As shown in Table 2, the confirmatory factor analysis showed that the model fit was not acceptable for a four-factor model of the 24-item PKU-K, a one-factor model of the six-item CSACD-K, and a two-factor model of the 16-item ECS-K. For the ECS-K, the composition of the care team subscale (three items) was excluded from the confirmatory factor analysis because of numerous missing values. In order to find the most parsimonious model, the Lagrange multiplier test was conducted in order to examine the model modification indices. Based on the test results, four error correlations for the PKU-K, three error correlations for the CSACD-K, and two error correlations for the ECS-K were added (see Figures 1–2, and 3). As shown in Table 2, the modified model showed an acceptable fit for the PKU-K and CSACD-K. However, for the ECS-K, although the model fit indices were improved with the modified model, still the model showed a poor fit.

**Table 2** Fit statistics for the Korean versions of the three instruments

| Instrument | Model | $\chi^2$(d.f.) | RMSEA | CFI | SRMR |
|---|---|---|---|---|---|
| PKU-K | Four-factor | $\chi^2$ (246) = 541.02, $P$ = 0.000 | 0.089 | 0.807 | 0.082 |
| | Modified four-factor | $\chi^2$ (242) = 466.49, $P$ = 0.000 | 0.078 | 0.853 | 0.076 |
| CSACD-K | One-factor | $\chi^2$ (9) = 29.74, $P$ = 0.000 | 0.120 | 0.976 | 0.021 |
| | Modified one-factor | $\chi^2$ (6) = 11.06, $P$ = 0.087 | 0.073 | 0.994 | 0.013 |
| ECS-K | Two-factor | $\chi^2$ (103) = 249.87, $P$ = 0.000 | 0.189 | 0.676 | 0.108 |
| | Modified two-factor | $\chi^2$ (101) = 222.83, $P$ = 0.000 | 0.174 | 0.732 | 0.102 |

CFI, comparative fit index; CSACD-K, Collaboration and Satisfaction About Care Decisions-Korean; ECS-K, Environmental Complexity Scale-Korean; PKU-K, Pain Knowledge and Use-Korean; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual.

 

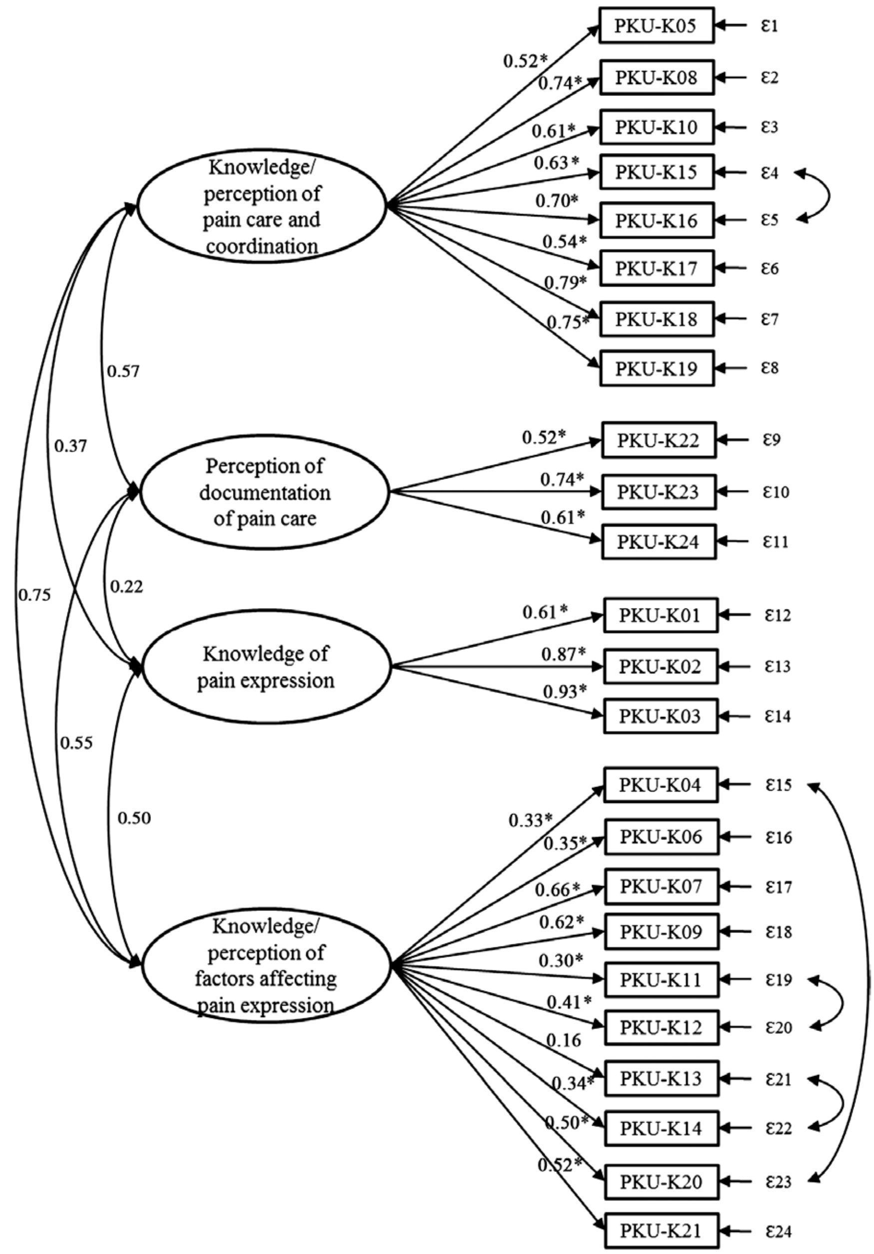


**Figure 1** Confirmatory factor analysis of the four-factor model of the Pain Knowledge and Use-Korean (PKU-K) ($n$ = 153). *$P$ < 0.001 and **$P$ < 0.05.

As shown in Figure 1, the correlations between the factors of the PKU-K ranged from 0.22 to 0.75. Except for Item 13, the factor loadings were significantly loaded on their respective factors and ranged from 0.30 to 0.93. After the four factors and their respective items were identified, the internal consistency reliability was tested for these factors. As shown in Figure 2, all the factor loadings of the CSACD-K were significantly loaded on the latent factor and ranged from 0.80 to 0.92. As shown in Figure 3, the correlation between the factors of the ECS-K was 0.93. All the factor loadings were significantly loaded on their respective factors and ranged from 0.56 to 0.81.

### *Correlation between the Collaboration and Satisfaction About Care Decisions and Environmental Complexity Scale and the Practice Environment Scale for the Nursing Work Index*

The collaboration subscale of the CSACD-K was positively correlated with the subscale of collegial nurse–

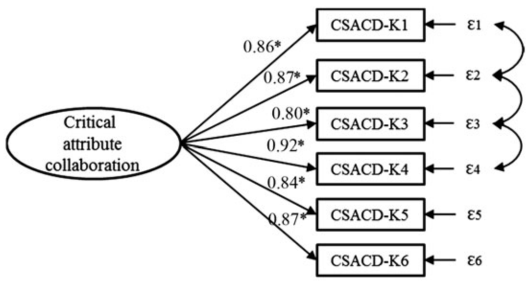


**Figure 2** Confirmatory factor analysis of the one-factor model of the Collaboration and Satisfaction About Care Decisions-Korean (CSACD-K) ($n$ = 159). *$P$ < 0.001.

physician relations of the KPES-NWI ($r$ = 0.51, $P$ < 0.001). However, there was no significant correlation between the ECS-K and the KPES-NWI ($r$ = −0.02, $P$ = 0.8339).

# DISCUSSION

This is the first study to evaluate the psychometric properties of the Korean versions of the PKU, CSACD, and ECS. The study's findings provide preliminary evidence of the reliability and validity of the Korean versions of these three instruments.

## Item analyses

The findings of the item analyses indicated that each item of the PKU-K, CSACD-K, and ECS-K correlated well with the total scale score. Polit and Beck (2012) recommended that the item-total correlation coefficients be at least >0.30. Although the coefficients of two PKU-K items were≤0.30, the overall items of the instrument had a good correlation with the total score, suggesting that the instrument's items were homogeneous.

## Reliability

The findings of the reliability test indicated that the PKU-K, CSACD-K, and ECS-K all had adequate internal consistency (Cronbach's $\alpha$ > 0.80). For the CSACD-K, similar results were obtained for the Japanese ($\alpha$ > 0.90) (Ozawa & Yokoo, 2012) and Greek ($\alpha$ > 0.80) (Papathanassoglou *et al.*, 2012) versions of the CSACD; this study was the first to examine PKU and ECS translations. However, the composition of the care team subscale of the ECS-K showed low internal consistency ($\alpha$ = 0.55). Similar results were obtained by Canadian and Australian investigators, who found that the composition of the care team subscale had low internal consistency ($\alpha$ = 0.42 and 0.56, respectively) (Duffield *et al.*, 2011; Latimer *et al.*, 2009). A possible reason for the low internal consistency of the

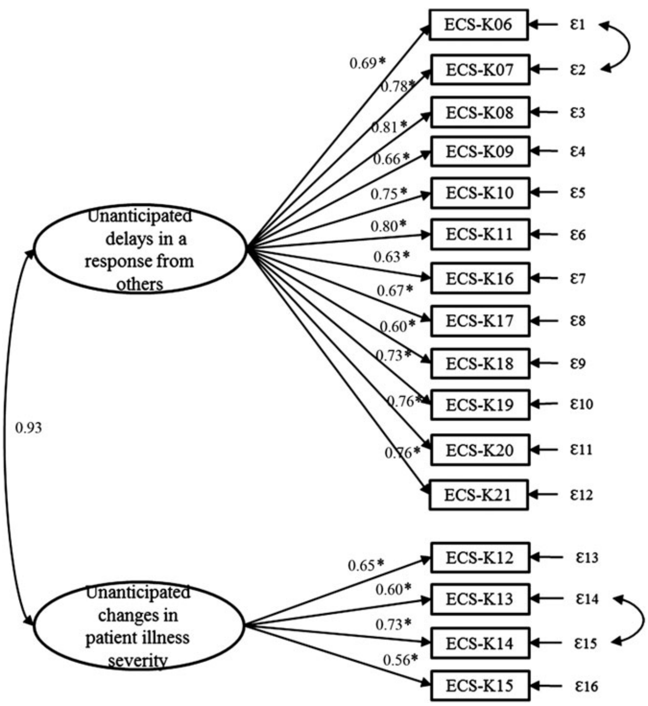


**Figure 3** Confirmatory factor analysis of the two-factor model of the Environmental Complexity Scale-Korean (ECS-K) ($n$ = 40). *$P$ < 0.001.

composition of the care team subscale is its lack of applicability to the current nursing work environment. In the current study, more than half of the participants responded with "not applicable" to the ECS-K item called "scheduled staff absent" on the composition of the care team subscale. This item might not be suitable for measuring the current work environment complexity in Korean NICUs. Overall, the findings demonstrate the strong internal consistency of the PKU-K, CSACD-K, and ECS-K for use with nurses in Korean NICUs. However, further refinement of the composition of the care team subscale of the ECS-K is necessary for the application of this instrument in Korean NICUs.

## Validity

### *Factor analysis*

The four-factor structure of the PKU-K that was produced by the Horn's parallel analysis and confirmatory factor analysis was confirmed as the original factor structure of the PKU, indicating satisfactory construct validity. The confirmatory factor analysis showed that all the items were significantly loaded on their intended factors, except for Item 13. In addition, the item-total correlation coefficient for Item 13, "Infants do not need analgesics due to their immature nervous systems," was <0.30. Thus, it might be advisable to revise this item in future research. The confirmatory factor analysis verified that the PKU-K had four independent subscales.

The Horn's parallel analysis and confirmatory factor analysis produced a one-factor structure for the CSACD-K. This was confirmed as the original factor structure of the CSACD, indicating satisfactory construct validity. Previously, Ozawa and Yokoo (2012) also identified a one-factor structure for the Japanese CSACD.

The three-factor structure of the ECS-K that was produced by the Horn's parallel analysis was confirmed as the original factor structure of the ECS, indicating satisfactory construct validity. However, in this study, the confirmatory factor analysis was conducted with a two-factor model of the 16-item ECS-K because of the many missing values for factor 3 (composition of the care team), which resulted in a poor model fit. Also, the correlation between the factors was >0.90, indicating that the two subscales might be highly correlated. A possible explanation for the poor model fit is the small sample size ($n = 40$) that was used to conduct the confirmatory factor analysis. Some items received a high number of "not applicable" responses that were coded as missing values. The listwise deletion method removed many cases with missing values from the analysis, reducing the sample to a size that was less than desirable for conducting a confirmatory factor analysis; for example, Russell (2002) recommended a sample of at least 100 cases for such an analysis. After the factor 1 and 2 items with a high number of "not applicable" responses were deleted, the model fit indices were improved: the RMSEA = 0.127, CFI = 0.887, and SRMR = 0.069. However, the sample size ($n = 65$) again was small for conducting a confirmatory factor analysis appropriately.

As an additional explanation for the high number of "not applicable" responses and the poor model fit of the ECS-K, the participants had to answer questions based on their shift;, thus, their response patterns might have differed because of differing shift circumstances. Of the participants, 44% worked the day shift, 32% the evening shift, and 24% the night shift. Evening shift nurses, for example, might have responded "not applicable" to the items that were related to nursing students, who carry out their clinical practice during the day shift. Also, the night shift nurses might have responded "not applicable" to items, such as "language barrier with family," "greater demand for routine parent teaching," and "greater demand for psychosocial support for family" because they rarely interact with patients' families.

Additionally, some items had a high number of "not applicable" responses across work shifts, primarily those involving "students on units," "scheduled staff absent," and "narcotic keys, medication, and supplies missing." The average percentages for these "not applicable" responses for the three shifts were high (59%, 51%, and 69% for the day, evening, and night shifts, respectively). The high numbers of these responses could indicate that they were not suitable for use in current Korean NICU settings. Thus, before the ECS-K is used to measure a NICU work environment, further study of the instrument by using a large sample of NICU nurses is called for, preferably with similar numbers of nurses working the three shifts. Based on this testing, the ECS-K can be further refined.

### *Correlation between the instruments*

The findings of the correlation tests indicated that the collaboration subscale of the CSACD-K and the collegial nurse–physician relations subscale of the KPES-NWI measured the same construct (nurse–physician collaboration) in Korean NICU settings. However, no correlation was found between the ECS-K and KPES-NWI, suggesting that these instruments might measure different perspectives on the nursing work environment in Korean NICU settings. That is, the ECS-K measures the nursing work environment as it relates to daily unit tasks (e.g. clarifying doctors' orders, teaching patients, and providing family support) (O'Brien-Pallas *et al.*, 1997), whereas the KPES-NWI measures the nursing work environment as it relates to hospital characteristics (e.g. nurse participation in hospital affairs, nursing foundations, and nurse manager ability) (Lake, 2002). Overall, the study's findings provide significant evidence for the construct validity of the PKU-K and CSACD-K.

### Limitations of the study

Some limitations were identified in this study. The first relates to the representativeness of the sample. The study's participants were recruited from seven NICUs in four cities, but all the hospitals were university-affiliated general hospitals. In addition, convenience sampling was used in this study. Therefore, the study's participants might not have been representative of all Korean NICU nurses. Consequently, further research involving NICU nurses that are recruited from different types of hospitals might be necessary in order to achieve greater generalizability. Another limitation is related to the use of self-reporting instruments. Even though the purpose of the study—that is, to evaluate the psychometric properties of the Korean versions of three instruments—was clearly explained to the study's participants, they could have been influenced by social desirability bias during instrument completion. Thus, further research involving objective measurements might be needed in order to evaluate the instruments' validity, including their criterion-related validity.

## CONCLUSION

This study provides significant evidence of the psychometric properties of the PKU-K, CSACD-K, and ECS-K for a sample of the Korean NICU nurse population. The use of reliable and valid Korean-language instruments is crucial in order to achieve a comprehensive understanding of the factors (e.g. nurses' knowledge about neonatal pain care, nurse–physician collaboration, and work environment) that affect Korean NICU nurses' pain care practice. Although further study and refinement of the ECS-K are needed in the future, the PKU-K, CSACD-K, and ECS-K will allow researchers to assess these factors in order to develop effective staff education programs and policies for infant pain relief in Korean NICUs. In addition, the translated instruments will be useful in future cross-cultural research exploring the factors that affect nurses' care of infant pain.

## DISCLOSURE

The authors declare no conflict of interest.

## AUTHOR CONTRIBUTIONS

H. M., C. V., C. G. P., A. K. M., L. L. M., and M. L. contributed to the conception and design of this study; H. M. conducted the statistical analysis and drafted the manuscript; C. V., C. G. P., A. K. M., L. L. M., and M. L. critically reviewed the manuscript and supervised the whole study process. All the authors read and approved the final manuscript.

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