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Psychometric Testing of the Persian Version of the Perceived Perioperative Competence Scale–Revised

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The clinical competence of nursing students in operating room (OR) is an important issue in nursing education. The purpose of this study was to evaluate the psychometric properties of the Persian Perceived Perioperative Competence Scale–Revised (PPCS-R) instrument. This cross-sectional study was conducted across 12 universities in Iran. The psychometric properties and factor structure of the PPCS-R for OR students was examined. Based on the results of factor analysis, seven items were removed from the original version of the scale. The fitness indices of the Persian scale include comparative fit index (CFI) = .90, goodness-of-fit-index (GFI) = .86, adjusted goodness-of-fit index (AGFI) = .90, normed fit index (NFI) = .84, and root mean square error of approximation (RMSEA) = .04. High validity and reliability indicated the scale's value for measuring perceived perioperative competence of Iranian OR students.

Keywords: operating room; competence; scale; psychometric testing; Persian Perceived Perioperative Competence Scale-Revised (PPCS-R)

Competence is a complex concept intertwined with knowledge, skills, and attitudes. Competence is meant to be the final product of educational systems (Strong & Folse, 2015). There are several tools for assessing clinical competencies in nursing students (Bahreini et al., 2011). However, there was a lack of a proper instrument to assess clinical competencies in operating room (OR) nursing students in Iran.

The Perceived Perioperative Competence Scale-Revised (PPCS-R), developed by Gillespie and Hamlin (2009) and revised by Gillespie, Polit, Hamlin, and Chaboyer (2012), is a useful instrument to assess the clinical competence of OR students.

BACKGROUND AND CONCEPTUAL FRAMEWORK

Education is essential for improving students' knowledge; competence; and professional, problem-solving, and critical-thinking abilities (Mohtashami, Pazargadi, Manoochehri,

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& Alavi Majd, 2014). The importance of education is more critical when students are prepared to provide health care for individuals (Bahreini et al., 2011). Skill, attitude, and knowledge are valuable prerequisites for professionals in health care environments (Mohtashami et al., 2014). Education is fundamental in preparing nursing students to obtain the required knowledge and competence for their caring discipline (Watson, 2005).

In Iran, OR nursing is a separate nursing specialty and degree program. OR nurses can work as circular or scrub nurses during surgical procedures. The purpose of OR nursing education is to enhance students' knowledge, skills, and attitudes required for patient care before, during, and after surgical procedures (Wu, Enskär, Lee, & Wang, 2015).

Assessing students' clinical skills indicated a gap between students' achieved and required capabilities for practice (Fan, Wang, Chao, Jane, & Hsu, 2015). Evidence showed that new nurses experience incompetence in their transitional period from students to health care professionals (Fan et al., 2015; Mohtashami et al., 2014). Competence is a complex phenomenon, interrelated with knowledge, skills, and attitudes (Gillespie, Chaboyer, Lingard, & Ball, 2012), and one of the most controversial subjects in different levels of health care systems, including education, practice, and management (Cushman et al., 2015).

In recent years in Iran, because of ever-increasing knowledge and society's expectations of quality care, the growing focus of nursing education has been on students' practical competence along with increasing the number of nurses in different fields (Bahreini et al., 2011), especially OR nurses. Therefore, clarifying nursing students' clinical competence and developing valid and reliable instruments to evaluate students' clinical competencies for preparing them for patient care are needed and require further research.

There is little evidence of systematic approaches to assess students' competence and develop reliable and valid instruments to measure nursing competencies (Wu et al., 2014). Several researchers have developed different instruments to measure perceived competence in nursing. Most of these instruments have been developed to measure specific domains of competence, such as assessment, planning, evaluation, patient care, decision making, cognitive ability, ego strength, social participation, research awareness (Clinton, Murrells, & Robinson, 2005; Cowin et al., 2008), work role, helping role, teaching–coaching, diagnostic functions, ensuring quality, managing situations (Meretoja, Isoaho, & Leino-Kilpi, 2004; Wangensteen, Johansson, & Nordström, 2014), basic knowledge, management, professionalism, nursing process, and problem solving (Safadi, Jaradeh, Bandak, & Froelicher, 2010). However, there is no valid and reliable tool to measure the competence of nursing OR students in Iran.

The PPCS-R is a valid and reliable instrument to assess clinical competence of OR nursing students. However, a Persian version of the scale with a cross-cultural adaptation is required. The aims of this study were to translate the PPCS-R scale into Persian and evaluate psychometric properties of the new version of the scale in Iranian students' culture and language.

DESCRIPTION, ADMINISTRATION, AND SCORING OF THE INSTRUMENT

PPCS-R is a valid and reliable scale and has been used in several studies. This instrument contains 40 items on the Likert scale scoring from 1 (*strongly disagree*) to 5 (*strongly agree*). The instrument has six subscales: Foundational Skills and Knowledge, Leadership,

Collegiality, Proficiency, Empathy, and Professional Development. The total scores of the instrument range from 40 to 200 (Gillespie, Polit, et al., 2012). PPCS-R has good internal consistency with a Cronbach's alpha of .96 for the whole instrument, and .81–.89 for the subscales, including Foundational Skills and Knowledge (nine items), Leadership (eight items), Collegiality (six items), Proficiency (six items), Empathy (five items), and Professional Development (six items). This scale has been translated into several languages, and the validity and reliability of different versions have been studied (Gillespie, Polit, et al., 2012).

METHODS

This cross-sectional study was carried out in 12 nursing or paramedical schools in Iran, 2014. In this study, the translation and psychometric testing of the instrument was conducted in four phases, including translation, face and content validity, confirmatory factor analysis, and reliability. For using an instrument in different cohorts, assessing psychometric properties and cultural adaptation of the instrument is fundamental for rigor of interpretation of the results (Rode, 2005).

Procedures

Phase 1: Translation. Cultural adaptation addresses compatibility between the original and new versions of a scale in accordance with face and content validity (Beaton, Bombardier, Guillemin, & Ferraz, 2000). The most common strategy for cross-cultural adaptation of an instrument is translation (Sperber, 2004). Severinsson (2012) stated that there is no single technique for translation of instruments. In the translation process of PPCS-R, we used protocol of Wild et al. (2005), including forward translation, reconciliation, back translation, back translation review, harmonization, cognitive debriefing, results and finalization, and final report.

Phase 2: Face and Content Validity. In this phase, the primary Persian version of the instrument was given to 10 experts to assess the instrument's content validity. The experts were asked to comment on reasonability, suitability, attractiveness, and the logical sequence of items as well as the conciseness and comprehensiveness of the tool. Then, the content validity index (CVI) of the tool was assessed. This indicator is the most commonly used quantitative method to determine the content validity of multiple-choice instruments. The CVI indicates relevance, simplicity, and clarity of items according to experts' judgment (Juniper, Guyatt, Streiner, & King, 1997; Lacasse, Godbout, & Sériès, 2002).

To estimate the CVI for each item, different attributes, such as *being simple and clear*, were scored using a four-choice Likert scale ranging from *not clear* to *very clear* and from *not simple* to *very simple* (Juniper et al., 1997; Lacasse et al., 2002). According to Waltz and Bausell's (1983) index, interpretation of the scores for CVI includes $<.70$ = unacceptable, .70–.78 = revision and correction, and $\geq .79$ = acceptable.

After evaluating content validity, the new version of the tool was given to 10 OR students to determine face validity. Items without meeting the criteria of simplicity, readability, and clarity were simplified and/or modified.

Phase 3: Factor Analysis. To establish construct validity, confirmatory factor analysis (CFA) was conducted by LISREL and EQS programs to ensure that the factor structure of the Persian PPCS-R is comparable with the English version. The LISREL, AMOS, and EQS were used for CFA to release model fit indices (Mueller, 1996). Severinsson (2012) reported that if fit indices do not fit the model, CFA will change to exploratory factor analysis (EFA).

Acceptable scores of fit indices include chi-squared goodness-of-fit test (χ^2/df) ≤ 3, root mean square error of approximation (RMSEA) ≤.08 (acceptable score), RMSEA ≤.05 (good score; Kline, 2010; Seo, Torabi, Blair, & Ellis, 2004), goodness-of-fit index (GFI) and comparative fit index (CFI) ≥.70 (acceptable score), GFI and CFI ≥.90 (good score), adjusted goodness-of-fit index (AGFI) ≥.70 (acceptable score), and AGFI ≥.90 (good score; Gil-Monte & Olivares Faundez, 2011; Loehlin, 1998).

One prerequisite of CFA is a proper sample size. Some scholars recommended 5–10 participants per item (Rattray & Jones, 2007; Worthington & Whittaker, 2006). For factor analysis, stratified cluster sampling was used. Twenty-three Iranian nursing or paramedical schools were divided into four geographical strata: northern, southern, western, and central. Twelve schools were randomly selected. In according with the inclusion criteria, 400 students participated in the study. Inclusion criteria were bachelors OR students enrolled in internships (Semester 7 or 8) who were willing to participate. Using the Kolmogorov-Smirnov test, normality of data was determined.

Phase 4: Reliability. Internal consistency of the scale was assessed by Cronbach's alpha coefficient. A Cronbach's alpha of .70 or more was considered satisfactory (Kolagari, Zagheri Tafreshi, Rassouli, & Kavousi, 2014). For conducting the test–retest and interclass correlation coefficient (ICC), 20 OR nursing students completed the Persian PPCS-R twice with a 2-week interval. ICC values of .40 or more were considered satisfactory ($r \geq .81$ = excellent, .61–.80 = very good, .41–.60 = good, .21–.40 = fair, and ≤.20 = poor; Kolagari et al., 2014). Data were analyzed using Statistical Package for the Social Sciences (SPSS) Version 18 and CFA was conducted using EQS Version 6.1.

ETHICAL CONSIDERATIONS

The study was approved by the Research Ethics Committee of Shahid Beheshti University of Medical Sciences, Iran. The study was explained to potential participants and consent forms were completed. The confidentiality of data and the right to withdraw was explained to all participants. Permission for translation and cross-cultural modification of the PPCS-R was obtained from the original instrument's author.

RESULTS

Description of Samples

From 400 participants, 357 students anonymously completed self-report questionnaires (response rate = 89.25%). Findings indicated that 57.43% of participants were female and 61.35% were single (Table 1).

Phase 2: Findings of Face and Content Validity. Based on the results of CVI, all items were scored greater than .90 and included in the new scale. The mean content validity scores for relevancy, clarity, and simplicity were 95%, 93%, and 95%, respectively.

Phase 3: Factor Analysis.

Confirmatory Factor Analysis. In the CFA model, some items were not significant; therefore, the model was modified. Using EQS Version 6.1, results of the CFA revealed that the initial version of the Persian PPCS-R was not tailored well enough to the model. All indices had poor goodness-of-fit (χ^2/df = 30, CFI = .30, GFI = .73, AGFI = .63, NFI = .30, and RMSEA = .08).

TABLE 1. Demographic Characteristics of Operating Room Students ($N = 357$)

Characteristic	*n*	%
Gender		
Male	152	42.5
Female	205	57.43
Age (year)		
20–25	301	84.31
26–30	56	15.69
Internship		
Semester 7	163	45.65
Semester 8	194	54.35
Marital status		
Married	138	38.65
Single	219	61.35
Place of residence		
Dormitory	201	56.30
House	156	43.70

Note. $N = 357$; n = number of participants in each group; % = percentage of participants in each group.

Exploratory Factor Analysis: Modifying the Model. After conducting the CFA, we found that the best way to obtain a better model was EFA. First, data were examined by the Bartlett's test of sphericity to reach sample adequacy ($p < .001$, $\chi^2 = 2717.660$, and Kaiser-Mayer-Olkin [KMO] = .602). Then, we conducted several EFA analyses to identify the best model. Finally, a five-factor model was identified, seven items (Items 2, 5, 18, 33, 37, 39, and 40) were deleted, and other items were categorized in the five-factor model. The five-factor model as the best modified model was chosen considering the 63.11% of the total variance. The model comprises 33 Likert-scale items. Each item's scores range from 1 to 5. The five factors include Factor 1, Foundational Skills and Knowledge, with seven items (Items 3, 7, 9, 26, 31, 36, and 38); Factor 2, Leadership, with nine items (Items 10, 11, 20, 21, 22, 25, 27, 28, and 34); Factor 3, Collegiality, with seven items (Items 4, 12, 13, 15, 19, 23 and 32); Factor 4, Proficiency, with four items (Items 1, 8, 14, and 16); and Factor 5, Professional Development, with six items (Items 6, 17, 24, 29, 30, and 35; Table 2).

Second Confirmatory Factor Analysis. Using a second CFA, all indices indicated strong goodness-of-fit. Finally, the new and modified model of the Persian PPCS-R with five factors and 33 items was confirmed (Table 3).

Phase 4: Reliability. The findings revealed that the Cronbach's alpha coefficient for the Persian version of the instrument was .86 and for subscales ranged from .62 to .84. Correlation between responses in a 2-week interval was .89 ($r = .89$), and ICC was .85. ICC for subscales ranged from .62 to .83.

TABLE 2. Results of the Exploratory Factor Analysis and Cronbach's Alpha Values of the Iranian Data

Factors	Items	Factor Loading	Alpha Value
Factor 1: Foundational Skills and Knowledge	My local knowledge of this department assists me to perform my OR role (Item 3).	.51	
	I plan and coordinate the needs in the theatre I am allocated (Item 7).	.50	
	Knowing the location of equipment in the OR assists me to perform my OR role (Item 9).	.64	
	Based on experience, I am able to identify actual or potential emergency situations and respond appropriately (Item 26).	.48	.70
	I use strategies to make the patient feel more comfortable (Item 31).	.73	
	I have detailed knowledge of anatomy and physiology (Item 36).	.79	
	I read current journals and literature that relate to clinical practice (Item 38).	.64	
Factor 2: Leadership	I take a leadership role to ensure the smooth running of the theatre (Item 10).	.57	
	I make difficult decisions when necessary (Item 11).	.86	
	I tailor my communication based on the mix of personalities in the team (Item 20).	.59	
	I respect the level of expertise of other members of the team (Item 21).	.61	
	I treat members as individuals who have different needs, abilities, and aspirations (Item 22).	.51	
	I troubleshoot and take appropriate action in the event of machine/equipment failures (Item 25).	.72	
	I treat members as individuals who have different needs, abilities, and aspirations (Item 27).	.64	
	I have the right amount of knowledge to practice in this specialty (Item 28).	.5	
	I establish rapport with patients that enhances their ability to express feelings and concerns (Item 34).	.58	

(Continued)

TABLE 2. Results of the Exploratory Factor Analysis and Cronbach's Alpha Values of the Iranian Data *(Continued)*

Factors	Items	Factor Loading	Alpha Value
Factor 3: Collegiality	I understand and anticipate the surgical procedure (Item 4).	.68	
	I take an active role in preceptoring or mentoring lesser experienced nurses (Item 12).	.63	
	I manage clinical situations when there is conflict between staff (Item 13).	.70	
	I encourage team members to use innovative solutions to solve traditional problems (Item 15).	.53	.70
	I feel comfortable in seeking assistance from my colleagues when I am unsure (Item 19).	.74	
	When communicating with other team members, I use language that is appropriate to the situation (Item 23).	.60	
	I provide appropriate reassurance and explanation for OR patients (Item 32).	.59	
Factor 4: Proficiency	I am familiar with most of the instrumentation in different specialties (Item 1).	.48	.62
	I know instinctively when surgery is not going well and am able to respond appropriately (Item 8).	.71	
	I provide clinical guidance to other staff members (Item 14).	.73	
	I delegate aspects of care according to role, functions, capabilities, and learning needs of other team members (Item 16).	.62	
Factor 5: Professional Development	When I am allocated to an area of the OR that is unfamiliar, I draw on my skills and experience (Item 6).	.60	
	I encourage active involvement in clinical decision-making processes (Item 17).	.72	
	I have mastered the terminology and vocabulary of OR nursing (Item 24).	.48	.64
	I am able to anticipate the needs of the situation (Item 29).	.51	
	I provide reassurance for patients using verbal and non-verbal strategies (Item 30).	.56	
	I maintain current knowledge of, and incorporate relevant organizational policies into practice (Item 35).	.69	

Note. OR = operating room.

TABLE 3. Confirmatory Factor Analysis of Five-Factor Model of the Persian Perceived Perioperative Competence Scale-Revised

Fit indices	χ^2	df	χ^2/df	CFI	GFI	AGFI	NFI	RMSEA
Values	129.6	48	2.6	0.9	0.86	0.9	0.84	0.04

Note. CFI = comparative fit index; GFI = goodness-of-fit index; AGFI = adjusted goodness-of-fit index; NFI = normed fit index; RMSEA = root mean square error of approximation.

DISCUSSION

Our findings acknowledged the validity and reliability of the Persian PPCS-R for measuring the competence level of OR students. Content validity was verified by an expert panel and was comparable with the results obtained by Gillespie and colleagues (2012). Construct validity was evaluated using CFA. In this study, participants' response rate was 89.25%. Polit and Beck (2008) reported that a response rate of more than 50% is satisfactory.

Statistical analysis of the initial Persian version of the instrument showed poor fitness indices of the items. These findings affirmed discrepancies between the languages and cultural contexts of the original and the initial Persian versions of the instrument. Severinsson (2012) addressed the importance of instrument translation, which is related to the cross-cultural adaptation of the scale for use in a new population. However, methodological pitfalls of the process may compromise the validity and reliability of translated instruments (Severinsson, 2012). Using a modified model, such as EFA instead of CFA, researchers can find an appropriate structural model to bridge the gap between the cultural adaptation and rigor of different versions of an instrument (Mueller, 1996; Severinsson, 2012).

Using the KMO, the sample size was confirmed for conducting EFA. Andersson, Christensson, Fridlund, and Broström (2012) identified that a KMO score greater than .06 is satisfactory for factor analysis. Finally, a new model was developed using several exploratory analyses. Considering the acceptable factor loading score greater than .4 (Streiner & Norman, 2008), seven items were deleted because of their irrelevancy to the Persian instrument. Kolagari and colleagues (2014) suggested that factor loadings of $< .4$ are weak and factor loadings $\geq .6$ are very strong. The final version of the Persian PPCS-R contains five factors and 33 items that are congruent with the statistical evidence (63.11% of total variance) and theoretical framework. Pett, Lackey, and Sullivan (2003) asserted that a newly developed scale should explain 60% of the total variance.

Our study was similar to the one conducted by Gillespie, Polit, and colleagues (2012) in using EFA to evaluate and/or delete items. However, the order of the items in each factor was completely different between the two studies. These differences might be because of discrepancies in students' knowledge, experience, skill, culture and language, and differences in curricular emphasis between the two target populations.

After completion of the EFA, a second CFA was conducted to approve the new model. Andersson and colleagues (2012) believed that the most frequent method of development and validation of a new instrument is conducting the EFA followed by the CFA. Our findings revealed goodness-of-fit between data and the model. In other words, the second CFA supported the EFA results in terms of the subscales of the new instrument. In

the study conducted by Gillespie, Polit, and colleagues (2012), the construct validity was examined using the EFA and CFA. The EFA was conducted to provide model specification, and then the CFA was conducted for validation of the model. The Persian PPCS-R was approved as a five-factor model including Foundational Skills and Knowledge, Leadership, Collegiality, Proficiency, and Professional Development. In contrast, Gillespie, Polit, and colleagues' scale consisted of six subscales, containing Foundational Skills and Knowledge, Leadership, Collegiality, Proficiency, Empathy, and Professional Development. The items of the Empathy subscale in the original version were distributed across the other subscales of the Persian version.

The Persian PPCS-R as a newly developed scale has a higher internal consistency reliability than the original scale. This result might be caused by a more concise psychometric testing of the new scale (Rode, 2005). An alternative rationale of this result is that modifying the established model increased the rigor of the new scale (Munro, 2005). Streiner and Norman (2008) demonstrated that increasing homogeneity can lead to a higher internal consistency of scales. In a new and well-designed scale, the satisfactory level of internal consistency is Cronbach's alpha of .7 or greater (Kolagari et al., 2014). The results of stability reliability of the scale show proper correlations among items and appropriate ICC that are similar to the results of related studies (Gillespie & Hamlin, 2009; Gillespie, Polit, et al., 2012). Three subscales (Foundational Skills and Knowledge, Leadership, and Collegiality) had higher internal consistency scores. Lower alpha scores of the other two subscales (Proficiency and Professional Development) were because of their smaller number of items (Mishel, 1997; Sajjadi, Rassouli, Abbaszadeh, Alavi Majd, & Zendehdel, 2014). However, alpha scores of the Persian version are similar to the alpha scores reported by Gillespie, Polit, and colleagues (2012). The Foundational Skills and Knowledge, Leadership, and Collegiality subscales have high internal consistencies (Cronbach's alpha $\geq$.7) and can be used alone; however, the best option is to use the whole instrument for collecting data in studies. Our results also indicate that the Persian version of the scale has good test–retest reliability.

CONCLUSION

The findings of this study confirm good results of the psychometric testing of the Persian PPCS-R. The Persian version is a rigorous five-subscale instrument applicable to assess the perceived perioperative competence level of Iranian OR students. Applying the new scale in research and practice will help to illuminate the Iranian students' competencies and needs for providing holistic care in OR. More studies with larger and different samples are recommended to further assess the rigor of the Persian PPCS-R.

LIMITATIONS

This study must be viewed in light of two potential limitations. First, the self-report feature of the PPCS-R instrument could bias the answers toward social desirability and popular norms. However, it was assumed that the anonymity of the responses could decrease the likelihood of this bias. Second, it should also be noted that applying the modification indices to guide CFA analysis could increase the probability of the findings being influenced by chance.

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