

REVIEW ARTICLE

Integrative literature review of patient classification tools for nursing intensity evaluation: Focusing on comparison of South Korean and international tools

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Abstract

Aim: This study aimed to review the literature on patient classification tools (PCTs) for assessing nursing strength and to compare South Korean and international tools.

Design: Integrative literature review.

Methods: We searched the relevant literature published from 2000–2017 in PubMed and two electronic databases in Korea in March 2017. Twenty-five published studies were reviewed.

Results: In most Korean studies, patients were classified by PCT, which were tested to ensure validity and reliability, followed by measurement of nursing time and development of the conversion index. In international studies, PCTs used were simpler than those in Korean studies; the results of estimation for optimum nurse staffing were reported. Most studies insufficiently reflected indirect nursing needs and patients' non-clinical factors.

The current PCTs used in Korean studies inadequately reflect the reality of nursing field. Therefore, development of new PCTs reflecting nursing intensity based on direct and indirect nursing activities is necessary.

KEYWORDS

economics, nursing, nursing staff, personnel staffing and scheduling, review, workforce

1 | BACKGROUND

Many studies have already shown that ensuring proper nurse staffing positively influences the quality of nursing services and patient safety. Countries such as the US, Australia, and Japan have mandated the minimum required level of nursing staffing by law. In South Korea (hereafter Korea), a graded fee system for nursing care—in which different fees are applied depending on the number of patients per nurse—is being implemented. In an attempt to encourage hospitals to employ more nurses, the higher the grade, the higher

the fee that is charged for inpatients. For tertiary hospitals, if one nurse takes care of four or more patients, the criteria for the lowest grade—grade six—is satisfied. For the highest grade, grade one, one nurse takes care of less than two patients (Ministry of Health & Welfare, 2017). However, this does not address the number of patients being taken care of by nurses working together in a shift. If the criteria were to be converted to the number of patients per shift, one nurse takes care of approximately 15 patients in grade six, and seven to eight patients in grade one. Given that the criteria for assessing nursing services, such as Korea's grading system, address only the

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likely minimum level of nurse/patient ratio, it would be impractical to view any outcome as optimal.

Various patient-related, hospital-related, and regional factors influence the hiring of nurses in hospitals (Park et al., 2013). Among many factors, patient-related (such as inpatients' nursing needs) and nursing organization-related factors (such as the transfer systems employed by nursing units), and the proficiency level of nurses could be direct factors. To determine the optimal number of nurses for nursing units, accurate data on factors affecting the level of nursing care are needed. Therefore, it is difficult to accurately estimate the demand for nurses due to deficiency of accurate data (Rauhala & Fagerström, 2004). Despite these limitations, studies on the estimation of nursing workload based on identifying the nursing needs of hospitalized patients have been continuously conducted.

To investigate inpatients' needs for nursing service, it is imperative to first classify patients based on the amount of their needs for nursing service. The score of inpatients' needs for nursing service is calculated using PCTs, and patients are classified based on their PCT scores. The patient classification system that reported the most research results is the RAFAELA system, which was developed by researchers at Oulu University Hospital in Finland in 1994. It estimated the optimal level of nurse staffing based on the results of patient classification and nursing intensity. Since 1990s, research on PCT has been steadily progressing in Korea. The Korean patient classification system (KPCS) tool has been most commonly used by researchers and clinical nurses since its development in 2000 by the Hospital Nurses' Association to measure nursing workload. A revised edition based on a tool originally developed in the US for application in Korea, often used in both clinic settings and research, was published in 2009. During the development, the validity, construct validity, and reliability tests for KPCS were conducted (Song et al., 2009). This revised tool consists of 12 domains, 50 nursing activities, and 73 items for general wards (Song et al., 2010), and is both complex and detailed. On the other hand, the PCS used in other countries, such as the Oulu patient classification (OPC) in Finland, is simpler than KPCS. The OPC of Finland is a prototype tool composed of only six items (Fagerström, Rainio, Rauhala, & Nojonen, 2000a, 2000b), and another simple Belgian tool was composed of 27 nursing activities (Sermeus et al., 2008). Moreover, there is another weakness in the KPCS, which classifies patients based on patients' needs focused on direct nursing service.

An integrative literature review of research findings on PCTs published within and outside Korea to calculate nursing need, as well as on how these findings are used, will provide significant evidence of the need for a new PCT. In addition, nursing workload indicates the amount of nursing work that should be provided according to the nursing needs of the patients. On the other hand, nursing intensity refers to the amount of nursing work described as a concept reflecting the level of proficiency of the nurses (Clarke, 2006). For example, when two nursing units may have a similar nursing workload, the nursing intensity may differ if the level of proficiency of nurses across the units is different. Therefore, to calculate the optimal level

of nursing staff, it is more effective to use nursing intensity rather than nursing workload.

1.1 | Research objective

This study aimed to comparatively review the characteristics of selected Korean and internationally published studies that have developed or applied PCTs for the evaluation of nursing intensity, related factors that were reflected in patient classification, and the application or utilization of the results of patient classification. In addition, it aimed to review the reliability and validity of the PCTs or nursing time measurements used by the selected studies.

2 | THE STUDY

2.1 | Design

This study was an integrative literature review exploring studies published in Korea or internationally that developed and applied PCTs for the measurement of nursing intensity in nursing units. It reviews the characteristics of patient classification methods and the use of classification results.

2.2 | Method

2.2.1 | Literature search, inclusion, and exclusion criteria

The data for this study were obtained from studies published in Korea or international studies published in English that developed or applied PCTs to evaluate nursing intensity in general wards and intensive care units between 2000 and 2017. Two Korean electronic databases, the Research Information Service System and the National Assembly Library, and one international electronic database, PubMed, were searched. For Korean studies, "patient classification," "severity," and "nursing intensity" were used as keywords to search titles. Studies duplicated across the databases were removed, yielding a total of 235 eligible studies. For international studies, the following keywords were used to search for titles: ("patient*" and "classification," "acuity," "severity") and ("nursing" and "intensity," "demand," "need"), yielding a total of 302 eligible studies.

A literature search was conducted from July 3 to 14, 2017. The following criteria was used to select studies: (a) conducted on patients or nurses in general wards or intensive care units; (b) classified patients for investigation of nursing intensity; (c) original articles; (d) published in Korean or English; and (e) published in peer-reviewed journals. The abstract and title were reviewed for an initial selection of 90 studies (33 Korean studies and 57 international studies), and full text articles were reviewed for a final selection of 25 studies (12

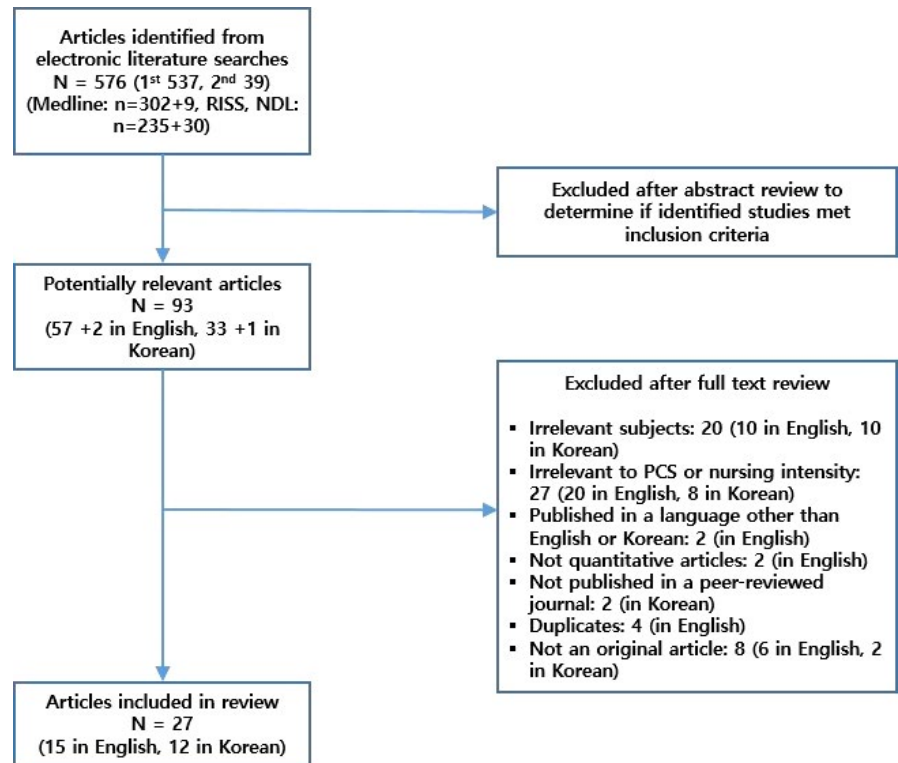


FIGURE 1 Literature selection process

Korean studies and 13 international studies). Two researchers independently selected the studies; when the researchers had different opinions, they reached consensus through discussion. The selection process of the 25 studies selected for this study is summarized in Figure 1.

2.2.2 | Data extraction

To extract data from the studies selected, the conceptual framework suggested by DeGroot (1989) for the evaluation of patient classification systems was used. DeGroot (1989) also suggested that the following six elements should be considered for the selection of appropriate patient classification systems: validity, reliability, simplicity/efficiency, utility, objectivity, and receptivity. Based on these six elements, data were gathered from the 25 selected studies as follows. First, in order to confirm the overall characteristics, objectivity, and utility of the selected studies, author, country, design, setting, objectivity, utility, and investigation contents were extracted. Second, in order to confirm the reliability, validity, and simplicity of the PCTs used, the number and name of domains in the tools, type of tool, rater, and the reliability and validity of the tools were extracted. For the eight studies that measured nursing time, the number and name of domains that measure direct and indirect nursing, rater, and the reliability and the validity of the tools used for measurement of nursing time were similarly extracted. As with the selection of studies, when the two researchers had different opinions, consensus was reached through discussion.

2.3 | Ethics

As this study involved a review of published literature, Research Ethics Committee approval was not required.

3 | RESULTS

3.1 | Summary of the selected studies

A total of 12 Korean studies and 13 international studies were selected. Of these, eight concerned intensive care units, whereas 17 dealt with general units. One study employed a pretest–posttest quasi-experimental design, and the remaining 24 employed a survey. Twelve studies were conducted in Korea, nine in Finland, two in Brazil, one in Sweden and one in Belgium. Eight studies measured nursing time and workload, six calculated the optimal number of nurses based on nursing intensity, and seven investigated other related variables. Fourteen studies aimed to develop and validate the tools, and 15 aimed to utilize the tools. Twenty-two studies investigated patient classification, eight investigated nursing time, and another eight investigated other related variables (Table 1).

3.2 | Literature on PCTs

Among the Korean studies, three on general nursing wards used the same tool, the KPCS, comprising 12 domains. Moreover, two studies on ICUs used the same tool comprising eight domains (Table 2).

TABLE 1 Data extraction for the patient classification systems identified in the literature

Author (year)	Country	Design	Setting	Study objectives			Investigation contents		
				PCS tool development	PCS tool utilization	PCS	PCS tool development	PCS tool utilization	Nursing time
Lee et al. (2000)	South Korea	Prospective, descriptive	ICU	1 university hospital internal medicine ICU	•	V	•	•	
Cho et al. (2005)	South Korea	Descriptive	ICU	5 university hospitals, seven ICU	•	M.	•	•	
Kim and Park (2007)	South Korea	Descriptive	Ward	2 internal units, a comprehensive specialized hospital, and 2 surgical nursing units.	•		•	•	
Song et al. (2009)	South Korea	Descriptive	Ward	6 hospitals	•		•	•	
Park et al. (2003)	South Korea	Descriptive	Ward	8 hospitals, general nursing unit		M, E1		•	
Cho et al. (2000)	South Korea	Descriptive	ICU	3 ICUs in one hospital	•	M		•	
Kim et al. (2013)	South Korea	Descriptive	Ward	1 advanced general hospital, 7 wards	•	V		•	
Lee and Song, (2005)	South Korea	Descriptive	Ward	1 university hospital, internal medicine and surgical ward		M		•	
Sung et al. (2007)	South Korea	Descriptive	ICU	2 advanced general hospitals, internal medicine, surgical ICU		M, E1		•	
Kim and Jang (2002)	South Korea	Descriptive	ICU	1 university hospital ICU	•	M		•	
Song et al. (2010)	South Korea	Descriptive	Ward	3 advanced general hospitals, internal medicine, surgical ward	•	M		•	
Kang et al. (2001)	South Korea	Descriptive	Ward	1 university hospital	•			•	
Aschan et al. (2009)	Finland	Descriptive	Ward	Hospital district of Helsinki and Uusimaa,		E2		•	
Sasso and Barra (2015)	Brazil	before-and-after quasi-experimental design	ICU	3 ICUs for adults at three major hospitals		V		•	
Fagerström et al. (2000a)	Finland	Descriptive	Ward	8 wards at one hospital		E2		•	
Fagerström et al. (2000b)	Finland	Descriptive	Ward	1 hospital	•			•	
Fagerström and Rauhala (2007)	Finland	Descriptive	Ward	86 wards from 14 different hospitals		E2		•	
Levenstam and Bergbom (2002)	Sweden	Descriptive	Ward	1 University hospital		E2		•	
Liljamo et al. (2016)	Finland	Delphi method	Ward	A panel of experts	•	V		•	
Lundgrén Laine and Suominen (2007)	Finland	Descriptive, retrospective	ICU	1 ICU	•	M		•	
Padilha et al. (2008)	Brazil.	Descriptive	ICU	4 different ICUs in 1 private hospital		V		•	
Rainio and Ohinmaa (2005)	Finland	Descriptive, retrospective	Ward	12 general wards of 1 hospital	•	E2, V		•	

(Continues)

TABLE 1 (Continued)

Author (year)	Country	Design	Setting	Study objectives			Investigation contents		
				PCS tool development	PCS tool utilization	PCS	PCS	Nursing time	Others
Rauhala and Fagerström (2004)	Finland	Descriptive, retrospective	Ward	●	V	●			
Rauhala and Fagerström (2007)	Finland	Descriptive, retrospective	Ward		V	●			●
Sermeus et al. (2008)	Belgium	Descriptive	Ward		E2	●			●

Note: Abbreviations: E1, Estimation of the nursing fee and cost; E2, Estimation of optimum nursing staffing model; ICU, intensive care units; M, Measurement of the nursing workload and nursing time; PCS, Patient classification system; V, Verification of the relevant variable.

Of the international studies, nine Finnish studies used the RAFAELA system, which consists of three steps; patient classification using OPC composed of 6 domains, nursing intensity point per nurse, and optimal level of nurses' workload established using the Professional Assessment of Optimal Nursing Care Intensity Level. Dal Sasso and Barra (2015), from Brazil, evaluated six cognitive domains using the National Aeronautics and Space Administration Task-Load index. Padilha et al. (2008), also from Brazil, confirmed nursing activity scores in intensive care units to investigate nursing workload and determine the association between nursing activity scores (NAS) and patient variables. Levenstam and Bergbom (2002) from Sweden used the Zebra system, which consists of four steps: patient classification, investigation of nursing activities, calculation of the optimum number of nurses and quality of nursing care. Sermeus et al. (2008) from Belgium confirmed the intensity of nursing activities based on the Belgian Nursing Minimum Data Set on nine areas and 23 items. The PCTs composed of 5–12 domains were rated by nurses, unit managers and attending nurses. Among the studies on PCTs, 14 did not report results of reliability test and 10 did not conduct the validity tests for the tools.

3.3 | Literature on nursing time measurement

Of the 25 selected studies, eight measured nursing time for each patient category. Results of these studies were summarized in terms of the participants, survey period, tool's name, details of direct and indirect nursing, rater, validity and reliability (Table 3).

Most studies from Korea directly measured nursing time. Of the 12 Korean studies, four were conducted in intensive care units, whereas four were in nursing ward units. Two studies calculated conversion indices that correspond to a score of one in applicable PCTs, and most studies investigated the mean daily nursing time per patient in each patient category or for patient classification scores. Most studies employed direct observation to measure nursing time, whereas Kang et al. (2001) classified nursing activities for patient classification based on the data saved from an electronic medical recording system.

The surveys of the nursing time were conducted by the staff nurses in nursing wards or intensive care units, nursing students, unit managers and researchers. Most of the surveyors who conducted observation of direct nursing time were nurses. In the two studies, the fourth-year nursing students and the nursing administrators surveyed the nursing time (Kang et al., 2001; Lee et al., 2000).

Nursing time was surveyed by dividing it into 8–13 domains of direct nursing and 4–8 domains of indirect nursing. Song et al. (2009) used 12 domains: vital signs, monitoring, respiration, hygiene, diet, excretion, exercise, examination, medication, treatment, special treatment, education and emotional support. Kim and Jang (2002) surveyed 13 domains including safety nursing, communication and education, emergency nursing and palliative nursing. For indirect nursing, Cho et al. (2000) surveyed 22 items in the following eight domains: preparing and organizing treatment, reviewing prescriptions,

TABLE 2 Characteristics of patient classification system used in selected literature

Measure		Number of areas or items	The content of the area	Raters	Type (factor/proto)	Validity results	Reliability results
Author (Year)	The name of PCS Tool						
Lee et al. (2000)	APACHE III, Critical Care Classification Tool	8 areas	APACHE III Tool: physiological, age, chronic health state patient severity classification tool (8 domains, 6 groups)	3 ICU nurse	Factor	Not reported	Not reported
Cho et al. (2005)	Developed Patient Classification Tool	8 areas, 82 items	Measurement and monitoring, daily activities such as sanitary nursing and position change, excretion, injection and medication, treatment and procedure nursing, respiratory care, nutrition, education and emotional support	ICU nurse	Factor	Construct validity	Not reported
Kim and Park (2007)	Developed Patient Classification Tool	12 areas	Hygiene management, nutrition, excretion, exercise and activity, education and counselling, emotional support, communication and awareness, treatment and examination, medication, measurement and observation, inter-departmental coordination for patients	A general ward nurse	Proto	Construct validity concurrent validity	Interrater reliability: Spearman's rho = A group = 0.89%/0.859 Spearman's rho = B group = 0.859
Song et al. (2009)	KPCS	12 areas, 50 nursing activity, 75 items	Vital sign measurement, monitoring, respiratory therapy, hygiene, diet, excretion, exercise, examination, medication, treatment, special treatment, education / emotional support	A general ward nurse and unit manager	Factor	Construct validity	Interrater reliability: 0.91 Hygiene, exercise, education and emotional support were 0.38, 0.61 and 0.57, respectively.
Kim et al. (2013)	KPCS-1 Hospital information system	12 areas, 50 nursing activity, 74 items	Vital sign measurement, monitoring, respiratory therapy, hygiene, diet, excretion, exercise, examination, medication, treatment, special treatment, education / emotional support	Attending nurse	Factor	Content validity	Not reported
Lee and Song (2005)	Tools used by Song Young-sun (1984)	5 areas	Hygiene, posture, dietary, intravenous, observation	Attending nurse	Proto	Content validity	Not reported
Sung et al. (2007)	Critical Care Classification Tool (Hospital Nursing Association, 1992)	Not reported	Not reported	Unit manager	Not reported	Content validity	Interrater reliability 90.6%
Song et al. (2010)	KPCS-1	12 areas, 50 nursing activity, 73 items	Vital sign measurement, monitoring, respiratory therapy, hygiene, diet, excretion, exercise, examination, medication, treatment, special treatment, education / emotional support	Attending nurse and unit manager	Factor	Content validity	Not reported
Kang et al. (2001)	Tools developed by the author	NA 28 nursing activities	Not reported	Not reported	Factor	Not reported	Not reported

(Continues)

TABLE 2 (Continued)

Measure		Number of areas or items	The content of the area	Raters	Type (factor/proto)	Validity results	Reliability results
Author (Year)	The name of PCS Tool						
Aschan et al. (2009)	RAFAELA System	6 areas	OPC: 1) planning and co-ordination of nursing care, 2) breathing, blood circulation and symptoms of disease, 3) nutrition and medication, 4) personal hygiene and secretion, 5) activity, sleep and rest, 6) teaching, guidance in care and follow-up care, emotional support.	Nurse	Proto	Not reported	Not reported
Sasso and Barra (2015)	NASA-TLX	6 areas (six cognitive categories)	NASA-TLX Mental, physical, temporal, effort, performance, frustration demand.	Not reported	Proto	Not reported	Not reported
Fagerström et al. (2000a)	OPC, PAONCIL	6 areas	OPC	148 nurses	Proto	Concurrent validity	Not reported
Fagerström et al. (2000b)	OPC, PAONCIL	6 areas	OPC	20 nurses/ward	Proto	Construct validity, Concurrent validity	Not reported
Fagerström and Rauhala (2007)	RAFAELA System	6 areas	OPC the daily nursing resources that have directly or indirectly been allocated to patients' nursing care. By using these two sets of data, a measure of nurses' workload as NCIP/N, 3) The optimal level of NCI workloads is then established simultaneously using the PAONCIL.	Nurse manager and IT-contact persons	Proto	Presenting relevant previous research results	Not reported
Levenstam and Bergbom (2002)	The Zebra system,	6 areas	Patient classification: hygiene, nutrition, observation, mobilization, uncontrolled output, extra need of nursing care. The Zebra system: 1) patient classification, 2) activity study, 3) staffing situation, 4) quality of nursing care	Head nurse	Proto	NA	NA
Liljamo et al. (2016)	FICNI, version 3.0, OPC	17 areas, 6 areas	FICNI, version 3.0: secretion, coping, fluid volume, health behaviour, co-ordination of care, medication, nutrition, respiration, circulation, metabolism, safety, daily activities, mental balance, sensory and neurological functions, skin integrity, life cycle, OPC	Experts	Proto	NA	NA
Padilha et al. (2008)	NAS	7 areas, 23 items	Basic activities, ventilatory support, cardiovascular support, renal support, neurological support, metabolic support, specific intervention	Not reported	Factor	Presenting relevant previous research results	Not reported

(Continues)

TABLE 2 (Continued)

Measure		Number of areas or items	The content of the area	Raters	Type (factor/proto)	Validity results	Reliability results
Author (Year)	The name of PCS Tool						
Rainio and Ohinmaa (2005)	RAFAELA System	6 areas, 3 steps	Step1: OPC, Step2: Nursing resource, Step3: PAONCIL, RAFAELA PCS = (OPC/Nursing resource) and PAONCIL	Not reported (Use medical records)	Proto	OPC, PAONCIL: Presenting relevant previous research results RAFAELA: Not reported	OPC, PAONCIL: Presenting relevant previous research results RAFAELA: Not reported
Rauhala and Fagerström (2004)	RAFAELA System	6 areas, 3 steps	OPC	Not reported (Use medical records)	Proto	OPC, PAONCIL: Presenting relevant previous research results, RAFAELA: Not reported	OPC: Not reported, PAONCIL: Not reported, RAFAELA: Not reported
Rauhala and Fagerström (2007)	RAFAELA System	6 areas, 3 steps	OPC	Not reported (Use medical records)	Proto	OPC: Not reported, PAONCIL: Not reported, RAFAELA: Presenting relevant previous research results	OPC: Not reported, PAONCIL: Not reported, RAFAELA: Presenting relevant previous research results
Sermeus et al. (2008)	San Joaquin Category using B-NMDS	9 critical indicators, 23 items	Nine indicators: activities of daily living, intravenous requirements, observations, 23 items: Belgian Nursing Minimum Data	Not reported	Factor	Presenting relevant previous research results	Not reported

Note: Abbreviations: APACHE, Acute physiology and chronic health evaluation; B-NMDS, Belgian Nursing Minimum Data Set; FICNI, Finnish Classification of Nursing Interventions; KPCS, Korean patient classification system; NAS, Nursing Activities Scores; NASA-TLX, National Aeronautics and Space Administration Task-Load index; NCI, Nursing Care Intensity; NCIP/N, Nursing Care Intensity points per nurse; OPC, Oulu patient classification; PAONCIL, Professional assessment of optimal nursing care intensity level; PCS, Patient classification system.

TABLE 3 Nursing time measurement method used in the selected literature

Author (year)	Subjects	Survey period	Measure			Raters	Validity results	Reliability results
			Tool name	Contents of direct nursing area	Contents of indirect nursing area			
Cho et al. (2005)	7 ICUs in 5 hospitals and 266.5 persons in ICU	2 days	Critical Patient Classification Tool developed by authors	79 items in 8 domains	23 items in 4 domains	ICU nurse	Correlation between patient classification score and direct nursing time per patient, Spearman's correlation coefficient ($r = .41$), Manual V/S ($r = .14$), Monitoring ($r = .30$), ADL ($r = .35$) IV therapy ($r = .42$), Treatment & Procedure ($r = .30$), Respiratory care ($r = .51$)	0.94
Park et al. (2003)	8 hospitals and 8 people, one ward and one intensive care unit. Not exactly described	2 days	Nursing activity survey instruments (Park et al, 1999), Patient classification tool (2000), Nursing cost research tool (Park, 1988)	Not reported	Not reported	Nurse	Distribution by patient group, Daily Average Nursing Time per Patient by Patient Taxonomic Group: Increased nursing time with higher severity of patient	Not reported
Cho et al. (2000)	3-5 years of experience 6 people,	11 days	Direct nursing activity questionnaires, indirect nursing activity questionnaires	166 items in 14 domains	22 items in 8 domains:	6 nurses with 3-5 years of experience	Not reported	Not reported
Lee and Song (2005)	Measuring daily working hours by observation unit	7 days	Tools developed by researchers	50 items in 11 domains	18 items in 5 domains	4th grade nursing college	1 professor in nursing professor in China, 1 nursing director, 2 head nurses, 2 charge nurses. -No value suggested	Not reported
Sung et al. (2007)	2nd grade hospital, Internal medicine, Surgery ICU, No number of patients = 118	4 days	Critical Patient Classification Tool by Jung (2000)	10 domains	Not reported	Nurse and nurse manager	Content validity. Three times to the expert group (5 researchers and 2 ICU executives. -No value suggested	90.6%
Kim and Jang (2002)	Measured the time required for 149 direct nursing activities	7 days	Tools developed by researchers	13 domains	Not reported	Researchers and two nurses	Content validity. 5 nurses with 4 years' experience and 1 professor of nursing professor. -No value suggested	Not reported
Song et al. (2010)	Nursing time (204 patients in 6 wards and 3 hospitals). Indirect nursing time: 6 nurses, 22 nurses, 9 nurse assistant	2 days	A tool that modified the nursing time measurement tool used by Yu (2009)	12 domains	4 domains	Nurse and unit manager	Not reported	Not reported
Kang et al. (2001)	1 patient at the daytime, 1 patient at the evening time and 1 patient at the nighttime	5 days	A tool developed by the researcher	Not reported	Not reported	nurse and nursing student	Not reported	Not reported

Note: Abbreviations: ADL, Activity of daily living; ICU, Intensive care unit; IV, Intravenous; V/S, Vital sign.

planning and rounding, contacting business, reporting and conferencing, writing reports and documents, environmental management and moving space. To measure validity, Cho et al. (2005) and Park et al. (2003) confirmed the correlation between patient classification scores and direct nursing time per patient. Three studies (Lee & Song, 2005; Park et al., 2003; Sung et al., 2007) tested content validity through expert groups, whereas other studies did not conduct validity test (Cho et al., 2005; Kang et al., 2001; Song et al., 2010).

4 | DISCUSSION

This study comparatively reviewed research trends of Korean and international studies on PCTs. A total of 25 studies were selected according to selection criteria. Most selected studies were quantitative, with one qualitative and one quasi-experimental study. This indicated a lack of variety in study designs for research on PCTs, with a deficit of experimental or qualitative studies. Korean studies could be classified into two groups: first, those aimed at the development of tools, and containing content validity with experts and subsequently construct validity in clinic settings; second, those that calculated conversion coefficients for nursing costs (Park et al., 2003; Sung et al., 2007) and nursing time (Cho et al., 2000, 2005; Kang et al., 2001; Kim & Jang, 2002; Park et al., 2003; Song et al., 2010; Sung et al., 2007) based on PCTs. Korean studies have focused on the calculation of conversion coefficients of nursing time and cost after the development of PCTs.

Abdella and Levine (1979) classified approaches for patient classification into prototype and factor type. Most studies from Korea used factor type, whereas international studies including the RAFAELA and Zebra systems used prototype. Although the approach using factor type can be more objective, it is limited as it cannot represent all of patients' needs for nursing; therefore, it could be rather less accurate. The RAFAELA system from Finland considered such shortcomings and concluded that it is more efficient and accurate to conduct a survey using prototype by expert nurses.

This study re-classified the purpose of the 25 studies from four perspectives: studies on (a) nursing workload and nursing time, (b) nursing cost and nursing charge, (c) calculation of staffing models and (d) other variables affecting PCTs. Of these, eight studies validated PCTs whereas only two studies calculated nursing charge or cost (Park et al., 2003; Sung et al., 2007). Eight of the 25 selected studies measured nursing workload and time, of which, seven were conducted in Korea and one, abroad. Unlikely research conducted in Korea, fewer studies among international journals measured nursing time. Traditionally, PCTs aim to allocate appropriate nursing personnel (Fagerström et al., 2000a, 2000b). Most Korean studies employed work sampling and time-and-motion study design. Traditional time studies have faced criticism owing to limited methodology, as they cannot comprehensively show the quality and characteristics of nursing activities. As nursing activities are complex and involve various simultaneous activities, multiple activities should be considered at the same time in a manner that cannot be achieved through

a simple calculation of time. Therefore, a traditional time study design cannot adequately reflect the realities of nursing. Moreover, it involves a great deal of time itself in addition to cost (Fagerström et al., 2000a, 2000b). A total of eight studies calculated nursing time based on PCTs, with seven Korean studies and one international study. This seems to be because international researchers have concluded that modelling staffing through simple calculation of time is limited.

In terms of the number of domains that comprise PCTs, most Korean studies used 10 domains or more, whereas international studies were simpler, using around six domains. Regarding validation of PCTs, only a few studies (Cho et al., 2005; Kim & Park, 2007; Song et al., 2009) reported validity test (Fagerström et al., 2000a, 2000b; Fagerström & Rauhala, 2007; Padilha et al., 2008) and reliability test (Sung et al., 2007). Among international studies, the validity and reliability tests were reported only in the Finnish studies. The Finnish studies cited the value of reliability and validity tests drawn from one specific study. The RAFAELA system consists of three steps. First, patient classification is surveyed using one of the simplest instruments—the OPC—which consists of the following six elements scored on a four-point scale and classified into four groups: (a) planning and coordinating nursing care; (b) respiration, circulation, and symptoms of illness; (c) nutrition and medication; (d) hygiene and secretion; (e) activity, sleeping, and rest; and (f) teaching and supervision of treatment and follow-up, and emotional support. Second, nursing intensity point per nurse is calculated using a daily nursing resource. Finally, the optimal level of nurses' workload is established using the Professional Assessment of Optimal Nursing Care Intensity Level (PAONCIL), measured on a seven-point scale (−3 indicates lowest priority task and + 3 highest priority task) (Fagerström et al., 2000a, 2000b). On the other hand, most Korean studies showed validity test, although some studies did not report reliability test. Compared to studies from Korea, international studies tended to have omitted the investigation of content validity.

For Korean studies, researchers developed and used KPCS as a PCT. They tended to insufficiently consider indirect nursing activities that also influence nursing intensity. Therefore, the PCTs being used do not adequately reflect the reality and underestimate the adequate level of nursing staffing. Even the studies that surveyed indirect nursing activities only measured nursing time to calculate nursing workload and failed to consider patients' disease or nursing skill mix. The skill mix determines the distribution of new and experienced nurses per shift, which affects their ability to cope with emergent situations such as cardiopulmonary resuscitation. Consequently, nursing intensity is underestimated because various factors affecting it were not reflected. In contrast, six of 13 international studies focusing on the calculation of nursing staffing (Aschan et al., 2009; Fagerström et al., 2000a, 2000b; Fagerström & Rauhala, 2007; Rainio & Ohinmaa, 2005; Sermeus et al., 2008) considered various variables affecting nursing intensity. Specifically, the RAFAELA system from Finland (Rauhala & Fagerström, 2007), the Zebra system from Sweden (Liljamo et al., 2016) and the NAS from Brazil (Padilha et al., 2008) are the cases. According to the result

from Rauhala and Fagerström (2007), the PCS was found to explain approximately 45% of variance in the nursing workload, whereas the nursing workload from non-patient factors explained 11% of the variance. The non-patient factors included administration, human resources, mental stress, cooperation within nursing units and cooperation between nursing units.

Levenstam and Engberg (1993) from Sweden proposed the Zebra system. This patient classification system includes two additional parts to record staffing situations and deficiencies in the quality of nursing from understaffing. For patient classification, direct nursing activities for each patient are measured for 24 hr. Patient classification includes six domains of direct nursing activities, and each domain has one to three determinators that reflect the level of nursing activities according to dependency level. Each combination of determinators reflects one of the four categories of direct nursing activities. Category one refers to minimal need of nursing activities, category two to average need, category three to above-average need and category four to intensive need. At the end of each month, the mean number of patients in each category of care, per day, is calculated for each nursing unit. In addition to the actual and required average daily staffing situation for each shift, the staffing situation per nursing unit is also calculated—as well as occupancy rate and turnover rate per bed—per month. These data are constructed into graphs for each nursing unit in each department, and these graphs are delivered to attending nurses or clinical managers monthly. Levenstam and Bergbom (2002) proposed that the Zebra system is sensitive to changes in patients' need for direct nursing activities. Further, they proposed that reliable patient classification systems are significant in explaining and recording changes in nursing needs.

Korean studies developed patient classification systems and confirmed their validity and reliability, calculated nursing time for patient categories or developed conversion coefficients. However, almost none of them attempted to develop appropriate staffing models or found variables that can be considered within nursing models, as was often done in international studies. By contrast, international studies attempted to calculate the adequate level of nursing staffing for each nursing unit by confirming nursing intensity. As indicated by these findings, in the future, Korean studies should aim to develop a model for calculation of optimum number of nurses based on PCT results, along with the development of PCT using a new approach. This review was limited to international studies published in English and Korean only. It is suggested that a wider, systematic review of literature should be carried out in the future.

5 | CONCLUSION

Based on the findings of this study, when comparing international studies with those conducted in Korea, the latter showed the following characteristics. Many studies did not sufficiently consider indirect nursing activities influencing nursing intensity as well as non-patient factors and approached nursing activities using only

simple time studies. There was a considerable lack of research suggesting a model for calculation of the optimum number of nurses based on the nursing intensity including workload and nursing time. Therefore, it is necessary to develop a PCTs using new approach that can reflect the patients' non-clinical factors, rather than time study. Additionally, it should develop a model for calculating optimum number of nurses based on precisely measured nursing strength, which reflects both indirect and direct nursing care.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

YK conceived the study, participated in its design and coordination, and helped to draft the manuscript. BP participated in the design of the study and performed the statistical analysis. All authors read and approved the final manuscript.

DATA AVAILABILITY STATEMENT

All result of data generated or analysed during this study are included in this published article. The data set analysed during the current study are available from the corresponding author on reasonable request.

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