Korean Society of
Adult Nursing

KJAN Korean Journal of Adult Nursing

Vol. 37 · No. 3 · August 2025

Korean Society of Adult Nursing

eISSN 2288-338X

Vol. 37, No. 3 August 2025

KJAN

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http://kjan.or.kr

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The Korean Journal of Adult Nursing (KJAN) is the official peer-reviewed research journal of the Korean Society of Adult Nursing. KJAN is devoted to the dissemination of groundbreaking research on the theories, practices, and education of adult nursing. Research on other subject areas or issues that contribute to adult nursing are published at the discretion of the Editorial Board. The goal of KJAN is to contribute health maintenance, health promotion, disease prevention, and recovery from diseases in adults by publishing research. KJAN is published four times per year at the end of February, May, August, and November. It was launched in 1989. The official title of the Journal is Korean Journal of Adult Nursing and the abbreviated title is Korean J Adult Nurs. This Journal is indexed in SCOPUS, CINAHL, KoreaMed, Google scholar and KCI.

Enacted in March 1989
Publishing 31 August, 2025

- **Publisher** Korean Society of Adult Nursing

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Full text is freely available URL: https://kjan.or.kr

* The articles in this journal are indexed/tracked/covered by SCOPUS, CINAHL, KoreaMed, KCI, Google scholar.

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Korean J Adult Nurs Vol. 37 No. 3, 189-214, August 2025
eISSN: 2288-338X
https://doi.org/10.7475/kjan.2025.0327

KJAN
Korean Journal of
Adult Nursing

Machine Learning Applications in Nursing-Affiliated Research: A Systematic Review

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Received: March 27, 2025
Revised: May 22, 2025
Accepted: July 30, 2025

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Purpose: This study analyzed the methodological characteristics of machine learning (ML) applications in nursing research, evaluated their reporting quality against standardized guidelines, and assessed progress toward clinical implementation. **Methods:** A PRISMA-compliant systematic review (PROSPERO CRD42024595877) searched nine English- and Korean-language databases through September 27, 2024. Included studies applied ML to a nursing question and had at least one nursing-affiliated author. Two reviewers independently extracted data following the Cross-Industry Standard Process for Data Mining (CRISP-DM) framework. Reporting quality was appraised using the TRIPOD+AI checklist. **Results:** Of 125 included studies, supervised learning predominated (93.6%), with random forest, logistic regression, and support vector machines as common algorithms. The most frequent performance metrics were the area under the receiver operating curve and accuracy. Mean TRIPOD+AI compliance was 50.4% (standard deviation = 9.37), with reporting quality lowest for data preparation (48.0%) and class imbalance handling (22.4%). Research focused on predicting pressure injuries, falls, and readmissions. Only seven studies described clinical deployment, often citing ethical or workflow barriers. **Conclusion:** While ML studies in nursing are increasing and show strong discriminatory accuracy, their impact is limited by inconsistent reporting, limited external validation, and rare clinical deployment. Translating these algorithms into practice requires adopting comprehensive reporting guidelines like TRIPOD+AI, documenting each CRISP-DM phase, and integrating nurse-centered decision-support pathways.

Key Words: Nursing; Machine learning; Systematic review

INTRODUCTION

1. Background

Artificial intelligence (AI) encompasses technologies that enable computers and machines to mimic human capabilities such as learning, understanding, problem-solving, decision-making, creativity, and autonomy [1]. AI is recognized as a defining technology of the Fourth Industrial Revolution [2], with the field continually achieving remarkable milestones—from Google DeepMind's AlphaGo in 2016 to OpenAI's ChatGPT in 2022 [3].

Machine learning (ML), a branch of AI, focuses on training algorithms to develop predictive or classification models based on data, allowing for learning and inference without explicit programming [1]. Enhanced computing power and the availability of large-scale datasets have fueled the rapid advancement and widespread adoption of ML across diverse sectors, including healthcare, finance, manufacturing, and transportation [4]. Due to its exceptional predictive capabilities, interdisciplinary research involving ML has expanded significantly, establishing it as a key technology for tackling contemporary challenges [4,5].

ML applications in nursing research are also becoming more prevalent [6]. For example, prior studies have predicted nursing students' graduation likelihood using academic performance in their first year, achieving over 80% accuracy, which increased to as high as 99% with three-year longitudinal data, thus enabling automated, personalized assessments for students at risk of attrition [7]. ML has also been used to predict the 30-day readmission probability for heart failure patients based on multiple clinical variables [8], and to forecast nurse turnover rates using personnel data [9]. In addition, automated extraction and analysis of nursing documentation have enhanced administrative decision-making, improving both speed and accuracy [10]. Successful ML implementation allows nurses to dedicate more time to direct patient care, thereby raising the overall quality of nursing services [11].

Nevertheless, several limitations remain regarding the application of ML in nursing research. When predicting rare events—such as specific disease occurrences or serious medical conditions—datasets are often imbalanced, containing significantly fewer event cases than non-events. Such an imbalance can undermine a model's ability to accurately detect rare cases, compromising both predictive performance and generalizability [12]. Moreover, heterogeneity in data collection methods—including varying formats, measurement techniques, and terminologies—leads to non-standardized datasets [12]. This heterogeneity complicates data preprocessing, diminishes model consistency and reliability [9], and is further aggravated by the challenges of data collection and limited participant recruitment commonly encountered in nursing studies, often resulting in small sample sizes [9]. Collectively, these factors adversely affect the performance and clinical relevance of ML models.

These constraints may ultimately impair ML models' performance and clinical validity. To harness the potential of ML in nursing, systematic analyses of current research are essential. Although the use of ML in nursing studies is expanding, comparison across studies remains difficult due to non-standardized evaluation criteria, inconsistent data handling methods, and variable reporting practices. Furthermore, assessments of practical applicability—including clinical utility, cost-effectiveness, and patient safety—are needed. Accordingly, this systematic review provides a comprehensive evaluation of the current landscape of ML in nursing research. Specifically, this study aims to (1) systematically identify and describe methodological characteristics using the Cross-Industry Standard Process for Data Mining (CRISP-DM) framework; (2) critically assess methodological rigor and reporting transparency according to the Transparent Reporting of a multivariable prediction model for Individual Prognosis or Diagnosis for Artificial Intelligence (TRIPOD+AI) checklist; and (3) evaluate practical deployment and clinical readiness. Through this multi-dimensional analysis, we aim to identify key gaps and offer evidence-based recommendations to guide future research toward improved reproducibility, standardization, and, ultimately, clinical impact.

2. Conceptual Framework

In this systematic review, the CRISP-DM methodology [13] was adopted as the conceptual framework for systematically evaluating studies employing ML techniques.

Earlier standardized data analysis methodologies, such as Knowledge Discovery in Databases (KDD) and Sample, Explore, Modify, Model, Assess (SEMMA), also include data preprocessing stages. However, these frameworks tend to focus primarily on analytical techniques rather than comprehensively guiding the entire analysis process [14]. In contrast, CRISP-DM offers a structured workflow with explicit guidance for each phase, ensuring alignment with broader business objectives. A key feature of CRISP-DM is its iterative feedback loop, which allows movement between phases as needed. For instance, if problems are identified during data preparation, the process can return to the business understanding phase to revise objectives accordingly. This flexibility sets CRISP-DM apart from more linear models like KDD and SEMMA, making it especially suitable for practice-oriented data analysis and clinical applications in nursing research.

CRISP-DM is a standardized process model for data mining projects, encompassing six phases: (1) business understanding, (2) data understanding, (3) data preparation, (4) modeling, (5) evaluation, and (6) deployment. In this review, study procedures were structured based on the CRISP-DM methodology, as outlined in Table 1. This conceptual framework enabled a systematic evaluation of nursing literature involving ML techniques.

METHODS

The protocol for this study was registered with PROSPERO (registration number: CRD42024595877) on February 10, 2024.

1. Study Design

This study is a systematic review aimed at identifying and critically appraising the methodological characteristics of ML applications in nursing research. The review was conducted according to the guidelines of the Cochrane Handbook for Systematic Reviews of Interventions 6.4 [15] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [16].

2. Key Questions and Eligibility Criteria

To achieve the study's overall objective of evaluating the methodological landscape and clinical readiness of nursing ML research, the following key questions were addressed. These were structured to align with the CRISP-DM framework and our central themes of reporting standards and practical application:

In the business understanding phase (phase 1), we examine the research objectives and questions of nursing studies applying ML techniques, and the reasons for applying ML in these studies. In the data understanding phase (phase 2), we investigate the data sources and data quality of nursing studies applying ML techniques. The data preparation phase (phase 3) examines the data preprocessing methods used in nursing studies applying ML techniques and the transparency with which they are reported to ensure reproducibility. In the modeling phase (phase 4), we assess how model training, validation, and testing are performed in nursing studies applying ML techniques. The evaluation phase (phase 5) considers the performance evaluation metrics used in nursing studies applying ML techniques and examines the extent to which they reflect clinical utility beyond algorithmic accuracy. The deployment phase (phase 6) addresses whether ethical considerations have been addressed and the degree to which these models have been practically deployed in clinical settings, bridging the gap from research to practice.

Inclusion criteria were as follows: (1) studies involving nursing research, operationalized as having at least one author affiliated with a nursing-related institution (e.g., nursing school or research center), chosen as an objective and reproducible proxy for identifying research likely to be informed by a nursing perspective; and (2) direct application of ML methodologies (e.g., predictive or classification models, including single-layer Artificial Neural Networks [ANNs]). During data extraction, studies were screened to ensure that only those employing ML techniques were included. Deep learning (DL) studies were identified and excluded based on the use of multi-layer neural networks. Studies were excluded if they: (1) lacked authors with a nursing background or affiliation; (2) did not directly apply ML as a methodology (e.g., studies evaluating ML-based wearable devices without directly applying ML); (3) were

Table 1. CRISP-DM Process Model Descriptions

No.	Phases	Short descriptions
1	Business understanding	- Determine business objectives, assess situation, define data mining goals, develop project plan. Understanding business goals and translating them into data mining objectives.
2	Data understanding	- Initial data collection, data description, data exploration, data quality assessment. Collecting data, familiarizing oneself with data, identifying quality issues, and gaining initial insights.
3	Data preparation	- Data selection, data cleaning, data construction, data integration, data formatting. All activities required to construct the final dataset from initial raw data.
4	Modeling	- Select modeling techniques, design tests, build models, evaluate models. Selecting, applying, and optimizing modeling techniques.
5	Evaluation	- Evaluate results, review processes, determine next steps. Evaluating the model from the perspective of achieving business objectives and reviewing the entire process.
6	Deployment	- Plan deployment, monitor and maintain the model, produce final reports, review project. Integrating the model into actual business processes and ensuring organizational usage of the outcomes.

CRISP-DM = Cross-Industry Standard Process for Data Mining.

not human-subject studies (e.g., animal or plant experiments, or robot development); (4) were review articles; (5) lacked full research results (e.g., abstracts or poster presentations only); or (6) used DL methodologies (e.g., multi-layer neural networks). The exclusion of studies using DL was intentional to ensure methodological coherence. Traditional ML (e.g., random forest, support vector machine [SVM], logistic regression) and DL (e.g., models with multi-layer neural networks such as Convolutional Neutral Networks [CNNs] or Recurrent Neural Networks [RNNs]) often differ significantly regarding data types, feature engineering, and model complexity. Combining these distinct paradigms would have introduced substantial heterogeneity, potentially obscuring trends specific to each. Thus, this review focuses on traditional ML techniques, which represent the foundational and most prevalent approach in the nursing literature to date.

3. Literature Search and Selection Process

Two researchers independently conducted the literature search from September 27 to September 28, 2024, including all literature published up to September 27, 2024. To effectively identify nursing-related literature, electronic databases were selected using the Core, Standard, Ideal (COSI) model proposed by the National Library of Medicine (NLM) [17]. Korean databases included KoreaMed, Kmbase, KISS, NDSL, and KISTI, while international databases comprised Cochrane CENTRAL, MEDLINE, and Embase. Additional sources included PubMed (provided by the NLM), specialized databases such as CINAHL and PsycINFO, and broad academic databases like Scopus and Web of Science.

Advanced searches were conducted using the Participant, Intervention, Comparison, Outcome, Time, Setting, and Study Design (PICOTS-SD) framework. The core search strategy combined terms related to participants (using keywords such as “nurs*” to capture variations of nurse/nursing) with terms representing study design focused on ML methodologies. Specifically, searches included “machine learning” together with techniques such as “classif*,” “regress*,” “predict*,” “forecast*,” “cluster*,” “dimensionality reduction,” “reinforcement learning,” or “policy learning” (using OR logic within this group and AND logic to combine with “nurs*”). The final search string was: ((Nurs*) AND ((Machine Learning) AND (Classif* OR Regress* OR Predict* OR Forecast* OR Cluster* OR "Dimensionality Reduction" OR "Reinforcement Learning" OR "Policy Learning"))).

Keywords were searched within Titles and Abstracts; when simultaneous searching in both fields was not possible, Abstract searches were prioritized. The goal was a comprehensive and systematic review of the extensive nursing-related literature. To ensure inclusivity and capture a broad range of relevant terms, truncation with the asterisk (*) was intentionally applied. For example, searching for “Nurs*” retrieved terms such as “nurses,” “nursing,” “nursing student,” and “nurse aide.” Controlled vocabularies like MeSH (for PubMed) or Emtree (for Embase) were not used. With the exception of database-specific adjustments to the Title/Abstract field, the same search string was otherwise used unchanged across all databases (Supplementary Table 1).

The initial database search yielded 540 articles from PubMed, 611 from Embase, 438 from MEDLINE, 72 from the Cochrane Library, 181 from CINAHL, 52 from PsycINFO, 548 from Web of Science, 1,199 from Scopus, and 12 from ScienceON, totaling 3,653 records. After removing 2,102 duplicates using EndNote 21, 1,551 records remained for screening. Titles and abstracts were reviewed, resulting in the exclusion of 1,285 records that were clearly unrelated to the research topic. Because detailed methodological information is often unavailable at this stage, a conservative approach was taken: records were excluded only when no relevance was evident, while ambiguous or potentially related items were retained for full-text screening. Subsequently, 266 full-text articles were assessed against the exclusion criteria, with 114 meeting the inclusion criteria. An additional 11 studies were identified by screening the reference lists of related systematic reviews. Ultimately, 125 studies were included in the final synthesis (Figure 1). The full list of the 125 included studies is provided in Appendix 1, cited in-text with an “A” prefix (e.g., [A1]). The 152 studies excluded at the full-text screening stage, along with reasons for exclusion, are listed in Appendix 2 and are cited with an “E” prefix (e.g., [E1]) when referenced.

4. Quality Assessment of Included Studies

The quality of the included studies was assessed using the TRIPOD+AI checklist [18]. TRIPOD+AI is an extension of the original TRIPOD 2015 guidelines, providing a comprehensive 27-item assessment tool specifically designed to ensure transparent reporting in ML-based predictive

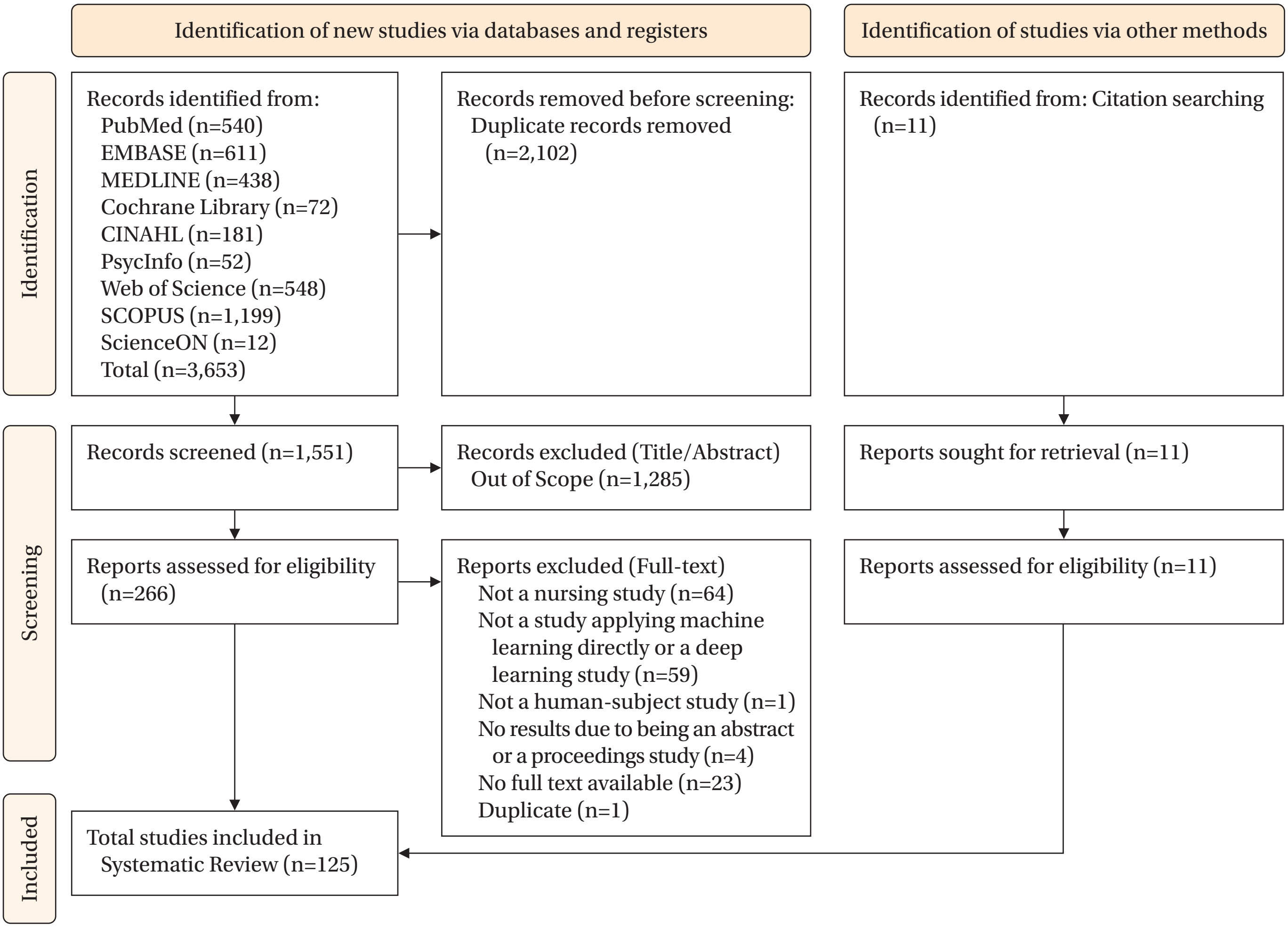

Figure 1. PRISMA flow diagram.

model studies. This checklist is optimized for evaluating both methodological rigor and the reliability of result interpretation in medical AI research. TRIPOD+AI systematically evaluates key domains, including: standardized reporting of model development and validation processes (e.g., data sources [item 5a], justification of sample size [item 10], and handling of missing data [item 11]), thereby emphasizing methodological transparency; AI-specific methodological considerations such as hyperparameter tuning (item 12c), class imbalance handling (item 13), and algorithmic fairness evaluation (item 14); and clinical applicability, including interpretation of model outcomes (item 15) and user interaction requirements in real-world clinical environments (item 27b), thus facilitating evaluation of nursing utility. Two independent reviewers (reviewer A and reviewer B), both trained in the TRIPOD+AI guidelines, assessed each included study. Discrepancies were discussed face-to-face; if consensus was not reached, a third reviewer (reviewer C) adjudicated.

5. Ethical Considerations

This study is a secondary data analysis of previously published literature, conducted using systematic review methodology. Ethical review approval was requested from the Institutional Review Board (IRB) of the researchers' affiliated institution (GWNUIRB-R2024-65), which confirmed that this research does not involve human subjects and is therefore exempt from further ethical review.

6. Data Analysis

The selected final articles were descriptively summarized in a case report format using Excel 2016 (Microsoft, Redmond, WA, USA). The case report template consisted of 29 items structured according to the phases of the CRISP-DM

Table 2. Data Extraction Plan

No.	Phases	Data extraction details
1	General characteristics	1) Journal name, 2) Year of publication, 3) Authors, 4) Proportion of nursing-affiliated authors (determined based on institutional affiliation), 5) Country, 6) Type of ML (supervised/unsupervised/reinforcement), 7) Type of algorithm used (prediction/classification/clustering, etc.)
2	Business understanding	8) Research objective, 9) Research design and methodology (KDD, CRISP-DM, etc.)
3	Data understanding	10) Tools and software used for data analysis, 11) Data source, 12) EDA methods, 13) Target of ML application, 14) Sample size
4	Data preparation	15) Data preprocessing techniques (normalization, standardization, encoding, etc.), 16) Predictor (explanatory/training) variables, 17) Number of predictor variables, 18) Target variable (the variable to be predicted, classified, or analyzed), 19) Data split ratio
5	Modeling	20) Applied ML algorithms and modeling techniques, 21) Hyperparameter tuning methods
6	Evaluation	22) Confusion matrix, 23) Performance evaluation metrics for classification and regression models, 24) Performance evaluation results for each model, 25) Best model, 26) Method of analyzing variable importance or the impact on the target variable (feature importance, SHAP value, etc.)
7	Deployment	27) Research environment, 28) IRB approval, 29) Whether the model was actually deployed

CRISP-DM = Cross-Industry Standard Process for Data Mining; EDA = exploratory data analysis; IRB = Institutional Review Board; KDD = Knowledge Discovery in Databases; ML = machine learning; SHAP = Shapley additive explanations.

methodology, as shown in Table 2. To improve coherence, the RESULTS section is organized in a two-tier hierarchy: (1) Methodological Characteristics of ML Studies, sub-organized by the CRISP-DM stages, and (2) Reported Outcomes and Practical Impact.

RESULTS

1. Methodological Characteristics of ML Studies

1) Quality assessment of included studies

The methodological quality of the 125 included studies was evaluated using the 27-item TRIPOD+AI checklist, which assesses transparent reporting in ML-based predictive model research. The average compliance rate was 50.4% (standard deviation = 9.37), with a range from 22.9% to 79.2%. Most studies consistently reported on model development or validation (98.4%), data sources (96.8%), and outcome definitions (98.4%). However, compliance was notably lower for data preparation (48.0%), class imbalance handling (22.4%), and algorithmic fairness (2.4%). No studies fully adhered to abstract reporting guidelines or shared their protocols publicly. These reporting gaps highlight persistent challenges in achieving transparency and reproducibility, particularly in areas such as preprocessing and fairness, which are critical issues for nursing-related applications. Only seven studies reported real-world deployment, further underscoring the limited clinical translation of ML models in nursing research. Notably, the lowest quality scores were observed in the studies by Choi et al. [A8] and Chavan et al. [A92], both with a score of 22.9%. In contrast, the highest quality score was achieved by Shao et al. [A106], at 79.2%.

2) General characteristics of the included studies

An analysis of country of origin showed that the United States produced the largest share of studies (n = 49, 30.8%), followed by China (n = 23, 14.5%) and South Korea (n = 17, 10.7%).

Examining the publication years from 2006 to 2024, only a few studies appeared in the early years: 2 (1.6%) in 2006, and just 1 each (0.8%) in 2007 and 2008. A significant increase occurred beginning in 2020, with 11 studies (8.8%) published in 2020, 20 (16.0%) in 2021, 18 (14.4%) in 2022, and 24 (19.2%) in 2023. The highest number, 26 studies (20.8%), was published in 2024.

Analysis of research team composition revealed that studies with 0%–25% nurse involvement were least common (n = 16, 12.8%), whereas those with 75%–100% nurse involvement were most frequent (n = 42, 33.6%), indicating that nurses comprised at least 25% of the team in the majority of studies.

Among the 125 studies, supervised learning methods were most prevalent (n = 117, 93.6%), while unsupervised learning was rare (n = 5, 4.0%), and a mixed approach appeared in three studies (2.4%).

In terms of algorithm types, classification algorithms dominated (n = 101, 80.8%), followed by regression (n = 14, 11.2%) and clustering algorithms (n = 7, 5.6%). The most common research objective was pressure injury/ulcer prediction (n = 24, 19.2%), followed by readmission- or utilization-related outcomes (n = 17, 13.6%), and fall-risk prediction (n = 10, 8.0%). The remaining studies (n = 74, 59.2%) covered a broad range of topics, including mental health screening, infection detection, workload assessment, and violence prevention.

With respect to journal distribution, *CIN: Computers, Informatics, Nursing* was the most frequently represented journal (n = 7, 5.6%), followed by *Applied Clinical Informatics, International Journal of Environmental Research and Public Health*, and *Journal of the American Medical Informatics Association*, each with four studies (3.2%). Additionally, *BMC Medical Informatics and Decision Making, International Journal of Medical Informatics, Journal of Advanced Nursing, Journal of Nursing Management*, and *Nursing Research* each published three studies (2.4%) (Table 3).

3) Summary of results according to phase 1: business understanding

Analysis of the 125 included studies identified pressure ulcers, falls, and hospital readmissions as major research foci. Pressure ulcer studies concentrated on early prediction of risk among hospitalized and postoperative patients, aiming to improve nursing quality and patient safety through targeted prevention strategies. Many emphasized the use of ML-based predictive models to identify high-risk patients and enable preventive nursing interventions. Studies related to falls focused on predicting fall risk in both hospitalized patients and nursing home residents, using ML to analyze clinical records, identify key risk factors, and enhance intervention strategies. Research on readmission prediction and management prioritized early identification of high-risk patients to improve management and reduce healthcare costs through timely intervention. These studies often targeted populations such as patients with diabetes, pediatric patients, and individuals requiring post-acute care, developing predictive models based on ML techniques.

Regarding data mining analysis frameworks, the majority of studies (n = 100) did not specify an analytic framework ("NI"—no information). Of those that did, CRISP-DM was most commonly mentioned (n = 3), followed by KDD (n = 2). Other frameworks cited once each included Data, Information, Knowledge, Wisdom (DIKW), the Ahituv Information Flow Model (Ahituv IFM), Plan-Do-Study-Act (PDSA), and the Healthcare Process Modeling to Phenotype Clinician Behaviors Framework (HPM-ExpertSignals). Supplementary Table 2 provides detailed descriptions of the objectives and data mining frameworks employed by all included studies.

4) Summary of results according to phase 2: data understanding

Analysis of the 125 included studies showed that R, Python, and SPSS were the most commonly used tools for data analysis. Additional software packages reported in some studies included SAS (SAS Institute, Cary, NC, USA), Weka (University of Waikato, Hamilton, New Zealand), MATLAB (MathWorks, Natick, MA, USA), MeCab (Nara Institute of Science and Technology, Ikoma, Japan), JMP Pro (SAS Institute), and Modeller (University of California, San Francisco, CA, USA). However, 21 studies did not explicitly specify which software was used. Regarding data sources, electronic medical records and electronic health records (EHRs) were the primary datasets. Other major sources included survey data, student academic records, nursing documentation, and hospital administrative data. Studies utilizing image or audio data were relatively rare.

Exploratory data analysis (EDA) primarily included descriptive statistical methods such as frequency analysis, percentages, mean, and standard deviation. Other methods, such as minimum and maximum values, interquartile range, and data ranges, were less frequently employed. Some studies included natural language processing analyses utilizing text mining, while clustering and dimensionality reduction analyses were occasionally employed. Regarding study populations, patient-centered research was most common, followed by studies targeting nurses, nursing home residents, and nursing students. Studies involving hospital administrators and older adults residing in the community were also present. The study with the largest sample analyzed data from approximately 3.6 million patients, followed by another study analyzing around 1.93 million patient episodes. Another large-scale study included about 1.53 million patients.

In contrast, the smallest study involved around 1,300 qualitative data points collected from 43 patients. Supplementary Table 3 provides detailed information on the software, data sources and types, EDA methods, study populations, and sample sizes for each included study.

Table 3. General Characteristics of the Selected Studies ($N=125$)

Characters	Categories	n (%)
Location[†]	Asia	71 (35.9)
	North America	59 (29.8)
	Europe	22 (11.1)
	Oceania	4 (2.0)
	South America	2 (1.0)
Publication year	Before 2020	26 (20.8)
	2020	11 (8.8)
	2021	20 (16.0)
	2022	18 (14.4)
	2023	24 (19.2)
	2024	26 (20.8)
Percentage of nurses on the research team (%)	0.0–0.25	16 (12.8)
	0.25–0.5	26 (20.8)
	0.5–0.75	41 (32.8)
	0.75–1.0	42 (33.6)
ML type	Supervised learning	117 (93.6)
	Unsupervised learning	5 (4.0)
	Supervised and unsupervised learning	3 (2.4)
Algorithm type	Classification	101 (80.8)
	Regression	14 (11.2)
	Clustering	7 (5.6)
	Classification, association rule mining	2 (1.6)
	Regression, dimensionality reduction	1 (0.8)
Research objective	Pressure-injury/ulcer	24 (19.2)
	Readmission/utilization	17 (13.6)
	Fall risk	10 (8.0)
	Others	74 (59.2)
Journal	*CIN: Computers, Informatics, Nursing*	7 (5.6)
	Applied Clinical Informatics	4 (3.2)
	International Journal of Environmental Research and Public Health	4 (3.2)
	Journal of the American Medical Informatics Association	4 (3.2)
	BMC Medical Informatics and Decision Making	3 (2.4)
	International Journal of Medical Informatics	3 (2.4)
	Journal of Advanced Nursing	3 (2.4)
	Journal of Nursing Management	3 (2.4)
	Nursing Research	3 (2.4)
	BMC Nursing	2 (1.6)
	Journal of Biomedical Informatics	2 (1.6)
	Journal of Emergency Nursing	2 (1.6)
	Journal of Medical Internet Research	2 (1.6)
	Journal of Nursing Scholarship	2 (1.6)
	Journal of the American Medical Directors Association	2 (1.6)
	International Journal of Nursing Studies	2 (1.6)
	Healthcare	2 (1.6)
	Innovation in Applied Nursing Informatics	2 (1.6)
	Nurse Education Today	2 (1.6)
	Archives of Psychiatric Nursing	2 (1.6)
	Others	69 (55.2)

ML=machine learning; [†]The number of “location” values exceeds the 125 included studies because location data were compiled for each author, and a single study could involve authors from multiple locations.

https://doi.org/10.7475/kjan.2025.0327

5) Summary of results according to phase 3: data preparation

Analysis of data preprocessing techniques across the 125 included studies showed that handling missing data was the most frequently employed approach. Methods for managing missing values included simple or multiple imputation, K-nearest neighbors imputation, omission of missing cases, and various recoding strategies. Standardization and encoding were the next most common preprocessing techniques. Standardization methods included Z-score standardization, scaling, and zero-centering, while encoding approaches comprised label encoding, one-hot encoding, use of dummy variables, and binary recoding. Feature selection methods included variable selection, identification of key predictors, the least absolute shrinkage and selection operator, and recursive feature elimination with cross-validation. Normalization techniques such as min-max normalization and other data normalization strategies were also described.

The majority of studies used fewer than 50 predictor variables, although studies employing text mining techniques (e.g., term frequency-inverse document frequency or Word2Vec), imaging, or sensor data often involved high-dimensional datasets with more than 100 predictors, sometimes ranging from 800,000 to 1,000,000 dimensions. In certain clinical and nursing studies, the number of independent variables varied depending on the feature engineering process and the study stage.

The most common outcome or target variables were related to pressure ulcers, such as pressure injury risk, occurrence, and hospital-acquired pressure injury. Studies on falls often analyzed fall occurrence and severity or type, from binary outcomes (fall/no fall) to more nuanced classifications. Readmission and healthcare utilization studies targeted outcomes such as readmission within defined timeframes (e.g., 30-day, 90-day), emergency department visits, hospital length of stay, and frequency of hospital visits. Additional studies focused on predicting infections (e.g., sepsis, urinary tract infections), mental and psychological states (depression, anxiety, burnout, suicide risk), and mortality.

For data partitioning, simple proportional splits (such as 70% training/30% testing or 80% training/20% testing) were common. Cross-validation methods, including 10-fold, 5-fold, 3-fold, and leave-one-out cross-validation, were also frequently applied. Supplementary Table 4 provides detailed information on data preprocessing methods, predictor and outcome variables, and data partitioning strategies used in the 125 included studies.

6) Summary of results according to phase 4: modeling

Analysis of the 125 included studies revealed that random forest was the most frequently employed ML algorithm, followed by logistic regression (including several modified forms), SVM (including variants), decision trees (including variants), and eXtreme Gradient Boosting (XGBoost). Other algorithms reported included CatBoost, Gradient Boosting Machine (GBM), LightGBM, Elastic Net, stochastic gradient descent, and Bayesian networks. Regarding hyperparameter optimization and parameter settings, most studies either used default parameters or did not report any details ("NI"). This indicates a general lack of explicit reporting or limited use of advanced hyperparameter tuning. Among studies that described tuning approaches, grid search was the most commonly used method. Supplementary Table 5 contains detailed descriptions of the ML models and hyperparameter optimization methods used in each study.

2. Reported Outcomes and Practical Impact

1) Summary of results according to phase 5: evaluation

Analysis of performance metrics and ML model usage across the 125 studies showed that the most frequently reported metric was the area under the receiver operating characteristic curve (AUC-ROC), cited in 68 studies. Accuracy was reported in 64 studies, while sensitivity and specificity appeared in 52 and 47 studies, respectively. Other reported metrics included F1-score (n=26), precision (n=25), positive predictive value (n=20), recall (n=19), and negative predictive value (n=18).

Random forest was most often identified by individual studies as the highest-performing algorithm in their comparisons (35 studies), either as the exclusive model or within comparative analyses. XGBoost was specifically reported as the top performer in 11 studies, either as "XGBoost" or "Only one used (XGBoost)," followed by GBM (n=8), logistic regression (n=15), and SVM-based methods (n=7). Additional algorithms such as M5P tree, ANNs, and Bayesian networks were also used in several studies.

For feature importance, 42 studies provided no information ("NI") or did not report explicit importance analyses. "Feature importance" was specifically reported in 19 studies, with Shapley additive explanations (SHAP) (n=10), information gain (n = 6), permutation importance, recursive feature elimination, and Gini impurity each appearing multiple times. Other methods occasionally used included logistic regression coefficients, mutual information, Markov blanket analysis, and normalized importance. Supplementary Table 6 gives detailed accounts of performance metrics, best-performing models, and feature importance techniques for each included study.

2) Summary of results according to phase 6: deployment

Among the 125 studies analyzed, hospital settings were the most frequently represented research environments, followed by home healthcare, nursing homes, community-based settings, and general healthcare contexts. IRB ethical approval was obtained in 95 studies (76.0%), while 30 studies (24.0%) did not report or obtain IRB approval.

Practical deployment and real-world implementation were described in seven studies. Examples included development of a mobile application for early delirium screening in long-term care, establishment of EHR systems for automated patient risk-factor collection, creation of AI-based systems for assessing emergency department visits and hospitalization risk, web-based applications applying ML models for stroke mortality prediction, pressure injury risk prediction for intensive care unit patients, and provision of online decision-support platforms along with real-time telemedicine services. Supplementary Table 7 provides detailed information about each study's setting, IRB approval status, and deployment cases.

A summary of all findings based on the CRISP-DM framework is provided in Table 4.

DISCUSSION

This review was designed to systematically evaluate the methodological characteristics, reporting quality, and clinical translation of ML in nursing research. Our findings reveal a field facing a critical paradox. While the use of ML is rapidly expanding, its translation into robust, reproducible, and clinically impactful tools is hindered by significant methodological shortcomings. This is starkly illustrated by a mean TRIPOD+AI compliance rate of only 50.4%, which signals substantial gaps in both reporting transparency and methodological rigor [18]. Major deficiencies in data preparation (48.0%), class imbalance handling (22.4%), and algorithmic fairness (2.4%) undermine transparency, particularly in the CRISP-DM Data Preparation and Modeling phases. Many studies also lacked clear frameworks during

Table 4. Summary of the Findings of This Study

Sections	Key findings
Quality appraisal of the studies	The TRIPOD+AI appraisal showed moderate compliance (≈50%). Core methods were well reported (>85%), but transparency and ethical aspects were weak (<25%).
General characteristics of the selected studies	USA (30.8%), China (14.5%), and Korea (10.7%) dominated. Most studies used supervised learning (93.6%), especially classification tasks (80.8%).
Problem definition for research objective	Top topics were pressure injury, fall, and readmission. Most studies lacked formal data-mining frameworks; CRISP-DM was the most used among those that did.
Data collection and exploration	R, Python, and SPSS were the most used tools. EMR/EHR and survey data dominated. Sample sizes ranged from 5 to over 3.5 million cases.
Data preparation	Common preprocessing included standardization, normalization, and imputation. Label encoding and one-hot encoding were frequent. Most studies used <50 predictors.
Model building	Random forest was the most used algorithm, followed by logistic regression, SVM, and XGBoost. Hyperparameter tuning was often omitted; Grid Search was most common when used.
Evaluation and review	AUC-ROC, accuracy, sensitivity, and F1-score were most reported. RF was most often top-performing; 42 studies did not report variable importance.
Deployment	Hospitals were the most common setting. IRB approval was reported in 76.0% of studies. Only seven studies described actual deployment.

AUC-ROC = area under the receiver operating characteristic curve; CRISP-DM = Cross-Industry Standard Process for Data Mining; EHR = electronic health record; EMR = electronic medical record; IRB = Institutional Review Board; RF = random forest; SVM = support vector machine; TRIPOD+AI = Transparent Reporting of a Multivariable Prediction Model for Individual Prognosis or Diagnosis+Artificial Intelligence extension; XGBoost = eXtreme gradient boosting.

the business Understanding phase, further weakening the prospects for clinical translation. Inadequate reporting of preprocessing and validation increases the risk of overfitting and reduces reproducibility, while neglect of fairness considerations may perpetuate social biases [19]. To address these issues, future research should adhere to TRIPOD+AI, publish relevant artifacts (e.g., preprocessing pipelines, fairness audits), and systematically address data imbalance to enhance clinical reliability. Standardized reporting is essential to align the rapid growth of the field with higher methodological quality. Our analysis reveals that the field is both maturing and globalizing, but this growth is marked by significant imbalance in its geographic and methodological focus, potentially producing a skewed evidence base [20,21]. The marked surge in publications since 2021, driven by improved data access and the impacts of coronavirus disease 2019, demonstrates rapid expansion [22,23]. However, this growth remains concentrated in certain countries and is heavily focused on supervised learning algorithms. This focus may bias the clinical questions addressed and the solution strategies chosen from a CRISP-DM business understanding perspective, thereby limiting global generalizability and methodological diversity. On a positive note, the strong presence of nurses—with over two-thirds of studies including at least 50% nursing authors—remains a notable strength [24]. Direct nursing involvement is critical for ensuring that research addresses authentic clinical problems and that models are designed with practical workflows in mind, thus improving clinical relevance and the likelihood of successful implementation. The prominence of journals like *CIN: Computers, Informatics, Nursing* underscores the field's shift toward digital methods but also highlights the need for broader dissemination across a wider spectrum of clinical and general nursing journals.

In the business understanding phase, our findings indicate that research has overwhelmingly focused on fundamental, high-impact clinical challenges: pressure ulcers, falls, and hospital readmissions. These topics not only appear frequently in the literature but also represent core nursing-sensitive outcomes where ML has a clear potential to enhance patient safety and optimize care quality. For example, the sustained emphasis on pressure ulcer prediction, from early explorations [25] to recent, more sophisticated applications [26], reflects an ongoing effort to shift from reactive treatment to proactive prevention. Similarly, the evolution of fall prediction models from initial systems [27] to tailored applications in nursing homes [28] demonstrates the field's progression toward targeting high-risk populations. Studies of readmission prediction, spanning patient groups from adults with diabetes [29] to pediatric populations [30], further illustrate the strategic use of ML to advance system-level goals such as cost reduction and continuity of care. Despite this clear clinical focus, a substantial gap exists in the formal use of data mining frameworks. Although CRISP-DM is the most frequently cited methodology, indicating recognition of the need for structured approaches [13], its principles were rarely applied thoroughly. This reveals a frequent disconnect between business understanding and data understanding, undermining the foundations for effective modeling and deployment.

A central paradox emerged in the Data Preparation and Modeling phases: although studies increasingly employ sophisticated techniques, progress was undermined by a persistent lack of reporting transparency, which threatens reproducibility. In the data preparation phase, for instance, researchers used a wide array of methods, ranging from standard encoding to advanced multiple imputation [31,32], and analyzed complex variables for predicting outcomes such as infections and mental health. In the modeling phase, random forests remained the most popular algorithm, recognized for their robust performance with complex data [33], alongside a wide array of other models from interpretable logistic regression to various boosting algorithms. However, this methodological sophistication was not matched by reporting rigor. Our TRIPOD+AI analysis identified transparency gaps that directly compromise reproducibility: for example, only 48.0% of studies reported on missing data handling (Item 11), and just 22.4% described their approach to class imbalance (Item 13), which is a crucial aspect for many clinical outcomes. This deficit extended to the modeling phase, where hyperparameter tuning was often limited to basic grid search [34], and no study reported plans for model recalibration (Item 12f) to address performance drift after deployment. This disconnect between methodological application and transparent reporting severely restricts replication and obscures risks, such as those related to class imbalance in rare but important clinical outcomes. Bringing these methodological threads together, we propose that future nursing ML studies explicitly map every methodological decision to the relevant CRISP-DM phase and publish corresponding artifacts, such as problem definition sheets, EDA dashboards, preprocessing pipelines, tuning logs, and drift-monitoring plans. This level of transparency will enhance reproducibility, facilitate peer auditing, and accelerate clinical translation.

In the evaluation phase, our analysis shows that nursing ML research continues to prioritize algorithmic performance over clinical interpretability, thus limiting translational potential. The reliance on global performance metrics, primarily AUC-ROC and accuracy, demonstrates an emphasis on overall model correctness. This pattern aligns with the frequent identification of ensemble methods like random forest as the top-performing algorithm, praised for their high predictive accuracy on complex nursing datasets [33]. Yet, this focus on aggregate performance can obscure clinical utility. For example, greater attention should be paid to metrics such as sensitivity and specificity, which often hold more clinical significance (e.g., minimizing false negatives for high-risk conditions). This narrow emphasis is compounded by a lack of model interpretability: most studies limited themselves to simple performance comparisons, with relatively little use of tools such as SHAP to explain predictions. This failure to prioritize explainability remains a major barrier to building clinical trust and ensuring that model decisions are safe and equitable. By focusing narrowly on a limited set of performance metrics—without sufficient regard for explainability or fairness audits—current practice falls short of fully satisfying the goals of the CRISP-DM evaluation phase, which should integrate model assessment with broader objectives for patient safety and health equity.

The most significant gap identified in this review lies in the deployment phase, as the vast majority of studies do not progress beyond model evaluation to real-world clinical implementation. Notably, only seven of the 125 analyzed studies reported any form of practical deployment, highlighting a critical research-to-practice gap. This scarcity reflects the immense challenges of clinical integration, which go far beyond model development and require addressing complex safety, reliability, and ethical issues [35]. While hospital-based research remains dominant, recent expansion into home and community care settings is a promising trend. Nevertheless, to bridge the divide between high-performing models and tangible patient impact, future work must prioritize implementation science. This includes developing user-centered evaluation standards and strengthening research on embedding ML tools into diverse clinical workflows to genuinely improve care quality and patient safety.

Concrete solutions include participatory design, real-time missing-data pipelines, and cluster randomized controlled trials. To translate predictive performance into bedside impact, we propose a three-tiered roadmap: (1) Participatory co-design, which involves engaging bedside nurses in early prototype testing to align alert frequency with cognitive load; (2) Integration with EHR and Clinical Decision Support, by leveraging Fast Healthcare Interoperability Resources-based Application Programming Interfaces so that model outputs populate existing decision-support widgets instead of separate dashboards; and (3) Prospective hybrid trials, combining A/B-tested usability endpoints with cluster randomized outcome metrics to evaluate both adoption and effectiveness. Key barriers include data governance concerns, alert fatigue, and algorithmic bias. Mitigation strategies may include federated learning to address data privacy, threshold-adaptive alerting, and continuous fairness audits.

In summary, when viewed through the CRISP-DM framework, methodological weaknesses accumulate across phases—from insufficient problem formalization and superficial data exploration, to opaque preprocessing, limited hyperparameter optimization, narrow evaluation, and minimal deployment planning. These limitations constrain the real-world impact of nursing ML. Addressing them will require transparent protocols, fairness-aware analytics, robust tuning and monitoring, and rigorous clinical trials to ensure that predictive models ultimately translate into improved patient outcomes and nursing practice.

Despite the review’s methodological rigor, several limitations should be acknowledged. First, the definition of 'nursing research' was operationalized by requiring at least one author with a nursing affiliation. While this provided an objective and reproducible screening criterion, it has limitations as a proxy for direct relevance to nursing practice. This approach may have excluded valuable interdisciplinary studies where ML was applied to nursing-sensitive outcomes (e.g., patient falls, pressure injuries) but conducted by teams lacking a formally affiliated nursing researcher. Conversely, it may have included studies where a nursing author's involvement was minimal and the research focus was not central to clinical nursing. Future reviews could use a more nuanced, two-stage approach: an initial broad search for nursing-sensitive outcomes, followed by a content-based assessment of each study’s direct applicability to nursing practice, though this would introduce greater subjectivity into the selection process. Second, while the review team's nursing background ensured clinical relevance, their interpretations of ML methods and performance may reflect a nursing-centered perspective; researchers from computer science or ML fields might have offered different evaluations of model selection, hyperparameter tuning, or performance metrics. Third, although the TRIPOD+AI checklist is suitable for evaluating clinical prediction models, it may not fully capture the methodological nuances of nursing research, particularly in studies involving exploratory or unsupervised approaches. The moderate mean compliance rate of 50.4% underscores broader issues in methodological rigor and reporting transparency. Fourth, our deliberate exclusion of DL studies, while necessary for methodological consistency, means that this review does not represent the entire landscape of AI in nursing. The rapidly growing body of research utilizing CNNs for medical imaging or RNNs for sequential EHR analysis falls outside the scope of this review. Consequently, our findings and conclusions are specific to traditional ML applications, and a separate, dedicated systematic review is needed to characterize the unique methodologies and challenges of DL in the nursing field.

Nevertheless, this review has notable strengths. It is the first synthesis to apply the TRIPOD+AI checklist and PRISMA framework to 125 nursing ML studies, anchored in a pre-registered PROSPERO protocol and structured by the CRISP-DM model. The search strategy encompassed nine international and five Korean databases, thereby minimizing language and regional bias. Dual independent screening and quality appraisal further reduced reviewer subjectivity, while the large sample size enabled robust identification of reporting and algorithmic trends spanning two decades. By linking checklist findings to phase-specific recommendations, this review provides actionable guidance for future nursing ML research and editorial policy development.

CONCLUSION

This study systematically reviewed and analyzed the application of ML in nursing, highlighting both its achievements and limitations. The use of ML in nursing research has recently increased rapidly, with a predominant focus on patient safety and healthcare quality improvement—particularly in areas such as pressure ulcer prediction, fall prevention, and hospital readmission management. Algorithms such as random forest, XGBoost, and logistic regression were widely employed, with performance metrics like AUC-ROC and accuracy most commonly used for evaluation. However, several factors limit comparability and reproducibility across studies, including inadequate reporting of data preprocessing methods, inconsistent performance evaluation criteria, and insufficient attention to algorithm fairness and ethical considerations. The generally low compliance rate with the TRIPOD+AI checklist underscores the need to improve transparency and reliability in nursing ML research. Additional shortcomings included insufficient detail on hyperparameter tuning and model performance evaluation processes, as well as limited real-world deployment of ML tools. Consequently, there is an urgent need to standardize research design and reporting practices to enhance the quality of ML studies in nursing. Adherence to structured reporting guidelines, such as TRIPOD+AI, can significantly improve transparency and reproducibility. Furthermore, future research should prioritize practical deployment in diverse clinical settings, ongoing model performance optimization, and fairness assurance to strengthen clinical applicability. By adopting systematic and standardized approaches, future nursing ML research can enhance practical relevance and contribute to improved patient-centered nursing care quality.

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

Study conception and/or design acquisition - EJK and SKK; analysis - EJK and SKK; interpretation of the data - EJK and SKK; and drafting or critical revision of the manuscript for important intellectual content - EJK and SKK.

FUNDING

None.

ACKNOWLEDGEMENT

None.

DATA AVAILABILITY STATEMENT

No new data were created or analyzed during this study. Data sharing is not applicable to this article.

SUPPLEMENTARY MATERIAL

Supplementary materials can be found via https://doi.org/10.7475/kjan.2025.0327.

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APPENDICES

Appendix 1. List of studies included in the systematic review

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Appendix 2. List of studies excluded in the systematic review

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ORIGINAL ARTICLE

Korean J Adult Nurs Vol. 37 No. 3, 215-230, August 2025
eISSN: 2288-338X
https://doi.org/10.7475/kjan.2025.0409

KJAN
Korean Journal of
Adult Nursing

Nursing Competence in Coping with Clinical Deterioration: An Evolutionary Concept Analysis

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Received: April 9, 2025
Revised: June 10, 2025
Accepted: July 10, 2025

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Purpose: This study aimed to clarify the concept of nursing competence in coping with clinical deterioration by employing Rodgers' evolutionary concept analysis, which reflects both sociocultural and temporal dimensions. **Methods:** A six-step concept analysis was conducted following Rodgers' methodology. A systematic literature review was performed using PubMed, Embase, CINAHL, and Google Scholar, yielding 35 relevant studies published between 2000 and 2025. Data extraction followed the Joanna Briggs Institute template, and quality was appraised using the STROBE checklist. **Results:** Four key attributes of nursing competence were identified: technical skills in patient monitoring, situational awareness and clinical intuition, decision-making regarding escalation of care, and communication and teamwork to ensure timely intervention. Antecedents included formal education, clinical experience, and institutional support. Consequences encompassed enhanced patient safety, increased nurse confidence, and greater professional autonomy. The concept was demonstrated to be dynamic and influenced by healthcare policies, such as the implementation of rapid response systems. **Conclusion:** Nursing competence in managing clinical deterioration is a multidimensional and evolving concept that is essential for patient safety. Clarification of this concept can inform the development of assessment tools and simulation-based education. Further research should explore its application across diverse healthcare contexts and address challenges related to escalation of care.

Key Words: Clinical competence; Clinical deterioration; Coping skill; Concept formation; Analysis

INTRODUCTION

In-hospital cardiac arrest (IHCA) remains a major concern in acute care settings, with incidence rates in the United States ranging from 0.8 to 4.6 cases per 1,000 hospital admissions [1]. Each year, approximately 300,000 patients experience IHCA, yet survival rates remain low, at around 25% [2]. Previous research has demonstrated that in nearly 80% of IHCA cases, abnormal changes in vital signs—such as tachycardia, tachypnea, or hypotension—were observed 6 to 24 hours prior to arrest [3]. These physiological changes are recognized as warning signs of clinical deterioration and underscore the crucial importance of early detection and timely intervention. Nurses, as frontline healthcare providers, play a pivotal role in identifying these signs, interpreting clinical assessments, and initiating appropriate escalation of care [4].

The term "clinical" derives from the Greek word "*klinein*", meaning "to lean" or "bed", which signifies bedside care. "Deterioration" comes from the Latin "*deteriorare*", meaning "to worsen". In clinical practice, deterioration refers to a gradual decline in a patient's physiological state, often preceding critical events such as cardiac arrest or multiple organ failure [5,6]. The concept of "nursing competence in coping with clinical deterioration" integrates the notion of coping (i.e., effectively responding to emergencies) with competence, which encompasses the knowledge, skills, and judgment required to fulfill a professional role. In high-risk clinical settings, this competence reflects a nurse's capacity to act expertly under pressure [7].

Internationally, health systems have responded to the need for early detection by introducing structured systems and policies. In the United States, the "100,000 Lives Campaign" launched in 2004 established rapid response teams (RRTs) as a standard for patient safety [8]. Similarly, Australia's National Safety and Quality Health Service Standards and the United Kingdom's National Institute for Health and Care Excellence (NICE) have developed comprehensive guidelines for recognizing and managing clinical deterioration. These include the use of early warning scores (EWS), interprofessional communication strategies, and training protocols [9,10]. Such measures have contributed to the standardization of roles and competencies in acute care nursing. Over the past two decades, the required competencies for nurses in these countries have evolved from basic physiological monitoring to more advanced skills, including clinical reasoning, interprofessional teamwork, and leadership in escalation processes.

In contrast, Korea only recently institutionalized the rapid response system (RRS) in 2019 as part of the National Patient Safety Comprehensive Plan [11], reflecting a delayed integration of systemic approaches to clinical deterioration [12]. Although this has led to improvements in policy and practice, ongoing challenges include limited nurse autonomy, delayed escalation, and underutilization of early warning systems [13]. Furthermore, despite its clinical significance, the concept of 'nursing competence in coping with clinical deterioration' has not been clearly defined or formalized within Korean nursing. Instead, related terms such as "emergency care" [14] and "emergency nursing competency" [15] have been used variably, often without explicit recognition of the evolving roles of nurses in complex and dynamic deterioration scenarios.

Given these discrepancies, the current study aimed to bridge the gap by clarifying the concept of nursing competence in coping with clinical deterioration using Rodgers' evolutionary concept analysis [16]. This approach highlights the dynamic nature of concepts, recognizing that they are shaped by historical, sociocultural, and organizational factors. By employing this method, the study aims to delineate the essential attributes, antecedents, and consequences of the concept, and to trace its evolution over time, especially in light of changes in healthcare technologies, patient acuity, system structures, and the expanding roles of nurses in both Western and Korean contexts. This analysis will contribute to greater conceptual clarity and support the development of contextually relevant educational, clinical, and policy strategies within the Korean healthcare system.

METHODS

1. Study Design

This study applied Rodgers' evolutionary concept analysis method, which emphasizes the dynamic and context-dependent nature of concepts, recognizing that they evolve over time in response to changes in sociocultural, technological, and organizational environments [16]. This approach is particularly well-suited to exploring complex and multifaceted concepts such as nursing competence in coping with clinical deterioration, which have undergone significant transformation alongside developments in healthcare systems and professional roles over the past two decades.

To strengthen the rigor of the analysis, the study included a deliberate exploration of the historical and cultural evolution of the concept, as recommended by Rodgers and Knafl [16]. The analysis focused on tracing how the competencies required for nurses responding to clinical deterioration have evolved over the past 25 years, in parallel with changes in healthcare systems, patient acuity, medical technology, and safety policies.

Given that in Korea, research and systemic integration regarding this concept remain in their early stages and are still largely insufficient, this study primarily relied on the analysis of international studies. The purpose was to provide a clarified and systematic understanding of the concept based on global evidence, offering foundational knowledge that can be adapted and applied appropriately within the Korean healthcare context.

2. Researcher Preparation

The principal investigator is a registered nurse with over 10 years of clinical experience in intensive care units, as well as experience as an RRT nurse in tertiary hospitals. The researcher conducted an extensive review of international literature from countries where clinical deterioration management systems are well established, such as the United States, the United Kingdom, and Australia. This global perspective was integrated into the analysis to ensure that the conceptual clarification reflects universal nursing competencies, while also providing a foundation for future adaptation and application in Korea's distinct healthcare environment.

In conducting Rodgers' evolutionary concept analysis, it is essential for researchers to maintain methodological rigor and reflexivity. Inclusion and exclusion criteria for selecting relevant literature must be clearly defined to ensure the credibility of the sample. To ensure the validity of the categorization process, one researcher (U.S.) and a research assistant (S.P.) independently classified the variables based on predefined criteria. They then engaged in iterative discussions to address and resolve any inconsistencies. When discrepancies could not be resolved through consensus, the responsible author reviewed the cases and made the final decision. This collaborative and structured approach enhanced the consistency and reliability of the classification framework.

Furthermore, it is crucial to avoid allowing preexisting understandings of the concept to bias the literature search or data interpretation [16]. As concept analysis is an iterative and interpretive process, all decisions regarding literature selection and conceptual interpretation should be systematically documented to enhance the study's trustworthiness and transparency. This reflective documentation process reinforces the reliability of the research and demonstrates the researcher's preparedness and awareness of potential bias.

3. Concept Analysis Procedure

The six-stage process of Rodgers' evolutionary concept analysis was systematically applied:

1) Identification of the concept and related terms

The core concept of 'nursing competence in coping with clinical deterioration' was identified, along with surrogate and related terms frequently found in the literature, such as "nursing ability", "nursing competence", and "nurse's role". Special attention was paid to examining how these terms have been used and understood across different countries and time periods.

2) Selection of the literature

A comprehensive literature search was conducted using keywords including "clinical deterioration", "patient deterioration", "nursing competence", "nursing ability", "nursing capacity", and "nursing role". Four databases (PubMed, Embase, CINAHL, and Google Scholar) were searched for literature published from January 2000 to March 2025, in order to capture the historical development of the concept over the past 25 years. Additional studies identified by hand search of references.

3) Data collection

A total of 593 articles were initially retrieved. After screening according to predefined inclusion and exclusion criteria, 35 articles were selected for the final analysis (Table 1, Figure 1, Appendix 1). Data extraction was conducted using the Joanna Briggs Institute (JBI) data extraction template and the STROBE checklist [17], ensuring methodological rigor throughout the process.

4) Data analysis

The selected articles were categorized into three time periods to analyze how understandings and expectations of nursing competence in coping with clinical deterioration have changed over time. Attributes, antecedents, and consequences were examined in relation to shifts in healthcare systems, patient safety policies, technological advancements, and the expanding roles of nurses within multidisciplinary teams. Cross-national comparisons were also performed to identify contextual similarities and differences. Through this process, the core components that consistently define nursing competence were identified. The synthesis of these components is summarized and systematically organized, presenting derived elements, key references, and the analytical process for attributes, antecedents, affecting factors, and consequences (Table 2).

5) Comparison with related concepts and clarification

The identified conceptual elements were compared with related concepts commonly used in Korea, assessing areas of overlap, distinction, and those requiring further clarification. This process was designed to ensure that the clarified concept is relevant for the Korean nursing context, while remaining consistent with international standards.

Table 1. Concept Analysis of the Research Papers Included in the Review ($N=35$)

	Authors (year)	Nation	Purpose/focus	Design	Concept definition
A1	Azimirad et al. (2022)	Finland	Explore nurse assessments of deteriorating patients	Qualitative	Clinical competence
A2	Bacon (2017)	USA	Lived experiences of nurses with patients who die due to failure to rescue	Qualitative	Nurses' role
A3	Burke and Conway (2023)	Ireland	Factors influencing nurses' escalation of care	Qualitative	Nurses' ability
A4	Butler (2018)	UK	Nurses' experiences post-education on managing deterioration	Qualitative	Nurses' ability
A5	Chua et al. (2020)	Singapore	Enhance doctor-nurse collaboration in escalations	Qualitative	Nurses' role
A6	Chua et al. (2013)	Singapore	Experience of frontline nurses with deteriorating patients	Qualitative	Nurses' ability
A7	Chua et al. (2023)	Singapore	Impact of automated rapid response systems	Mixed methods	Nurses' ability
A8	Al-Ghraiybah et al. (2024)	Australia	Effect of nursing environment, staffing, and surveillance on patient mortality	Descriptive	Nurses' ability
A9	Al-Moteri et al. (2020)	Australia, Saudi Arabia	Examine cognitive biases in recognizing deterioration cues	Experimental	Nurses' ability
A10	Allen (2020)	USA	Identify barriers for non-critical care nurses in recognizing and responding to early signs of clinical deterioration	Literature review	Nurses' ability
A11	Foley and Dowling (2019)	UK	Investigate how nurses use early warning scores in acute settings	Case study	Nurses' ability
A12	Wood et al. (2019)	Australia	Explore early warning score use for detecting patient deterioration	Literature review	Nurses' ability
A13	Dalton et al. (2018)	UK	Identify factors influencing nurses' assessment of patient acuity	Qualitative study	Nurses' ability
A14	Douglas et al. (2014)	Australia	Develop and test a scale for barriers to nurses' physical assessment	Instrument development study	Nurses' ability
A15	Dalton (2022)	UK	Understand nurses' recognition and response to patient deterioration	Mixed methods	Nurses' ability
A16	Dresser et al. (2023)	USA	Examine factors influencing nurses' clinical judgment in identifying and responding to deterioration	Qualitative	Nurses' ability
A17	Fontenot et al. (2022)	USA	Assess impact of standardized physical assessment program on early recognition of deterioration	Quasi-experimental	Clinical competence
A18	Gazarian et al. (2010)	USA	Explore decision-making cues used by nurses in pre-arrest situations	Qualitative	Nurses' ability
A19	Douw et al. (2016)	Netherlands	Evaluate Dutch Early Nurse Worry Indicator Score (DENWIS) for early detection of deterioration	Observational	Nurses' ability
A20	Duff et al. (2018)	Australia	Evaluate the impact of the DeTER program on skills in recognizing and responding to deterioration	Quasi-experimental	Nurses' ability
A21	Haegdorens et al. (2023)	Belgium	Assess the predictive value of combining the Nurse Intuition Patient Deterioration Scale (NIPDS) with the National Early Warning Score (NEWS) for predicting serious adverse events	Prospective cohort study	Nurses' ability
A22	Jensen et al. (2018)	Norway	Describe and synthesize the impact of early warning scores and rapid response systems on nurses' competence	Literature review	Nurses' competence

(Continued on the next page)

https://doi.org/10.7475/kjan.2025.0409

Table 1. Continued

	Authors (year)	Nation	Purpose/focus	Design	Concept definition
A23	Jin et al. (2022)	Korea	Examine nurses' perception and performance in communication during clinical deterioration	Descriptive	Nurses' ability
A24	Lavoie et al. (2020)	Canada	Investigate agreement between nurse judgments at handoffs and early warning scores	Observational	Nurses' ability
A25	Liu et al. (2024)	China	Evaluate the effectiveness of educational strategies for recognizing deterioration	Literature review	Nurses' ability
A26	Massey et al. (2017)	Australia	Identify factors influencing ward nurses' recognition and response to deterioration	Literature review	Nurses' ability
A27	Mbuthia et al. (2024)	Kenya	Explore detection and response to clinical deterioration by general ward nurses	Mixed-methods	Nurses' ability
A28	Odell et al. (2009)	UK	Examine the role of nurses in detecting deterioration in ward patients	Literature review	Nurses' role
A29	Orique et al. (2019)	USA	Examine capacity and tendency of nurses to perceive deterioration cues	Descriptive	Nurses' ability
A30	Hart et al. (2014)	USA	Explore perceived self-confidence and leadership abilities in deterioration events	Descriptive	Nurses' role
A31	Peebles et al. (2020)	Australia	Evaluate a just-in-time training program to improve response to deterioration	Quasi-experimental	Nurses' ability
A32	Rosli et al. (2023)	Malaysia	Determine critical care nurses' physical assessment skills usage	Descriptive	Nurses' ability
A33	Warren et al. (2021)	USA	Evaluate impact of Modified Early Warning Score (MEWS) on knowledge and response to deterioration	Quasi-experimental	Nurses' ability
A34	Xu et al. (2023)	China	Develop and validate tool to measure junior nurses' response abilities	Mixed-methods	Nurses' ability
A35	Donnelly et al. (2024)	UK	Explore, map and synthesize existing research related to the ward nurses' role in recognizing and responding to clinical deterioration	Literature review	Nurses' role

6) Development of conceptual framework and hypotheses

A conceptual model integrating the identified attributes, antecedents, and consequences was developed (Figure 2). Based on the evolutionary analysis, hypotheses were formulated regarding the relationships among these components and their anticipated impact on nursing practice outcomes. While grounded in international research, the resulting model was structured to provide both theoretical rigor and practical applicability, serving as a reference for Korean healthcare settings aiming to enhance nursing competence in clinical deterioration management.

RESULTS

1. Temporal Evolution of the Concept

The selected studies were organized into three periods for analysis: 2000–2010 (emerging systems), 2011–2020 (system establishment and expansion), and 2021–2025 (competence refinement and proactive nursing leadership). The conceptual elements—attributes, antecedents, and consequences—were examined both for their content and for how they evolved over time, considering the influence of healthcare policy, technological advancements, and changing professional expectations. For this study, the 35 selected articles were systematically categorized into these three distinct timeframes to allow for an in-depth

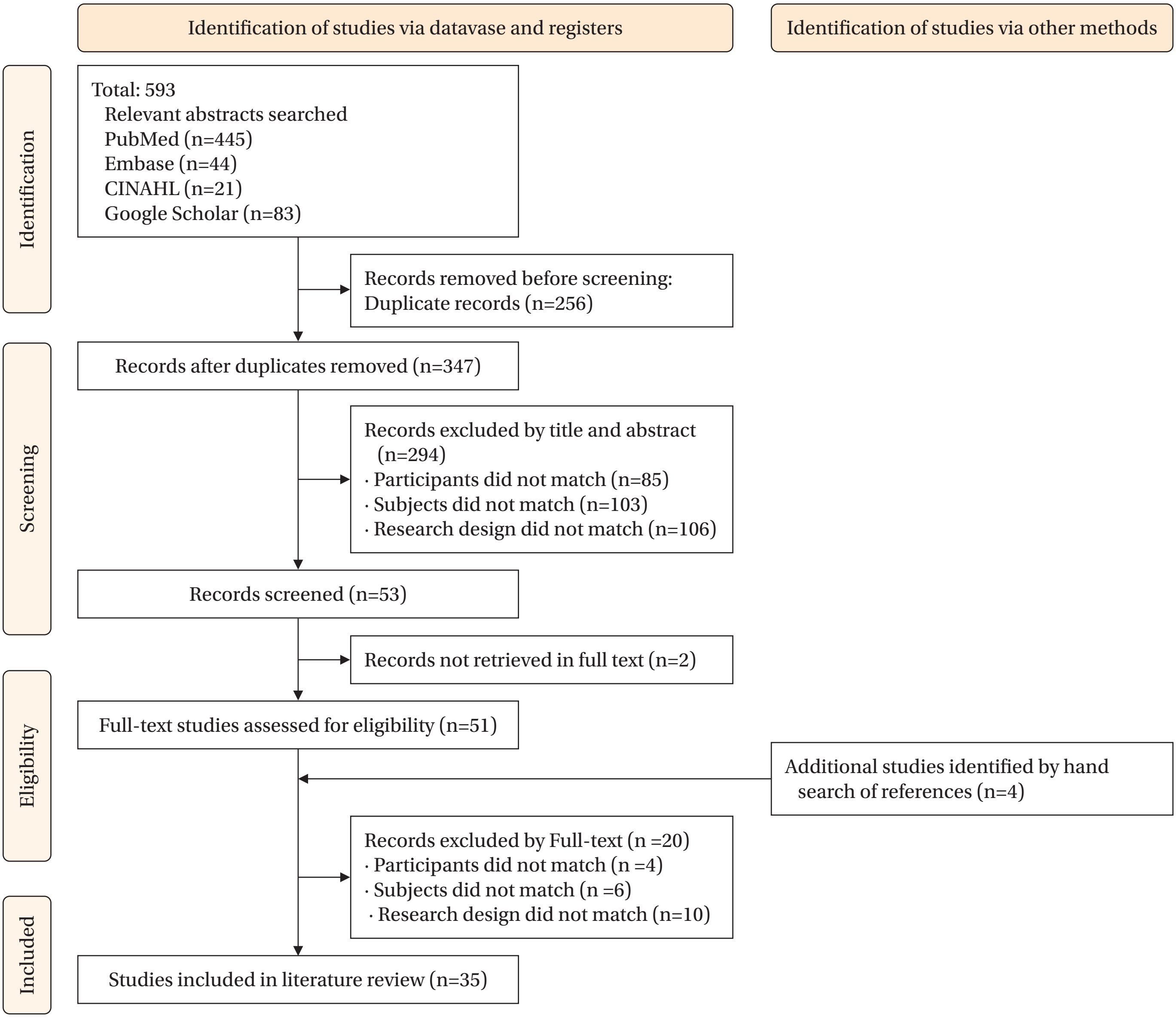

Figure 1. Flow of study analysis through the different phases of the literature review.

temporal analysis of the evolution of nursing competence in coping with clinical deterioration.

During 2000–2010 (emerging systems), the literature primarily focused on basic clinical skills, including vital signs monitoring, fundamental patient assessment (ABCD [Airway, Breathing, Circulation, Disability] approach), and early recognition of physiological changes [A4,A18,A28]. Nurses' roles were largely limited to data collection and reporting, with minimal participation in decision-making or care escalation. The emphasis was on strengthening individual clinical skills to enable early detection of deterioration, mirroring the initial phase of structured patient safety system implementation in Western countries.

In the 2011–2020 (system establishment and expansion) period, research reflected a shift toward more systematized responses to patient deterioration, marked by the global proliferation of EWS and RRS [A2,A5,A6,A8-14,A20-22,A24,A26,A29-31,A33]. The nurse's role expanded from that of an observer to an active participant in patient safety, requiring competencies in situational awareness, interdisciplinary communication, and the use of standardized escalation protocols [A4,A8,A11,A14,A20,A24,A31]. This period also involved a growing emphasis on simulation-based training, team leadership, and decision-support systems to improve nursing responses [A26,A30,A31].

Finally, the 2021–2025 period (competence refinement

Table 2. Derivation of Components on Nursing Competency to Cope with Clinical Deterioration

Component	Derived elements	Summary of derivation process	Representative references
Antecedents	Education and training: Comprehensive education, simulation-based training, and updated knowledge on EWS and RRS systems	Identified as essential preparatory factors to develop necessary competencies. Many studies emphasized the critical role of structured training, simulation, and system familiarity in improving nurses' readiness for clinical deterioration situations.	[A15,A22,A25,A31]
	Clinical experience: Accumulation of bedside experience in recognizing and managing clinical deterioration	Derived from descriptions of experiential learning improving situational awareness and decision-making. Studies consistently reported that repeated exposure to clinical deterioration cases strengthens nurses' intuitive and judgmental skills.	[A15,A25]
	Resources and system support: Availability and accessibility of systems such as EWS, RRS, supportive policies, and resource adequacy	Synthesized from studies highlighting the necessity of accessible tools and system infrastructure to support timely recognition, decision-making, and care escalation.	[A3,A22]
Attributes	Technical skills: Vital signs monitoring, physical assessment, ABCD assessment, and timely intervention skills	Consolidated from studies reporting the need for nurses' technical proficiency in assessments and interventions as fundamental attributes in deterioration response.	[A15,A29,A34,A35]
	Situational awareness and intuition: Ability to detect subtle changes, interpret early deterioration cues, and apply clinical intuition	Frequently noted in studies describing the importance of situational awareness and intuitive reasoning, especially when vital signs alone do not capture the full clinical picture.	[A13,A15,A22,A29]
	Decision-making skills: Clinical reasoning, independent judgment, and decision-making in escalation scenarios	Extracted from studies detailing the nurse's role in critical judgment and escalation decision-making during patient deterioration events.	[A5,A11,A15,A22]
	Communication and teamwork for escalation: Clear communication, interdisciplinary teamwork, and leadership in escalation	Repeatedly emphasized in the literature as key components enabling timely escalation and collaborative interventions during emergencies.	[A5,A23,A26]
Consequences	Improvement in patient safety: Prevention of deterioration events, reduction of mortality and adverse outcomes	Reported as primary outcomes from effective recognition and response to deterioration, leading to better clinical outcomes and reduced patient harm.	[A4,A5,A11,A15,A22]
	Enhanced confidence of nurses: Increased self-efficacy, professional autonomy, and leadership capabilities in managing clinical deterioration	Derived from studies demonstrating improved nurse confidence and leadership capabilities after gaining experience and success in managing clinical deterioration events.	[A5,A15,A22,A34]
Affecting factors	Individual factors: Clinical knowledge, skills, experience, self-confidence Task factors: Complexity of clinical judgment, workload in deterioration scenarios Organizational factors: Hierarchical culture, leadership support, teamwork environment Environmental factors: Availability of monitoring tools, staffing, access to RRS, EWS	Synthesized from descriptions across studies where personal, organizational, and environmental contexts influenced the development and application of nurses' competencies. Especially noted were the impact of workload, team dynamics, system availability, and institutional support on nurses' timely and safe response to deterioration.	[A3,A5,A8,A16,A21,A23,A28,A30,A33,A34,A35]

ABCD = Airway, Breathing, Circulation, Disability; EWS = early warning score; RRS = rapid response system.

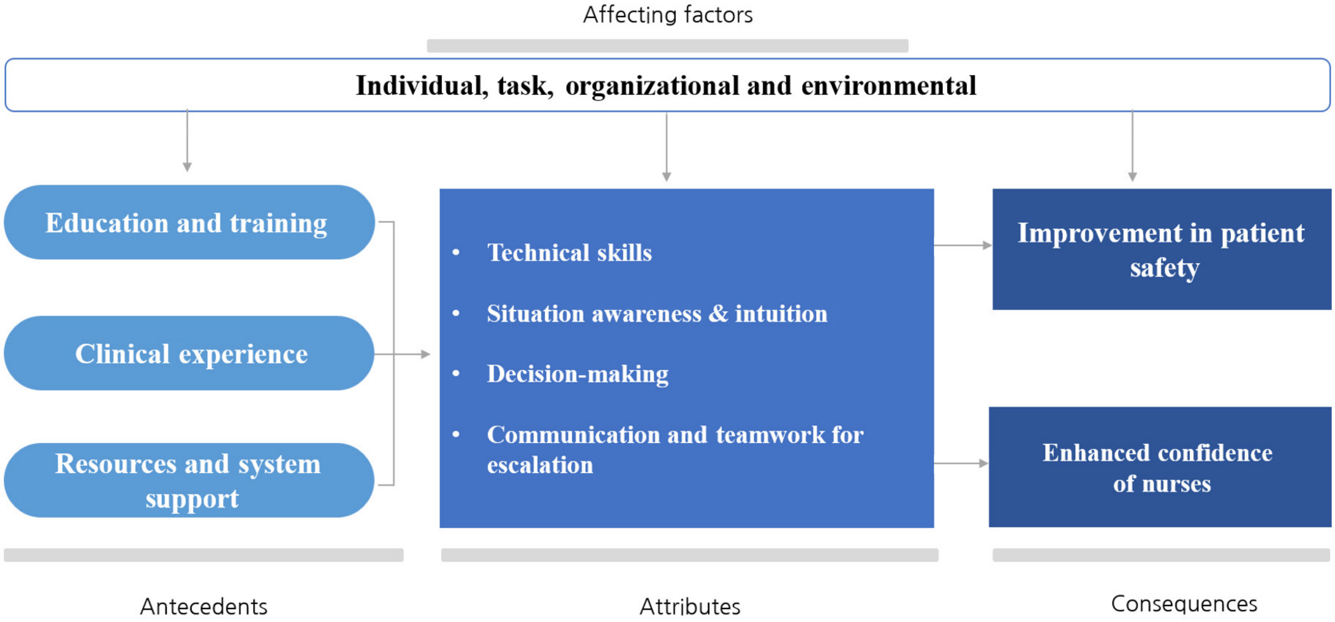

Figure 2. Antecedents, attributes, and consequences of competency to cope with clinical deterioration.

and proactive nursing leadership) was characterized by a proactive, leadership-centered approach to clinical deterioration management [A1,A3,A7,A15-17,A19,A23,A25,A27,A32,A34,A35]. Nurses were expected to take advocacy roles, lead team-based interventions, and utilize advanced technologies—such as AI-driven patient monitoring systems—to anticipate deterioration and act with greater autonomy [A19,A21,A24,A25,A34]. The concept of nursing competence became increasingly integrative, encompassing technical skills, clinical judgment, teamwork, decision-making, and proactive leadership. This trend reflects the global movement toward empowering nurses as central agents in transforming patient safety culture.

2. Cross-National Comparisons

To further increase the contextual relevance of the analysis, cross-national comparisons were conducted, focusing on studies from the United States [A2,A10,A16,A17,A18,A29,A30,A33], the United Kingdom [A4,A11,A13,A15,A28,A35], and Australia [A8,A12,A14,A20,A26,A31], which represented the majority of the selected literature.

This comparison highlighted both similarities and differences in how the concept of nursing competence in coping with clinical deterioration was developed and operationalized in different countries. Common themes included the progressive shift from an emphasis on technical skills toward the development of decision-making, leadership, and interdisciplinary communication competencies—largely propelled by the institutionalization of EWS and RRS during the 2010s.

However, notable country-specific differences also emerged. For example, studies from the United Kingdom emphasized early recognition through structured tools and team-based communication protocols, such as the Situation, Background, Assessment, and Recommendation (SBAR) framework. In contrast, Australian studies frequently focused on simulation-based training and nurse-led escalation behaviors. U.S. studies were more likely to address the integration of advanced technologies and advocated for nurse autonomy in activating RRS without prior physician approval.

These cross-national insights provided a nuanced understanding of how sociocultural, policy, and systemic factors have shaped the evolution of the concept, offering guidance for its adaptation in contexts like Korea, where such systems remain in early stages of implementation.

3. Conceptual Derivation

Nursing competence in coping with clinical deterioration refers to the ability to flexibly and continuously manage and resolve problems in situations characterized by hemodynamic instability due to diminished physiological com-

https://doi.org/10.7475/kjan.2025.0409

pensation, accompanied by subjective or objective signs [6]. Coping with clinical deterioration requires the recognition of trends in a patient's condition over time and the ability to interpret them—a process often described as complex and demanding. In clinical practice, nurses are expected to integrate their formal education, accumulated experience, and intuitive judgment. This competence involves the ability to collect objective data based on nursing knowledge, recognize signs of physiological compromise, interpret and understand the patient's condition, and make decisions that facilitate appropriate escalation of care [A5,A34].

In this study, the concept of nursing competence in responding to clinical deterioration is defined as a series of professional abilities to promptly recognize early signs of patient decline, make accurate clinical judgments, and initiate escalation of treatment as needed. This competence encompasses technical assessment skills, situational awareness and clinical intuition, clinical decision-making, and effective interdisciplinary communication and teamwork. It can be strengthened through repeated clinical exposure, structured education, and the implementation of supportive systems such as the EWS and RRS. Ultimately, this competence contributes to improved patient safety, enhanced nurse confidence, and the advancement of a collaborative and responsive organizational culture in healthcare settings (Figure 2).

4. Conceptual Components

1) Surrogate and related terms

In the general nursing literature, terms such as "nursing performance," "nursing practice," and "clinical competencies" are often used interchangeably. Similarly, within the context of clinical deterioration, related terms—including "nursing performance," "nursing ability," "nursing capacity," and "nursing role"—frequently overlap conceptually with nursing competence in coping with clinical deterioration [A1,A34].

2) Affecting factors

This study identified factors influencing nursing competence in responding to clinical deterioration—encompassing antecedents, attributes, and consequences—across four levels: individual [A3,A16,A34], task [A8,A30,A33], organizational [A5,A21,A23,A28], and environmental [A35]. These multi-level influences reflect the complex interplay among personal capabilities, role-related demands, institutional structures, and broader clinical settings.

3) Antecedents

Antecedents refer to the events or conditions that must occur before the concept can manifest [16]. In this context, the question "What must precede the demonstration of nursing competence in coping with clinical deterioration?" was repeatedly considered. The primary antecedents identified in this study are as follows:

(1) Education and training

Education and training focused on clinical deterioration are essential. Nurses must be equipped with both theoretical knowledge and practical skills relevant to emergency situations. This includes instruction on the use of RRSs, EWS, clinical judgment, communication, and interprofessional collaboration [A15]. Ongoing on-site education and immersive simulation-based training that realistically replicates clinical deterioration scenarios have been shown to enhance nurses' self-efficacy and confidence [A25]. Integrating diverse educational strategies and materials into structured programs is emphasized as a way to strengthen nurses' response capabilities [A22]. Furthermore, just-in-time training methods tailored to real-time clinical contexts promote self-directed learning and foster the acquisition of situational knowledge and skills [A31].

(2) Clinical experience

Repeated clinical exposure plays a critical role in building situational awareness and decision-making ability. Nurses' accumulated experience fosters intuitive reasoning and pattern recognition in similar clinical situations [17]. This experiential knowledge enables early identification of deviations from a patient's baseline and promotes intuitive responses to deterioration. Previous studies have shown that peer support during care escalation is highly valued, and the influence of experienced senior nurses is particularly significant [A15,A25].

(3) Resources and system support

Adequate access to resources and system support is essential for nurses to fully demonstrate their competencies. The availability of tools such as the EWS and RRS empowers nurses, supports clinical decision-making, and boosts confidence in care escalation [A3]. These systems also facilitate effective communication [A3,A22]. Furthermore, the use of EWS reinforces the importance of vital signs and increases nurses' vigilance in recognizing clinical deterioration [A22].

4) Attributes

Conceptual attributes are the essential characteristics that define and distinguish a concept. Identifying these attributes makes it possible to generalize the concept to all related cases. The process of attribute definition is central to concept analysis. In this study, the attributes of nursing competence in coping with clinical deterioration were specified as follows:

(1) Technical skills

Among the various competencies required of nurses, the measurement of vital signs—a fundamental aspect of patient assessment—is crucial in the early identification of patients at risk for clinical deterioration. Timely detection allows for sufficient intervention to prevent failure to rescue [A29]. It is necessary to establish evidence-based guidelines for the frequency of vital sign monitoring, methods of physical assessment for patient safety, and appropriate clinical responses to deterioration [A35]. Instruments used to assess nurses' ability to recognize and respond to clinical deterioration typically include elements such as gathering and analyzing disease-related information [A34]. The primary assessment (ABCD) is used to evaluate airway patency, respiratory and circulatory function, and neurological status, prioritizing treatment in trauma and medical patients with potential life-threatening conditions. The goal of primary assessment is to identify and address life-threatening situations immediately. For nurses, the primary survey represents the initial stage of patient assessment and functions not merely as a data collection exercise but as a critical process for the early recognition of clinical deterioration [A15].

(2) Situation awareness and intuition

Situational awareness refers to the ability to rapidly detect changes in a patient's condition, interpret these changes, and prepare an appropriate clinical response [18]. This constitutes the first step in decision-making and enables nurses to anticipate future clinical developments [19]. Previous clinical care experience is a major contributor to a nurse's ability to detect patient changes at an early stage [A13].

The importance of intuition within nurses' competencies for assessing deteriorating patients is increasingly recognized, emphasizing that detection of deterioration extends beyond monitoring physiological changes or vital signs alone [A22]. The Dutch Early Nurse Worry Indicator Score (DENWIS) includes indicators such as changes in respiration, circulation, temperature, mental status, anxiety, pain, unexpected symptoms, a general feeling of unwellness reported by the patient, subjective nurse observations, and intuition without objective evidence [20]. A distinguishing feature of this tool is its inclusion of subjective indicators, such as anxiety, pain, and patient-expressed concerns, beyond vital signs. Intuitive insights allow nurses to identify high-risk patients earlier, even when vital signs have not reached abnormal thresholds, underscoring the role of "worry" as a precursor to clinical deterioration [20,A15].

(3) Decision-making ability

Decision-making ability refers to the nurse's capacity to promptly select and implement the most appropriate interventions in situations of clinical deterioration [A5]. Nurses must assess the degree of patient deterioration and determine whether escalation of treatment is warranted. Even when familiar with RRS activation criteria, nurses may rely more heavily on their clinical judgment and personal experience than on strictly following protocols or predetermined rules [A5,A11]. Nurses are expected to choose the most effective course of action in a given situation, directly affecting patient safety.

In clinical decision-making, nurses assess not only physiological variables, but also factors such as potential instability, illness severity, nursing records, and patient baseline information. EWS serve as valuable tools to support decision-making in these situations [A22]. Continuous patient surveillance is essential to collect the data necessary for informed decisions [A15]. Accurate assessment enables nurses to recognize subtle changes in clinical status, facilitating timely and appropriate responses.

(4) Communication and teamwork for escalation

To ensure timely and effective escalation of care, nurses must be able to communicate clearly and collaborate efficiently with multidisciplinary teams. This includes overcoming hierarchical barriers that may exist between physicians, nurses, and other healthcare professionals [A5]. Communication is pivotal in the escalation process; delays are often attributed to negative attitudes toward seeking assistance [A26]. Nurses frequently report anxiety and uncertainty about when and how to activate escalation protocols, even when deterioration is recognized.

A Korean study examining communication during clinical deterioration events found that "timeliness" scored highly, whereas "openness" scored lowest, highlighting persistent issues related to hierarchical culture within hospital settings [A23].

5) Consequences

Consequences refer to the outcomes or effects that occur when the concept is enacted [16]. This study explored the question: "What are the expected outcomes of nursing competency in coping with clinical deterioration?" The anticipated outcomes are as follows:

(1) Improvement in patient safety

Early recognition of clinical deterioration significantly improves patient outcomes and safety [A11]. Timely and appropriate responses can prevent progression of deterioration and facilitate rapid stabilization of the patient's condition. Delayed responses to deterioration are associated with lower survival rates and poorer clinical outcomes [4]. All nurses must provide high-quality, safe care to achieve optimal outcomes. Nurse managers should be aware of the competencies needed to identify and respond to clinical deterioration, as these directly impact patient outcomes [A34]. Additionally, a positive nursing practice environment is associated with reduced patient mortality, indicating that improvements in work environments contribute to safer patient care [A8].

(2) Enhanced confidence of nurses

Confidence refers to a nurse's belief in their ability to successfully perform a given task [A22]. Repeated experience in managing clinical deterioration enhances confidence and strengthens a nurse's capacity to respond effectively in similar situations. Negative emotions such as stress and anxiety in response to clinical deterioration can be mitigated through increased confidence and self-efficacy [A22]. Conversely, a lack of confidence may hinder a nurse's ability to manage clinical deterioration effectively [A5]. Confidence is critical in various clinical processes, including nursing performance, vital sign assessment, patient monitoring, clinical decision-making, communication with physicians, RRT activation, and treatment escalation [A15,A34]. Furthermore, hospital organizational culture should shift from blaming individual nurses for inexperience or system failures to promoting mutual support and collaboration [A16].

DISCUSSION

Although the importance of coping with clinical deterioration has been widely recognized through practical experience in various countries and healthcare institutions, the concept of clinical status deterioration itself remains poorly defined. This lack of clear and systematic understanding has made it difficult to elucidate the development of core nursing competencies, integrate these competencies into nursing curricula, and establish relevant policy frameworks.

This study applied Rodgers' evolutionary concept analysis method to clarify the concept of nursing competence in coping with clinical deterioration, focusing on its development across temporal and cultural contexts. The analysis confirmed that this concept has evolved dynamically over the past two decades, closely mirroring advancements in patient safety systems, technology adoption, and the professionalization of nursing roles—particularly in countries such as Australia, the United Kingdom, and the United States, where RRSs were introduced and standardized earlier [8-10].

The clarified concept of nursing competence in coping with clinical deterioration refers to a multifaceted capacity encompassing nurses' abilities to assess patient circumstances, monitor vital signs, apply clinical intuition, and engage in effective communication and teamwork with colleagues and RRTs. This integrative view reflects the increasingly complex role of nurses in ensuring early recognition and appropriate escalation in deteriorating patient situations.

First, this study explored the temporal and contextual evolution of the concept. The review of 35 international studies over a 25-year period highlighted how nursing competence in coping with clinical deterioration has transitioned from a focus on technical, task-based competencies to a holistic, leadership-oriented model. During the initial phase (2000–2010), nursing roles in patient deterioration management were largely concentrated on physiological assessment, vital signs monitoring, and primary survey (ABCD) [A5,A12,A13]. Nurses primarily acted as data collectors and reporters, with limited involvement in decision-making or escalation. Between 2011 and 2020, with the global spread of EWS and RRS systems, the focus expanded to include situational awareness, interdisciplinary communication, and structured escalation protocols [A3,A8,A22]. Nurses increasingly became recognized as active participants in patient safety teams, requiring competencies in recognizing deterioration, collaborating across disciplines, and initiating escalation [A15,A20,A26].

From 2021 onward, the concept has further evolved toward proactive nursing leadership, clinical advocacy, and advanced decision-making in the early stages of deterioration [A19,A24,A25,A34]. Nurses are now expected to initiate interventions, lead team communication, and advocate for improvements in patient safety culture at the organizational level, often supported by advanced technologies such as AI-assisted monitoring [21-23].

These changes reflect global healthcare trends, including an aging population, the rise in chronic diseases, and increased emphasis on safety culture and interdisciplinary teamwork [2,4,8]. Notably, heightened patient acuity and complexity have raised expectations for nurses' leadership in escalation processes and critical care management [12].

Second, this study examined cultural and contextual reflections using the case of Korea. The Korean healthcare system is at an earlier stage of this evolution; the Korean RRS was only institutionalized in 2019 [11], and nursing roles in clinical deterioration remain limited within a hierarchical, physician-centered model. This constrains nurses' autonomy and decision-making authority. Korean nurses continue to encounter barriers such as high patient loads, insufficient staffing, rigid reporting structures, and hierarchical cultural norms, all of which hinder their ability to exercise core competencies such as situational awareness, proactive decision-making, and interdisciplinary collaboration.

While the international literature consistently emphasizes the necessity of leadership empowerment, communication skill development, and simulation-based training [19,20,22], these elements remain underdeveloped in the Korean nursing context, highlighting the need for deliberate adaptation of globally derived concepts to address local sociocultural and organizational constraints.

Third, the findings of this concept analysis have significant implications for Korean nursing practice and policy development. Based on the clarified concept and its evolutionary trajectory, several strategic implications are proposed for Korean nursing practice and policy. First, educational reforms are urgently needed to move beyond the traditional focus on technical skills. Incorporating scenario-based simulations, reflective learning from adverse events, and critical thinking workshops are essential strategies to foster competencies aligned with the proactive and integrative roles required for managing clinical deterioration [23,24].

Additionally, policy reforms should consider enabling nurses to activate the RRS independently, without prior physician approval, as successfully implemented in countries such as the United States, the United Kingdom, and Australia [9-12]. From an organizational perspective, workforce management strategies must prioritize maintaining safe patient-to-nurse ratios, especially during night shifts, to establish an environment where clinical decision-making and escalation processes can be executed promptly and effectively [11,12].

Furthermore, there is a critical need to implement culturally sensitive communication training programs—such as SBAR frameworks adapted to the specific dynamics of Korean clinical settings—to address nurses’ hesitation and uncertainty regarding communication and escalation. These strategic directions align with global recommendations emphasizing interdisciplinary collaboration, nurse empowerment within patient safety systems, and the promotion of proactive behaviors for timely escalation in deteriorating patient situations [1,4,8,11].

This study is the first to systematically clarify the concept of nursing competence in coping with clinical deterioration using Rodgers’ evolutionary method, incorporating both historical and cultural perspectives. Unlike previous domestic studies that focused on isolated skills, this research presents a comprehensive, leadership-oriented conceptual model that aligns with international standards while also addressing Korea’s unique healthcare context.

By broadening the scope of nursing competence beyond traditional emergency care, the clarified concept integrates key attributes such as patient assessment, vital signs monitoring, situational awareness, intuition, clinical decision-making, and team communication. These competencies directly contribute to improved patient safety, enhanced nurse confidence, and strengthened professional autonomy.

Furthermore, this study provides a theoretical foundation for the development of nurse-led escalation systems, informs policy reforms, and guides the redesign of nursing education in Korea. Effective management of clinical deterioration not only improves patient outcomes but also promotes a culture of collaboration and mutual support within healthcare organizations [A35].

A notable limitation of this study is the lack of domestic literature, necessitating reliance on international sources for concept clarification. Given the increasing patient acuity associated with an aging population, chronic diseases, and emerging infectious diseases such as coronavirus disease 2019, further research is required to refine and contextualize this concept within Korean clinical settings. Future studies should focus on developing reliable assessment tools for evaluating nurses' response competencies to deterioration, and on designing simulation-based education programs to enhance these capabilities. Additionally, research should examine barriers to recognition and escalation, and propose strategies to overcome them, with an emphasis on fostering effective communication and teamwork among nurses, physicians, and RRS teams.

CONCLUSION

This study clarified the concept of nursing competence in coping with clinical deterioration using Rodgers' evolutionary concept analysis method, based on a review of 35 international studies from 2000 to 2025. The analysis demonstrated that nursing competence has evolved from a task-oriented focus to an integrated model emphasizing early recognition, clinical judgment, decision-making, communication, and leadership.

Key conceptual attributes were identified, including technical skills, situational awareness, critical thinking, and interprofessional collaboration. Antecedents such as clinical experience, structured education, and simulation-based training were shown to be essential for developing competence, while influencing factors included organizational culture, staffing levels, and system support (e.g., EWS, RRS). Competent nursing responses were consistently linked to improved patient safety, timely escalation, and increased nurse confidence.

Cross-national comparisons revealed that Western countries have adopted proactive, nurse-led escalation systems more fully than countries still in earlier stages of implementation, such as Korea. These findings suggest the need for contextual adaptation, especially in settings with hierarchical clinical structures and limited nurse autonomy.

The clarified concept provides a foundational framework for developing educational curricula, institutional policies, and competency assessment tools aimed at enhancing nurses' ability to respond effectively to clinical deterioration. Future efforts should prioritize empowerment, simulation-based training, and system-level support to strengthen nursing leadership in acute care settings and promote patient safety outcomes.

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CONFLICTS OF INTEREST

The author declared no conflict of interest.

FUNDING

None.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to Park Soohyung, Senior Clinical Research Associate at Premier Research, for dedicated assistance with data collection and coordination throughout the study.

DATA AVAILABILITY STATEMENT

The data can be obtained from the corresponding authors.

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Appendix 1. List of Studies Included in Concept Analysis

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ORIGINAL ARTICLE

Korean J Adult Nurs Vol. 37 No. 3, 231-244, August 2025
eISSN: 2288-338X
https://doi.org/10.7475/kjan.2025.0204

KJAN
Korean Journal of
Adult Nursing

Development and Effectiveness of a Mobile Application-Based Health Management Program for Middle-Aged Men with Andropause: A Non-equivalent Control Group Pretest-Posttest Study

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Received: February 4, 2025
Revised: April 22, 2025
Accepted: June 17, 2025

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Purpose: This study aimed to develop and evaluate the effectiveness of a health management program using a mobile application for middle-aged men experiencing andropause. **Methods:** A quasi-experimental design with a non-equivalent control group pretest-posttest structure was employed. The study took place from June 27 to August 30, 2024, with participant recruitment occurring from June 27 to July 10, 2024. In total, 61 participants (30 in the experimental group and 31 in the control group) participated from July 15 to August 20, 2024. The experimental group received an application-based health management program, while the control group did not. **Results:** The experimental group showed significant improvements in subjective quality of life, health-promoting behaviors, and subjective health status compared to the control group ($p < .001$). **Conclusion:** This study confirms that mobile applications can effectively manage health during andropause in middle-aged men. Further research with a larger sample size is recommended to validate these findings.

Key Words: Andropause; Health information management; Male; Mobile applications

INTRODUCTION

Andropause, derived from the Greek words *andras* (man) and *pausē* (cessation), refers to a clinical condition marked by a decline in masculinity due to age-related hormonal changes [1]. It is a syndrome associated with androgen deficiency, primarily testosterone, leading to various physiological and psychological symptoms [2]. Conditions such as androgen deficiency in the aging male, late-onset hypogonadism, and partial androgen deficiency in aging men are commonly observed in men undergoing andropause [3].

In 1946, Werner published a seminal paper titled “The Male Climacteric” in the *Journal of the American Medical Association*, outlining the clinical presentation of andropause [4]. Since then, extensive research has examined the relationship between testosterone deficiency and associated symptoms, including diminished libido, reduced muscle mass and strength, impaired cognitive function, and overall decline in physical and mental well-being [5].

The prevalence of andropause exceeds 60% among middle-aged men, significantly affecting their quality of life [6]. If left unmanaged, andropause may contribute to chronic diseases such as metabolic syndrome, osteoporosis, and cardiovascular disorders [7]. Thus, raising awareness and promoting proactive, evidence-based health management strategies are essential for mitigating the long-term impacts of andropause.

Middle age represents a peak period of social capability and a heightened need for recognition. However, it is also characterized by stress and instability due to experiences of andropause symptoms, aging-related physical and psychological changes, retirement, and shifting family dynamics [8]. With a life expectancy of 83.3 years in Korea, advances in science and medical technology contribute to steadily increasing lifespans. Both men and women entering middle age at 40 years are expected to live an additional 40 years or more, prompting increased interest in quality-of-life enhancement during this extended period [9]. Nonetheless, Korea's 2022 Organization for Economic Co-operation and Development (OECD) life satisfaction score was 6.1 out of 10, below the OECD average of 7.4 [10]. A previous study by Kim and Park [11] identified factors such as andropause symptoms, depression, family bonding, physical activity, and monthly income as significant contributors to quality of life during early middle age. In later middle age, social support, subjective health status, job security, job stress, and smoking status were key influencing factors. Another study by Kim and Sung [12] identified self-esteem, stress, andropause symptoms, and monthly income as significant factors impacting quality of life among middle-aged men.

With the increasing impact of andropause symptoms on quality of life in middle-aged men, there is an urgent need for effective prevention and management strategies [12]. Educational programs emphasizing proper nutrition and physical activity, specifically tailored to middle-aged men, are essential for effectively managing andropause symptoms [11]. Since mobile applications were introduced in Korea in November 2009, various applications have rapidly emerged. Currently, over 90% of Koreans use smartphones. This widespread smartphone usage has facilitated the introduction of health-related applications [13], making them essential tools for self-management, patient education, and healthcare [14]. Education through mobile applications enables tailored, individualized learning regardless of time and place. Leveraging smartphones, familiar to the general public, provides an accessible and cost-effective means of promoting health management and andropause prevention in men, maximizing benefits at minimal costs.

Despite the increasing use of mobile applications in healthcare, prior research on their effectiveness in health promotion, particularly for andropause management, remains insufficient [12]. While existing studies have explored digital health interventions in chronic disease management, mental health, and physical activity promotion, research specifically addressing mobile application effectiveness in improving health outcomes for middle-aged men experiencing andropause is limited [4]. This gap highlights the need for additional research into the potential benefits and limitations of mobile health applications within this population.

Furthermore, although previous research has explored digital health interventions, there is a lack of in-depth comparisons between different types of interventions implemented across diverse populations [4,5]. A more thorough discussion of mobile application-based health programs, covering their design, implementation, and long-term effectiveness, could strengthen the study's context. Integrating findings from various mobile health interventions—such as diabetes management, cardiovascular disease prevention, and smoking cessation—would provide broader insights into the effectiveness of digital tools in managing andropause.

Most previous studies on middle-aged men have focused on specific aspects, such as relationships between andropause symptoms, stress, or quality of life [12,15], or have identified influencing factors without proposing comprehensive intervention strategies [11]. In contrast, this study develops and implements a structured health management program specifically tailored for middle-aged men experiencing andropause. The program systematically aims to enhance health-promoting behaviors, subjective health status, and overall quality of life. By integrating nutritional, physical activity, and psychological education through an accessible mobile application, this study addresses existing research gaps and provides an innovative, practical solution for middle-aged men facing andropause-related challenges. Thus, this study aims to develop and evaluate the effectiveness of a mobile application-based health management program tailored for middle-aged men experiencing andropause.

METHODS

1. Study Design

This study used a quasi-experimental design featuring a non-equivalent control group pretest-posttest structure to develop and evaluate the effectiveness of a health management improvement education program for middle-aged men experiencing andropause. This study was reported in accordance with the CONSORT (Consolidated Standards of Reporting Trials) guidelines.

2. Setting and Samples

The study was conducted from June 27 to August 30, 2024, targeting middle-aged men experiencing menopausal symptoms who visited urology departments at university hospitals in Seoul, Gyeonggi, and Gangwon provinces. Participants were recruited from June 27 to July 10, 2024, and data collection along with the intervention occurred from July 15 to August 20, 2024.

The inclusion criteria were as follows: participants were middle-aged men aware of their andropause (male menopause) symptoms who voluntarily consented to participate after fully understanding the study's purpose. Participants had to communicate effectively and respond adequately to questionnaires. They could have common chronic conditions like prostate disorders, hypertension, hyperlipidemia, or diabetes, but they must not have been receiving specialized medical treatments, such as hormone therapy (e.g., testosterone replacement therapy). Additionally, their male hormone levels (e.g., total testosterone or free testosterone) should either not have been measured within the previous 6 months, or, if measured, results had to be at borderline levels without an established diagnosis or treatment plan.

The exclusion criteria were as follows: individuals requiring professional psychiatric treatment were excluded. Participants with physical disabilities hindering their use of mobile devices for the program were also excluded. Additionally, those already involved in other health management programs or clinical studies were not eligible to participate.

The sample size was calculated using G*Power 3.2 software [16], with a significance level of .05, statistical power of .80, and a medium effect size of .50. The required sample size per group was 27. Considering a potential dropout rate of 20%, 80 participants (40 per group) were recruited.

Participants were allocated to experimental and control groups through a non-randomized, convenience-based method. After verifying eligibility and obtaining consent, participants were sequentially assigned based on recruitment order and geographic accessibility. To minimize selection bias and enhance group equivalence, participants were matched by age and treatment history whenever possible. Although randomization was not implemented due to practical and ethical constraints in clinical settings, statistical tests confirmed homogeneity between groups before the intervention.

In the experimental group, 10 participants withdrew due to personal reasons (e.g., difficulty using the application or attending educational sessions). In the control group, nine participants withdrew due to relocation, business trips, or travel, preventing post-intervention data collection. Ultimately, data from 61 participants—30 in the experimental group and 31 in the control group—were included in the final analysis (Figure 1).

Control group participants were selected via convenience sampling from the same hospitals and matched with the experimental group by age and treatment history.

3. Instruments

1) Subjective quality of life

In this study, subjective quality of life refers to an emotional evaluation that reflects a cognitive assessment of one's overall life. The measurement tool used was the Subjective Quality of Life Scale, which was adapted and refined by Lee [17] from Campbell's Index of Wellbeing [18]. This scale consists of eight items, each rated on a 5-point Likert scale, reflecting emotional evaluations based on recent experiences. Higher scores indicate greater satisfaction with life. Lee [17] reported a reliability coefficient (Cronbach's α) of .90; this study achieved a slightly higher reliability coefficient of .91.

2) Health-promoting behaviors

Health-promoting behaviors were measured using the Health Promotion Lifestyle Profile-II (HPLP-II), initially developed by Walker et al. [19] and adapted for a Korean context by Seo and Hah [20]. This instrument includes 50 items divided into six sub-factors: health responsibility (8 items), physical activity (8 items), nutrition (9 items), spiritual growth (9 items), interpersonal relationships (8 items), and stress management (8 items). Items are scored on a 4-point Likert scale, with higher scores indicating more frequent health-promoting behaviors. Cronbach's α for reliability was .94 at original development, .92 in the adaptation by Seo and Hah [20], and .94 in this study.

3) Subjective health status

Subjective health status was measured using the Health Self Rating Scale, originally developed by Northern Illinois University [21] and later adapted and revised by Shin and

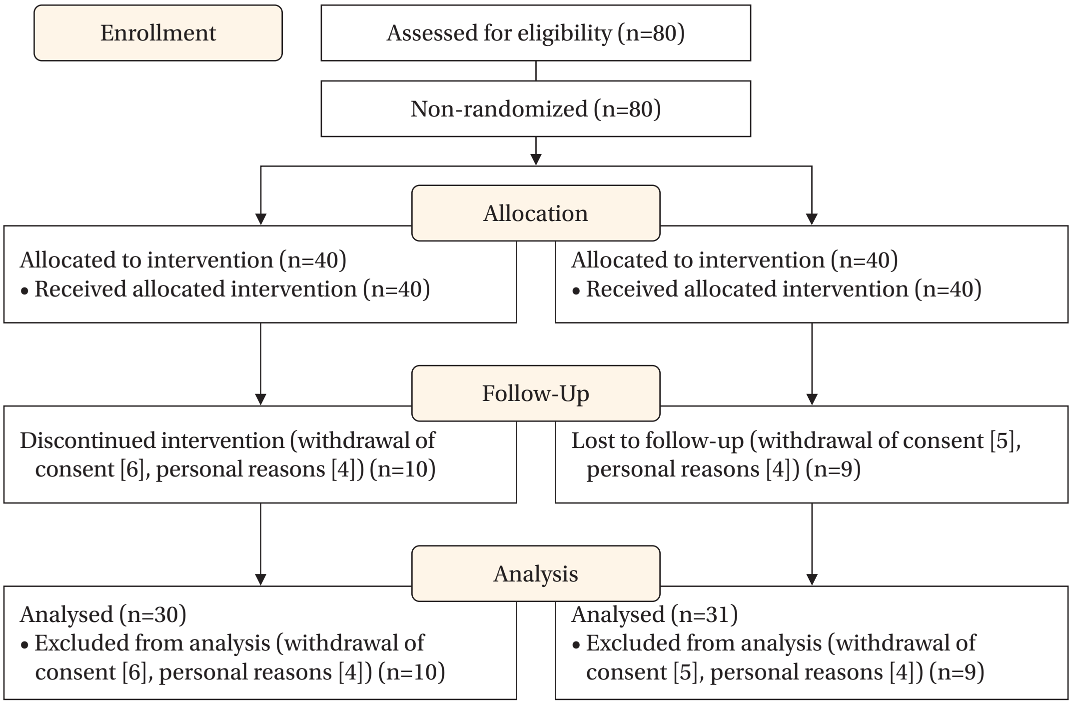

Figure 1. CONSORT 2010 flow diagram.

Kim [22]. This scale consists of three items rated on a 5-point Likert scale, with higher scores indicating better subjective health. Cronbach's α for reliability was .70 in Shin and Kim's study [22] and .84 in the present study.

4. Research Procedure

This study developed a mobile educational application designed to promote health management among middle-aged men experiencing andropause. The application development followed Keller's ARCS (Attention, Relevance, Confidence, Satisfaction) motivational model [23] and multimedia instructional design principles [24]. The application aimed to enhance user motivation, improve health literacy, and encourage sustainable self-care behaviors (Appendix 1).

The mobile educational application used in this study was structured to support sustainable health behavior changes by increasing user engagement and self-efficacy. It included six key functions: educational content on andropause management, self-assessment checklists, symptom tracking, reminder alarms, peer support via a bulletin board, and application usage guidance. Additional features such as quizzes, educational videos, and an expert Q&A section were integrated based on user feedback to improve usability and satisfaction, as described in a previous study [25].

5. Data Collection Period and Procedure

Data collection was conducted from July 15 to August 20, 2024. With cooperation from the directors of participating hospitals, the research team carried out educational sessions and collected data at outpatient urology clinics. To ensure clear role distinctions between educators and data collectors, all research team members underwent training beforehand. Two primary educators delivered the intervention, while two assistant educators handled participant recruitment, administered the pre-test surveys, and guided participants through application installation.

The primary educators conducted face-to-face educational sessions and orientations, providing detailed instructions on both the content of the health management program and usage of the mobile application. Participants received individualized support, including additional guidance and feedback when encountering difficulties with the application. The structure of the mobile-based health management program, including its main menus and submenus, is presented in Table 1 and Appendix 2.

The assistant educators distributed and collected questionnaires, managed participant interactions, and conducted follow-up surveys. They also provided telephone con-

Table 1. Homogeneity Test of Participants' General Characteristics

Variables	Categories	n (%) or M ± SD		χ^2/t (*p*)
		Experimental group (n = 30)	Control group (n = 31)	
Region	Seoul	11 (36.7)	12 (38.7)	2.07 (.356)
	Gangwon province	6 (20.0)	9 (29.0)	
	Gyeonggi province	13 (43.3)	10 (32.3)	
Age (year)		54.33 ± 5.66	53.77 ± 4.77	0.42 (.678)
Andropause treatment duration	≤ 6 months	15 (50.0)	23 (74.2)	4.18 (.382)
	7–12 months	10 (33.3)	6 (19.4)	
	13–18 months	3 (10.0)	2 (6.4)	
	19–24 months	1 (3.3)	0 (0.0)	
	> 24 months	1 (3.3)	0 (0.0)	
Marital status	Single	5 (16.7)	3 (9.7)	3.49 (.175)
	Married	25 (83.3)	25 (80.6)	
	Divorced	0 (0.0)	3 (9.7)	
Living with family	Alone	6 (20.0)	4 (12.9)	0.50 (.973)
	With spouse	7 (23.3)	8 (25.8)	
	With children	1 (3.3)	1 (3.2)	
	With spouse and children	14 (46.7)	16 (51.6)	
	Other	2 (6.7)	2 (6.5)	
Education level	≤ High school graduate	4 (13.3)	11 (35.5)	5.10 (.165)
	College graduate	9 (30.0)	7 (22.6)	
	University graduate	10 (33.3)	10 (32.3)	
	Graduate school or higher	7 (23.3)	3 (9.7)	
Annual income level (million KRW)	10–20	0 (0.0)	1 (3.2)	1.31 (.715)
	21–30	1 (3.3)	1 (3.2)	
	31–40	8 (26.7)	6 (19.4)	
	≥ 41	21 (70.0)	23 (74.2)	

Percentages may not sum to 100 due to rounding.
M = mean; SD = standard deviation.

sultations to ensure participants understood and effectively applied the educational content.

The intervention for the experimental group took place between July 15 and August 20, 2024. Participants engaged in a 14-day self-learning program via the application, accessing it at least once daily.

Before the intervention, a baseline survey was administered to assess participants' health-promoting behaviors, subjective health status, and quality of life using standardized instruments. Participants received comprehensive explanations of the survey content and completion methods. Subsequently, during an application orientation session, two educators assisted participants with installing the application and provided detailed explanations about the program's goals, participation methods, daily telephone consultation schedules, post-intervention survey procedures, and interview guidelines.

During the intervention period, participants performed daily self-directed learning through the application, complemented by daily telephone consultations with educators to reinforce content comprehension. After the intervention, assistant educators conducted a post-intervention survey to re-evaluate health-promoting behaviors, subjective health status, and quality of life. Additionally, participants completed individual interviews lasting 30–40 minutes to assess their satisfaction, application experiences, and overall impressions of the program.

For the control group, only pre- and post-intervention surveys were conducted, separated by a 14-day interval. In line with ethical considerations, after study completion, the mobile application was offered to control group participants. During the intervention period, the control group received a brief, one-time explanation emphasizing the importance of health management; however, no educational materials or interventions were provided.

6. Ethical Considerations

This study received approval from the Institutional Review Board of Sahmyook Seoul Hospital (IRB No: 116286-202403-HR-02). Before data collection, participants were informed of the study's purpose, confidentiality, absence of direct compensation or risk, and their rights to refuse or withdraw participation at any time. Written informed consent was obtained from all participants. All collected data were anonymized and accessible only to the research team. Regardless of group assignment, participants received a small token of appreciation for their voluntary participation.

7. Data Analysis

Data analysis was performed using the IBM SPSS/WIN version 24.0 software (IBM Corp., Armonk, NY, USA), applying the following statistical methods:

Descriptive statistics including frequency, percentage, mean, and standard deviation (SD) were used to analyze participants' general characteristics, health-promoting behaviors, subjective health status, and quality of life. Normality of data distributions in both groups was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Homogeneity between experimental and control groups prior to intervention was tested using parametric methods such as the independent t-test and chi-square test. Within-group differences before and after the intervention were examined using the paired t-test for parametric data and the Wilcoxon signed-rank test for non-parametric data, depending on data characteristics. Differences between groups post-intervention were analyzed using the independent t-test, the chi-square test, and the Mann-Whitney U test. *p*-values of less than 0.05 were considered significant. Lastly, the reliability of measurement instruments was confirmed by calculating Cronbach's α.

RESULTS

1. Homogeneity Test of Participants' General Characteristics

To evaluate the development and effectiveness of the educational mobile application for health management among middle-aged men experiencing andropause, a homogeneity test on participants' general characteristics was conducted. The results confirmed no statistically significant differences between experimental and control groups at a significance level of 5%, ensuring homogeneity (Table 1). Specifically, 36.7% of experimental participants and 38.7% of control participants resided in Seoul; this difference was not statistically significant (t = 2.07, *p* = .356). In Gangwon province, representation was 20.0% in the experimental group and 29.0% in the control group. Participants from Gyeonggi province accounted for 43.3% of the experimental group and 32.2% of the control group.

The mean age was 54.33 years (SD = 5.66) in the experimental group and 53.77 years (SD = 4.77) in the control group, with no significant difference (t = 0.42, *p* = .678).

For the duration of andropause treatment, 50.0% of the experimental group and 74.2% of the control group had received treatment for less than 6 months; this difference was not statistically significant (t = 4.18, *p* = .382). Treatment durations of 7 to 12 months were reported by 33.3% of experimental participants and 19.4% of controls, while durations of 13 to 18 months were reported by 10.0% and 6.4%, respectively. Only 3.3% of experimental participants had 19 to 24 months of treatment, compared to 0.0% in the control group. Treatment duration exceeding 24 months was reported by 3.3% of experimental participants and none in the control group.

Regarding marital status, 16.7% of experimental and 9.7% of control participants were single, with no significant difference (t = 3.49, *p* = .175). Married participants constituted 83.3% of the experimental group and 80.6% of the control group. No experimental participants reported being divorced, whereas 9.7% of control participants were divorced.

In terms of living arrangements, 20.0% of experimental participants and 12.9% of control participants lived alone, with no significant difference (t = 0.50, *p* = .973). Living with a spouse was reported by 23.3% of experimental participants and 25.8% of control participants. Living only with children was reported by 3.3% of the experimental group and 3.2% of the control group. Participants living with both spouse and children accounted for 46.7% of the experimental group and 51.6% of the control group, while other living arrangements were reported by 6.7% of the experimental group and 6.5% of the control group.

Educational attainment revealed no significant differences (t = 5.10, *p* = .165), with 13.3% of experimental and 35.5% of control participants having a high school diploma or less. University-level education was reported by 30.0% of experimental and 22.6% of control participants. Bachelor's

https://doi.org/10.7475/kjan.2025.0204

degrees were held by 33.3% of experimental and 32.3% of control participants, while graduate-level education or higher was reported by 23.3% and 9.7%, respectively.

Regarding income levels (reported as annual income), no participants in the experimental group and 3.2% of participants in the control group reported earning between 10 and 20 million KRW per year, with no statistically significant difference between the groups (t = 1.31, *p* = .715). Among the participants, 3.3% of the experimental group and 3.2% of the control group earned between 20 and 30 million KRW annually. An income between 30 and 40 million KRW was reported by 26.7% of participants in the experimental group and 19.4% in the control group. Lastly, a majority of participants in both groups earned over 50 million KRW annually 70.0% in the experimental group and 74.2% in the control group.

2. Homogeneity Test of Participants' Subjective Quality of Life, Health-Promoting Behaviors, and Subjective Health Status

To evaluate the homogeneity of the experimental and control groups regarding subjective quality of life, health-promoting behaviors, and subjective health status prior to intervention, both parametric (independent t-test) and non-parametric (Mann–Whitney U test) analyses were conducted. The results confirmed no statistically significant differences at the 5% significance level, indicating homogeneity between groups in these variables prior to intervention (Table 2).

Regarding subjective quality of life, the mean scores were 2.98 (SD = 0.89) in the experimental group and 2.77 (SD = 0.70) in the control group, showing no significant difference (t = 1.005, *p* = .319). Similarly, the Mann-Whitney U test confirmed no significant difference (Z = –1.150, *p* = .250). The median scores were 3.06 (25th–75th percentiles = 2.13–3.50) in the experimental group and 2.75 (25th–75th percentiles = 2.25–3.00) in the control group.

With respect to health-promoting behaviors, the mean scores were 2.20 (SD = 0.58) for the experimental group and 1.97 (SD = 0.46) for the control group, with no significant difference (t = 1.739, *p* = .087). The Mann–Whitney U test also showed no significant difference (Z = –1.428, *p* = .153). The median scores were 2.20 (25th–75th percentiles = 1.79–2.60) for experimental participants and 1.86 (25th–75th percentiles = 1.62–2.38) for controls, corresponding to a small difference.

For subjective health status, the mean scores were 2.86 (SD = 0.82) in the experimental group and 3.08 (SD = 0.64) in the control group, with no statistically significant difference (t = –1.163, *p* = .249). The Mann–Whitney U test similarly showed no significant difference (Z = –0.834, *p* = .404). The median scores were identical at 3.00, with interquartile ranges of 2.00–3.42 for the experimental group and 2.67–3.33 for the control group, confirming minimal variation between groups.

3. Pre-Post Comparison of Subjective Quality of Life, Health-Promoting Behaviors, and Subjective Health Status

The analysis of pretest and posttest measurements in the experimental group, conducted using both parametric (paired t-test) and non-parametric (Wilcoxon test) methods, revealed statistically significant improvements at the 5% significance level in subjective quality of life, health-promoting behaviors, and subjective health status. These results indicate that the health management improvement education program effectively enhanced these aspects for middle-aged men experiencing andropause. Conversely, the control group demonstrated no statistically significant differences between pre- and post-intervention measures. Moreover, the comparison between experimental and control groups after the intervention, analyzed us-

Table 2. Homogeneity Test of Participants' Subjective Quality of Life, Health-Promoting Behaviors, and Subjective Health Status

Variables	Items	Experimental group (n = 30)	Control group (n = 31)	Z (*p*)
Subjective quality of life	M ± SD	2.98 ± 0.89	2.77 ± 0.70	–1.150 (.250)
	Median (25th–75th percentiles)	3.06 (2.13–3.50)	2.75 (2.25–3.00)	
Health-promoting behaviors	M ± SD	2.20 ± 0.58	1.97 ± 0.46	–1.428 (.153)
	Median (25th–75th percentiles)	2.20 (1.79–2.60)	1.86 (1.62–2.38)	
Subjective health status	M ± SD	2.86 ± 0.82	3.08 ± 0.64	–0.834 (.404)
	Median (25th–75th percentiles)	3.00 (2.00–3.42)	3.00 (2.67–3.33)	

M = mean; SD = standard deviation.

ing independent t-tests and Mann-Whitney U tests, showed statistically significant differences at the 5% significance level. Posttest results confirmed that the experimental group scored higher than the control group on subjective quality of life, health-promoting behaviors, and subjective health status (Table 3).

For subjective quality of life, the experimental group's mean score increased significantly from 2.26 (SD = 0.86, median = 2.19, 25th–75th percentiles = 1.59–2.69) before the intervention, to 2.98 (SD = 0.89, median = 3.06, 25th–75th percentiles = 2.13–3.50) after the intervention. In the control group, the mean score decreased from 2.75 (SD = 0.69, median = 2.75, 25th–75th percentiles = 2.25–3.00) pre-intervention to 2.40 (SD = 0.79, median = 2.00, 25th–75th percentiles = 1.88–2.81) post-intervention. The paired t-test showed that the experimental group significantly improved in subjective quality of life post-intervention (t = 2.34, *p* = .028), and the Mann-Whitney U test confirmed this statistically significant difference (Z = 2.33, *p* = .019).

Regarding health-promoting behaviors, the experimental group's mean score significantly increased from 2.20 (SD = 0.58, median = 2.20, 25th–75th percentiles = 1.79–2.60) pre-intervention, to 2.57 (SD = 0.64, median = 2.63, 25th–75th percentiles = 2.06–3.10) post-intervention. In the control group, the mean score rose from 1.97 (SD = 0.46, median = 1.86, 25th–75th percentiles = 1.62–2.38) before the intervention, to 2.31 (SD = 0.43, median = 2.64, 25th–75th percentiles = 2.22–2.82) after the intervention. The paired t-test indicated a statistically significant improvement for the experimental group in health-promoting behaviors (t = 2.31, *p* = .021), further supported by the Mann-Whitney U test (Z = 2.15, *p* = .032).

For subjective health status, the experimental group's mean score significantly increased from 2.86 (SD = 0.82, median = 3.00, 25th–75th percentiles = 2.00–3.42) before the intervention to 3.40 (SD = 0.66, median = 3.67, 25th–75th percentiles = 3.00–3.67) after the intervention. In the control group, the mean score rose from 3.08 (SD = 0.64, median = 3.00, 25th–75th percentiles = 2.67–3.33) pre-intervention to 3.45 (SD = 0.76, median = 3.67, 25th–75th percentiles = 3.00–4.00) post-intervention. The paired t-test showed that the experimental group's improvement in subjective health status post-intervention was statistically significant (t = 2.44, *p* = .019), and the Mann-Whitney U test also confirmed this significant difference (Z = 2.02, *p* = .043).

DISCUSSION

In South Korea, public awareness and management strategies for male andropause remain relatively limited, and health promotion services offered by public health centers for this issue are also insufficient. Building upon prior research, this study developed a health promotion program aimed at improving symptom management for middle-aged men experiencing andropause [4]. The findings confirmed that homogeneity was successfully established between the experimental and control groups, which is essential for verifying the research's overall validity and strengthens the reliability of the program's effectiveness evaluation. With established homogeneity, the experimental group demonstrated significant improvements in subjective quality of life, health-promoting behaviors, and perceived health status. These outcomes provide critical evidence supporting the educational program's effectiveness for health management in middle-aged men.

In contrast, the control group showed no significant improvements in health-promoting behaviors, subjective health status, or quality of life compared to the experimental group. This lack of improvement may be attributed to the complex interplay of external factors such as voluntary participation in health management, insufficient educational support, low motivation, the short duration of the in-

Table 3. Comparison of Subjective Quality of Life, Health-Promoting Behaviors, and Subjective Health Status

Variables	Items	Experimental group (n = 30)		Control group (n = 31)		t (*p*)/Z (*p*)
		Pre	Post	Pre	Post	
Subjective quality of life	Paired differences (M ± SD)	2.26 ± 0.86	2.98 ± 0.89	2.75 ± 0.69	2.40 ± 0.79	2.34 (.028)/
	Median (25th–75th percentiles)	2.19 (1.59–2.69)	3.06 (2.13–3.50)	2.75 (2.25–3.00)	2.00 (1.88–2.81)	2.33 (.019)
Health-promoting behaviors	Paired differences (M ± SD)	2.20 ± 0.58	2.57 ± 0.64	1.97 ± 0.46	2.31 ± 0.43	2.31 (.021)/
	Median (25th–75th percentiles)	2.20 (1.79–2.60)	2.63 (2.06–3.10)	1.86 (1.62–2.38)	2.64 (2.22–2.82)	2.15 (.032)
Subjective health status	Paired differences (M ± SD)	2.86 ± 0.82	3.40 ± 0.66	3.08 ± 0.64	3.45 ± 0.76	2.44 (.019)/
	Median (25th–75th percentiles)	3.00 (2.00–3.42)	3.67 (3.00–3.67)	3.00 (2.67–3.33)	3.67 (3.00–4.00)	2.02 (.043)

M = mean; SD = standard deviation.

tervention, and environmental influences that could have impacted their health behaviors and quality of life.

To enhance the validity of future research, researchers should more rigorously control these external variables and refine the study design. Additionally, careful consideration of these external influences is necessary when comparing experimental and control groups to strengthen the reliability of findings.

This study's intervention lasted approximately 2 weeks, making it challenging to evaluate its medium- to long-term effects. Particularly, further follow-up research is necessary to assess whether improvements in health-promoting behaviors and lifestyle changes persist over time. Future research should, therefore, evaluate the sustainability of these effects over longer periods, such as 6 months or one year.

This study demonstrated that mobile application-based health education positively influenced health promotion among middle-aged men. Further research is required to validate the effectiveness of this educational approach in greater depth and to develop additional strategies enhancing its practical applicability.

Andropause is characterized by substantial physical and psychological changes, making middle age a critical period for enhanced health management. Previous studies have confirmed that physical and emotional symptoms of andropause negatively affect subjective quality of life and health behaviors [26]. Therefore, middle-aged men should emphasize proactive health management upon entering andropause. The health promotion program developed in this study significantly addresses these issues. According to the findings, the experimental group experienced meaningful improvements in subjective quality of life, health-promoting behaviors, and perceived health status following participation [27].

The educational program used an integrated approach to comprehensively address the physical and emotional needs of men experiencing andropause, demonstrating a positive impact on their overall health. Specifically, the intervention provided education via a mobile application—covering essential knowledge, dietary recommendations, and exercise guidance—and included practice monitoring, which constituted targeted interventions specifically for middle-aged men with andropause. These elements were intentionally designed to address core health concerns related to andropause during the development process. By offering fundamental knowledge, the program increased participants' understanding of andropause; dietary and exercise guidance provided practical strategies for symptom management, and the application's monitoring feature reinforced sustained participation and adherence, encouraging positive behavioral changes.

This study highlights that a targeted intervention effectively improved self-management among middle-aged men. By integrating various aspects of health management (knowledge provision, behavioral practices, and real-time monitoring), the program offered a holistic and systematic approach [28]. This integrative method facilitated not only the management of physical symptoms but also promoted consistent engagement in health-promoting behaviors, enhancing overall well-being.

Therefore, ongoing data collection is essential for establishing structured and personalized programs as crucial tools in promoting health among men experiencing andropause. Such efforts will help alleviate andropause symptoms and expand opportunities to enhance overall quality of life.

The experimental group, which received the mobile educational intervention, exhibited significant improvements in health-promoting behaviors, subjective health status, and quality of life compared to the control group. These results align with previous research highlighting the effectiveness of mobile health interventions for enhancing physical, emotional, and overall well-being, especially in middle-aged men experiencing andropause.

The findings of this study are consistent with prior research demonstrating that mobile health interventions effectively improve health behaviors, subjective health status, and quality of life [29,30], reinforcing the potential of mobile health programs for managing health during andropause. The study supported all three hypotheses, confirming significant improvements through the mobile educational program. The program's success can be attributed to its accessible and personalized approach. However, limitations include the short intervention period and reliance on self-reported data. Future research should include longer follow-up periods and objective outcome measures to further validate these findings.

However, this study has certain limitations. The use of convenience sampling limits the generalizability of the results. Additionally, participants were drawn from specific geographic regions (Seoul, Gyeonggi, and Gangwon provinces in Korea), further restricting the broader applicability of the findings. Future research should involve larger and more diverse samples to enhance the validity and applicability of the results.

CONCLUSION

This study evaluated the impact of an educational program designed to improve symptoms of andropause and promote health among middle-aged men. It specifically assessed the program's influence on subjective quality of life, health-promoting behaviors, and subjective health status. The experimental group demonstrated statistically significant improvements compared to the control group, underscoring the program’s effectiveness in enhancing health management among middle-aged men experiencing andropause.

Middle-aged men undergo significant physical and emotional changes during andropause, which, if inadequately managed, can lead to reduced quality of life and health deterioration. Consequently, structured and individualized health promotion programs are critically needed to effectively address these challenges. The program developed in this study utilized a mobile application-based educational approach, delivering accessible health management information free from constraints of time and location. This enabled participants to easily integrate health management practices into their daily routines, highlighting the program’s practical utility in facilitating consistent health behaviors.

The findings emphasize the necessity of systematic, regular educational programs to help middle-aged men manage the physical and emotional changes associated with andropause and to improve overall health. Mobile application-based health education is particularly promising as an essential tool within such programs. It is crucial to continue refining these methods so that more middle-aged men can effectively manage andropause symptoms and enhance their quality of life.

Based on the results of this study, the following recommendations are proposed: First, given the limited number of participants, further research involving continuous data collection with more diverse populations is necessary to develop effective health management programs tailored for men experiencing andropause. Second, due to the current lack of systematic support for andropause-related health promotion programs within public health services, increased efforts in awareness campaigns and educational initiatives are essential.

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

Study conception and design acquisition - SJP and YSL; data collection - SJP and YSL; analysis and interpretation of the data - SJP and YSL; discussion and conclusions -suggestions: SJP; english review - SJP and YSL; abstract and references and final submission - YSL; drafting and critical revision of the manuscript - SJP and YSL.

FUNDING

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. RS-2022-00166296).

ACKNOWLEDGEMENT

Application development was done by It's JLAB Co., Ltd.

DATA AVAILABILITY STATEMENT

The data can be obtained from the corresponding authors.

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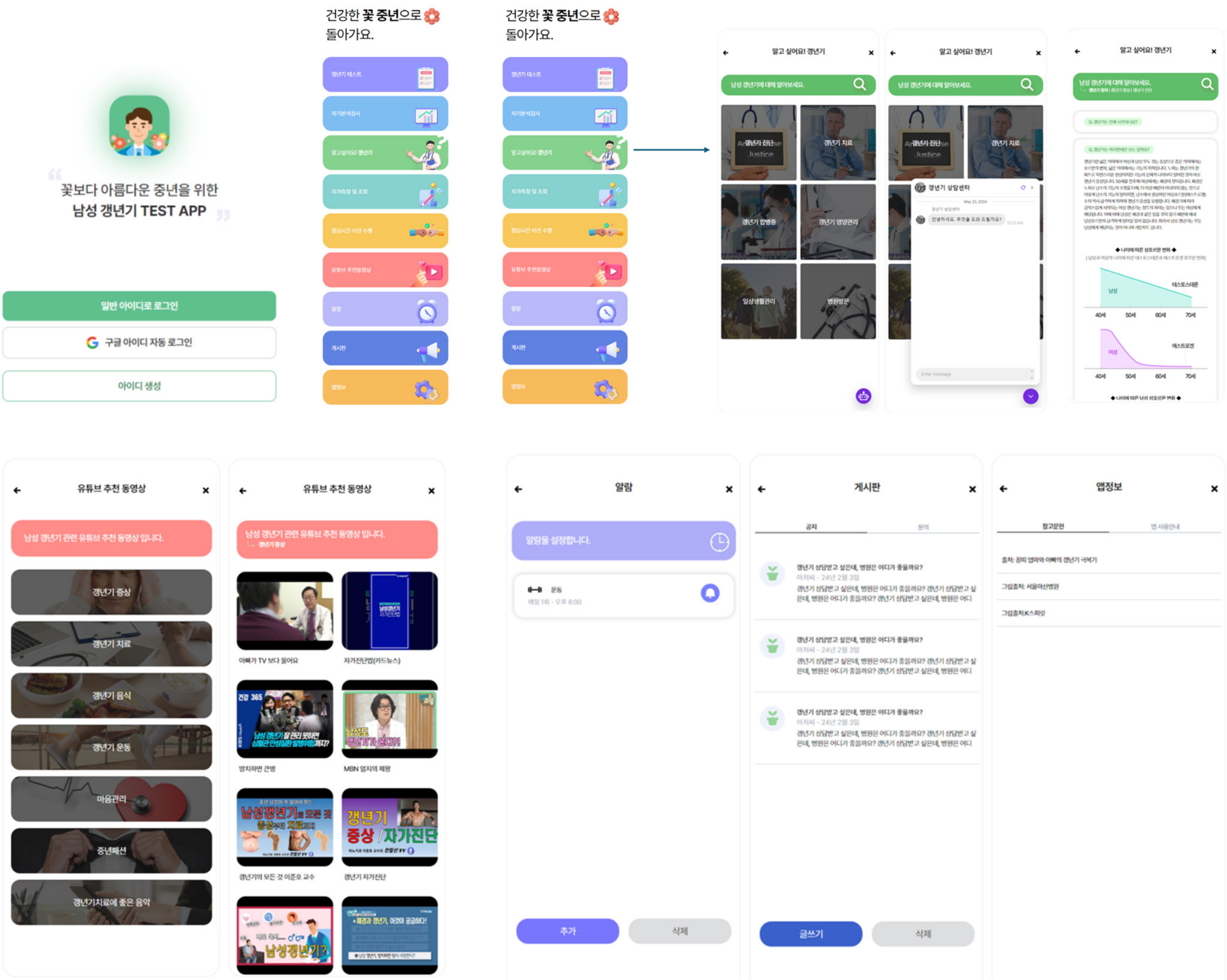
APPENDICES

Appendix 1. Structure of the Mobile-Based Andropause Health Management Program

Day	Education topic	Educational method	Remarks	App feature
1	App usage orientation and program introduction	In-person education+app download instructions	App usage instructions and installation support	App information
2	Understanding male menopause	Watch app video+quiz	Concept Understanding and Problem Check	Education
3	Exercise and physical activity	Self-learning with app content	Providing a Practice Checklist	Education+self-assessment
4	Nutritional management and healthy eating habits	Self-study with app content	Including sample diet plan	Education+self-assessment
5	Stress awareness and management techniques	Self-study with app content	Including deep breathing and meditation video	Education
6	Sleep hygiene education	Self-study with app content	Sleep diary instructions	Self-assessment+inquiry
7	Week 1 review and quiz	App review content	Providing phone feedback	Learning module (quiz)
8	Health behavior implementation strategies	Self-Study with app content	Encouraging lifestyle routine review	Education
9	Utilizing family and social support	Self-study with app content	Providing tips for family involvement	Bulletin board
10	Emotional management and self-motivation enhancement	Self-study with app content	Including examples of positive self-talk	Education
11	Setting personal health goals	Self-study with app content	Guidance for setting SMART goals	Self-assessment
12	Problem-solving strategies	Self-study with app content	Scenario-based learning	Education
13	Plan for maintaining healthy lifestyle habits	Self-study with app content	Providing a practice checklist	Education+self-assessment
14	Overall review+app usage satisfaction survey	In-person interview (30–40 minutes)	App usage feedback and satisfaction survey	App information+Q&A
Daily	Daily phone consultation	-	Review and feedback	Alarm+inquiry

App = application.

Appendx 2. Main menu and sub-menu interfaces of the health education application.



안녕하세요. 무엇을 도와 드릴까요?

갱년기 상담받고 싶은데, 병원은 어디가 좋을까요?
아저씨 - 24년 2월 3일
갱년기 상담받고 싶은데, 병원은 어디가 좋을까요? 갱년기 상담받고 싶은데, 병원은 어디가 좋을까요? 갱년기 상담받고 싶은데, 병원은 어디

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ORIGINAL ARTICLE

Korean J Adult Nurs Vol. 37 No. 3, 245-256, August 2025
eISSN: 2288-338X
https://doi.org/10.7475/kjan.2025.0308

KJAN
Korean Journal of
Adult Nursing

Self-Rated Health among People with Chronic Kidney Disease: A Secondary Data Analysis

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Received: March 8, 2025
Revised: June 3, 2025
Accepted: July 30, 2025

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Purpose: Self-rated health in individuals with chronic diseases is influenced by various factors, including dietary adherence and physical activity. However, limited research has investigated how these factors relate to self-rated health among people with chronic kidney disease. Therefore, this study aimed to describe self-rated health and identify its associated factors in this population. **Methods:** This cross-sectional, secondary data analysis utilized datasets from the seventh Korea National Health and Nutrition Examination Survey, which were collected between 2016 and 2018. A total of 557 participants (mean age = 74.8 years) with a glomerular filtration rate of < 60 mL/min/1.73 m^2 were included. Data from health interviews and examinations were analyzed to assess self-rated health, dietary adherence, and physical activity. Descriptive and inferential statistical methods were employed for analysis. **Results:** Among the 557 participants, 42.6% rated their health as poor. Factors such as sex, age, income, smoking history, anxiety/depression, number of comorbidities, glomerular filtration rate, and physical activity were significantly associated with self-rated health. In contrast, dietary adherence did not exhibit a significant association. **Conclusion:** Understanding the factors associated with self-rated health can inform the development of nursing interventions aimed at improving self-rated health among patients with chronic kidney disease.

Key Words: Kidney diseases, chronic; Health surveys; Nursing; Self-rated health

INTRODUCTION

Globally, approximately 850 million individuals are affected by kidney disease, a figure that is double the prevalence of diabetes, which impacts 420 million people [1]. The global prevalence of chronic kidney disease (CKD) exceeds 10%, with reported rates of 10.4% in men and 11.8% in women [1,2]. In South Korea, the prevalence of CKD among adults aged 19 years and older was reported to be 8.4% in 2021 [3]. Over the past decade, medical expenditures for CKD treatment in South Korea have doubled [2,3]. Beyond its clinical and economic burden, CKD significantly affects individuals' perceptions of health and overall well-being [4-7].

Self-rated health (SRH) is a simple yet efficient measure that captures individuals' perceptions of their health, integrating biological, psychological, and social aspects, including personal cultural beliefs [6]. Among people with CKD, SRH is an important indicator of renal disease complications and hospital admissions, and it has also been significantly associated with mortality [4,6]. Previous studies have found that 47% to 53% of adults with Stage 3 to 5 CKD perceive their health as poor to fair [5], which is higher than the proportions reported among those with hypertension (37%) and diabetes (39.7%) [8,9]. Individuals with CKD experience significant health burdens—including symptoms, functional limitations, and disease-related distress—all of which may negatively influence their SRH [5-7]. Given that SRH is a strong predictor of adverse clinical outcomes in CKD, assessing SRH and identifying its associated factors are essential [5,10,11]. According to previous research, SRH in individuals with CKD is associated with several key factors, including sociodemographic characteristics (e.g., age, household income) [7,10]; clinical indicators (such as body mass index [BMI], comorbid conditions, chronic illnesses) [7,10,12]; health behaviors (e.g., smoking, physical activity [PA], sleep quality) [7]; inflammatory markers (e.g., C-reactive protein, white blood cell count); and psychosocial variables (e.g., stress, activity limitation). This multifactorial nature of SRH aligns with the Wilson and Cleary model of health-related quality of life, which conceptualizes SRH as an outcome influenced by biological, functional, behavioral, and psychosocial domains [13]. Although the multifactorial nature of SRH has been explored in previous studies of CKD, research on this topic remains limited. Further investigation is needed to more accurately identify the diverse factors associated with SRH.

Dietary adherence, defined as following healthcare providers' dietary recommendations, is essential for managing CKD and may influence SRH by improving clinical outcomes and overall well-being [6,14]. As dietary adherence helps control metabolic disturbances and reduces symptom burden, it may contribute to better self-perceived health in individuals with CKD [5,6,14]. Given that adherence to health behaviors is linked to improved health perceptions [5,15], dietary adherence could represent a modifiable factor for enhancing SRH in CKD. However, findings from studies on other chronic diseases remain inconsistent [5,14], and the association between dietary adherence and SRH in CKD is not well established, highlighting the need for further research.

PA is well documented to promote health by alleviating disease-related symptoms, improving physical function, and reducing comorbidities, all of which contribute to better SRH [16,17]. Despite its established benefits in other chronic conditions, research examining the impact of PA on SRH in CKD remains limited. As both dietary adherence and PA are modifiable health behaviors, understanding their relationship with SRH could provide valuable insights for CKD management.

This study aimed to address this gap by analyzing data from the Korea National Health and Nutrition Examination Survey (KNHANES) to examine SRH and its associated factors, including dietary adherence and PA, among people with CKD.

Several factors have been identified as affecting SRH in individuals with CKD. Lee et al. [12] reported that older patients (≥65 years) were less likely than younger patients to perceive their health as poor to fair. They also found that poor-to-fair SRH was associated with higher BMI and a greater burden of comorbidities. Similarly, Ko et al. [7] identified multiple factors linked to poor SRH, including older age, current smoking, cardiovascular disease, diabetes, hypertension, impaired sleep, elevated C-reactive protein levels, and increased white blood cell counts. In addition, Lee and Suh [10] found that household income, activity limitation, stress, and the number of comorbidities were significantly associated with subjective health status in people with CKD. Despite these findings, research on the factors influencing SRH in this population remains limited. Overall, SRH in people with CKD is affected by age, BMI, comorbidities, chronic diseases, lifestyle factors (such as smoking and impaired sleep), inflammatory markers, and psychosocial variables, including household income, activity limitation, and stress.

The association between dietary adherence, PA, and SRH in people with CKD remains underexplored. Studies on other chronic diseases, such as diabetes, metabolic syndrome, and cardiovascular disease, suggest that adherence to a healthy diet is linked to better SRH [11]. Individuals with these conditions who follow dietary guidelines tend to perceive their health more positively [5], while avoiding eating out has been associated with poorer SRH among those with multiple chronic conditions [15]. Although dietary adherence is recognized as a determinant of SRH, findings remain inconsistent, and few studies have specifically investigated this relationship in people with CKD.

Previous studies have identified PA as a key determinant of SRH in individuals with multimorbidity [11,16]. Increased PA has been associated with better SRH, mitigating the negative impact of multimorbidity [11,16,17]. Similarly, research on chronic obstructive pulmonary disease suggests that higher PA levels contribute to improved SRH [17]. However, little is known about this relationship in people with CKD. Given that PA is a modifiable factor, understanding its role in SRH could help identify patients at risk for poorer health perceptions. This study may provide insights for developing nursing interventions to enhance SRH among people with CKD.

This study was designed to describe SRH and to identify

https://doi.org/10.7475/kjan.2025.0308

its associated factors, including dietary adherence and PA, among people with CKD.

METHODS

1. Study Design

This cross-sectional, descriptive, secondary analysis utilized data from the seventh KNHANES.

2. Setting and Samples

The KNHANES has been conducted annually by the Korea Centers for Disease Control and Prevention (now the Korea Disease Control and Prevention Agency) since 1998. The survey is designed to assess family health and nutritional status, monitor trends in health risk factors and the prevalence of major chronic diseases, and provide data for the development of health policies in Korea [18]. This study used data from the seventh KNHANES, collected between 2016 and 2018, as it was the most recent dataset available at the time that included all essential variables required for analysis. The KNHANES is a population-based study of the health and nutritional status of the non-institutionalized civilian population of Korea [18]. Participants are selected using a multistage, clustered, and stratified random sampling method, with proportional allocation based on geographic area, sex, and age group from national census data, to ensure a representative, nationwide sample. KNHANES excludes military personnel, prison inmates, hospital patients, children in nurseries, and individuals in social homes [18]. For inclusion in this study, participants had to be at least 20 years old, have data for serum creatinine, and have an estimated glomerular filtration rate (eGFR) of 60 mL/min/1.73 m^2 or less [19].

3. Measures

1) Demographic and clinical factors

Demographic and clinical factors in this study were selected based on findings from previous research involving people with CKD [7,10,12]. Demographic factors included sex, age, income, education, marital status, and household members. These data were obtained from health interviews using a structured questionnaire.

Clinical factors included smoking history, alcohol consumption, anxiety/depression, BMI, comorbidities, and eGFR. All data were obtained from the health interviews except for body weight, height, and creatinine. Smoking history was categorized as current, past, or never smokers. Alcohol consumption was classified into three groups: none, 1 drink/month to 1 drink/week, or ≥2 drinks/week. Index scores from the EuroQol-5D (EQ-5D) questionnaire, an instrument for measuring health-related quality of life, were used to evaluate anxiety and depression. The EQ-5D includes five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. For anxiety/depression, participants responded with one of the following: “I am not anxious or depressed,” “I am moderately anxious or depressed,” or “I am extremely anxious or depressed.” Responses were categorized as “yes” (moderately or extremely anxious/depressed) or “no” (not anxious/depressed). BMI was calculated as weight in kilograms divided by height in meters squared and classified as underweight (<18.5 kg/m^2), normal (18.5–24.9 kg/m^2), or overweight (≥25.0 kg/m^2). Weight and height were measured directly by trained investigators using a stadiometer and scale, with participants wearing light clothing and no shoes [18]. Comorbidities were defined based on participants’ self-reported history of physician-diagnosed diseases. These included cardiovascular, musculoskeletal, respiratory, neuropsychiatric, genitourinary, dermatological, endocrine-metabolic, eye and ear, gastrointestinal diseases, and cancer. The eGFR was calculated from serum creatinine levels using the CKD-EPI creatinine equation [19]. Blood samples for serum creatinine were collected after at least an 8-hour fast, processed appropriately, immediately refrigerated, and transported in cold storage to a central laboratory within 24 hours [18]. eGFR was classified into three categories according to the stages of kidney disease: stage 3, 30–59 mL/min/1.73 m^2; stage 4, 15–29 mL/min/1.73 m^2; and stage 5, <14 mL/min/1.73 m^2 [19].

2) Dietary adherence

Dietary adherence was assessed using two questions from the health interviews: one on compliance with dietary therapy and one on restricting eating out [18]. Participants were asked, “Are you complying with diet therapy for the underlying disease?” with responses of “yes” or “no.” Those who answered “yes” were expected to follow a therapeutic meal plan. The frequency of eating out was assessed with the question, “On average, how often did you eat out rather than have home-cooked food?”—including restaurant meals, delivery, take-out, and food service. Participants could choose from seven options: more than twice per day, once per day, 5 or 6 times per week, 3 or 4 times per week, 1 or 2 times per week, 1 to 3 times per month, or never (less than once per month). Responses were then classified as either “less than once per week” or “more than once per week.”

3) Physical activity

PA was measured using the Global Physical Activity Questionnaire (GPAQ), developed by the World Health Organization (WHO), which is widely used to evaluate PA levels [20]. Participants responded to 15 questions regarding PA in three domains: activity at work, travel to and from places, and recreational activities. They were asked to specify both the number of days per week and the duration per day spent on each activity. For analysis, these three domains were divided into five subdomains: vigorous work, moderate work, transport, vigorous recreation, and moderate recreation, in accordance with the GPAQ guidelines [21]. Total PA was calculated as the sum of the respective minutes spent in moderate and vigorous activities across all domains (work, transport, and recreation) within a week. To standardize the calculation, one minute of vigorous activity was converted into two minutes of moderate activity [22]. Total PA was then classified into two categories: more than 150 minutes per week or 150 minutes or less per week, based on the WHO recommendation that adults engage in at least 150 minutes of moderate PA per week [23].

4) Self-rated health

During the health interview, SRH was assessed using the question, “How do you rate your general health condition?” Participants rated their health as “very good,” “good,” “fair,” “poor,” or “very poor.” For analytical purposes, these five response options were grouped into two categories: good (very good, good, or fair) versus poor (poor or very poor). This dichotomous coding scheme—with three positive and two negative responses—has been commonly used in previous studies, as it improves statistical analysis and the interpretation of mean values [24].

4. Data Collection

KNHANES questionnaires include three components: a health interview, a health examination, and a nutrition survey [18]. These components collect detailed information on sociodemographic characteristics, health behaviors, medical conditions, biochemical profiles, and dietary intake using standardized procedures. Health interviews and examinations are conducted by trained medical staff and interviewers, while the nutrition survey is performed by dieticians. Health interview staff must complete intensive training and practice under supervision before beginning survey work. According to standardized protocols, all health examination procedures are performed by trained medical personnel, and all equipment is calibrated regularly. Detailed quality control instructions for the survey are available [18].

5. Ethical Considerations

The seventh KNHANES was approved by the institutional review board at the site where the original study was conducted. All surveys are performed with participants’ written consent to KNHANES. Ethical approval for this secondary data analysis was waived by the institutional review board of the institution where this analysis was conducted (No. 2021-0072-01).

6. Statistical Analysis

All statistical analyses were performed using SPSS software version 25.0 (IBM Corp., Armonk, NY, USA). Sampling weights were applied to all analyses to ensure representativeness of the Korean population. These sample weights accounted for the complex survey design, survey nonresponse, and post-stratification. Weights were constructed using the inverse of selection probabilities and response rates, and were further adjusted to reflect the sex- and age-specific structure of the Korean population (post-stratification).

Descriptive statistics were used to summarize the demographic and clinical characteristics of the sample and other study variables. Univariate and multivariate logistic regression analyses were conducted to identify factors associated with SRH. All variables were included in the multivariate logistic regression to determine independent associations with SRH. Odds ratios were presented with 95% confidence intervals. Statistical significance was defined as a two-tailed p-value of $< .05$.

RESULTS

1. Sample Characteristics and Study Variables

A total of 557 respondents with CKD were included in this study (Figure 1). The mean age of participants was 74.7 years. Of the participants, 56.8% were men, and 40.4% were between 70 and 79 years old, representing the largest proportion in any age group. Approximately 59.8% of the sample had received a middle school education or less. The majority of participants had stage 3 CKD. Regarding dietary adherence, 394 participants (72.5%) reported not complying with dietary therapy. In terms of SRH, 320 (57.4%) reported good SRH, while 237 (42.6%) reported poor SRH (Table 1).

2. Factors Affecting SRH among People with CKD

Several variables were significantly associated with SRH among people with CKD in the univariate logistic regression analysis. Among demographic factors, older age and a mid-level household income ($786–2,355 per month) were significantly associated with better SRH, while a greater number of household members approached statistical significance. Regarding clinical factors, alcohol consumption of two or more times per week, absence of anxiety or depression, fewer comorbidities, and higher eGFR levels (15–59 mL/min/1.73 m^2) were all positively associated with better SRH. In terms of PA, engaging in 150 minutes or more of PA per week was significantly associated with better SRH.

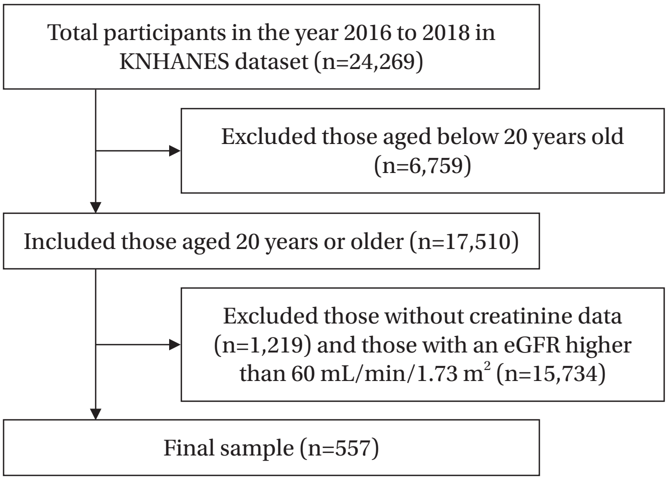

Figure 1. Flowchart for the study sample. eGFR = estimated glomerular filtration rate; KNHANES = Korea National Health and Nutrition Examination Survey.

In the multivariate logistic regression analysis, several variables remained significant predictors of SRH. Among demographic factors, male sex and older age (≥70 years) were associated with better SRH, while mid-level household income approached significance. For clinical factors, both past and current smoking status, presence of anxiety or depression, and a higher number of comorbidities were negatively associated with good SRH. In contrast, participants with an eGFR of 15–59 mL/min/1.73 m^2 were more likely to report good SRH than their counterparts with lower eGFRs. As for PA, those who engaged in 150 minutes or more of PA per week had significantly higher odds of reporting good SRH (Table 2).

DISCUSSION

Compared to previous studies reporting poor SRH in 31.1% [7] and 38.6% [10] of people with CKD, our study found a higher prevalence, with 42.6% of participants reporting poor SRH. Additionally, participants with CKD in this study were more likely to report poor SRH than those with diabetes or hypertension, at 39.7% [9] and 37% [8], respectively. This may be attributed to the greater self-management burden associated with CKD, including strict dietary restrictions and progressive decline in kidney function, which may present greater challenges than other chronic conditions [25].

Various factors were found to be associated with SRH among people with CKD. We observed that men reported better SRH than women. Previous studies [7,12] have also demonstrated that men and women with CKD may differ in their health evaluations. Women tend to be more attentive to mild symptoms and minor chronic signs, whereas men focus more on life-threatening conditions [7,26]. These sex differences may contribute to variations in SRH among individuals with CKD.

Our findings indicate that older adults reported better SRH than younger people, possibly due to differences in health perceptions and behaviors. Younger people with CKD are more likely to engage in unhealthy behaviors, while older adults tend to adopt healthier lifestyles. Furthermore, older adults may have lower health expectations, leading to a more favorable perception of their status, whereas younger individuals' higher expectations may result in lower SRH scores [5,12]. However, previous studies [7] have reported conflicting results, suggesting a complex

Table 1. Demographic and Clinical Factors, Dietary Adherence, and Physical Activity in People with Chronic Kidney Disease (*N* = 557)

Variables	Categories	Total	Self-rated health	
			Good (n = 320, 57.4%)	Poor (n = 237, 42.6%)
		M ± SD or n (%)		
Sex	Female	263 (43.2)	141 (39.7)	122 (48.4)
	Male	294 (56.8)	179 (60.3)	115 (51.6)
Age (year)		74.75 ± 7.56	76.26 ± 6.98	72.74 ± 7.13
	< 60	47 (11.9)	20 (8.2)	27 (17.5)
	60–69	105 (18.3)	53 (16.3)	52 (21.2)
	70–79	234 (40.4)	138 (43.0)	96 (36.5)
	≥ 80	171 (29.5)	109 (32.5)	62 (24.8)
Income ($)	< 785	296 (47.9)	151 (42.3)	145 (56.4)
	786–2,355	193 (36.8)	126 (41.7)	67 (29.4)
	> 2,355	68 (15.2)	43 (16.0)	25 (14.1)
Education	≤ Middle school	369 (59.8)	209 (59.0)	160 (60.9)
	High school	115 (22.9)	60 (20.7)	55 (26.2)
	≥ College	73 (17.4)	51 (20.3)	22 (12.9)
Marital status	Single	209 (35.3)	111 (32.7)	98 (39.3)
	Married	348 (64.7)	209 (67.3)	139 (60.7)
Household members	1	140 (20.1)	71 (16.7)	69 (25.1)
	2	254 (42.5)	149 (44.4)	105 (39.7)
	≥ 3	163 (37.4)	100 (38.9)	63 (35.2)
Smoking	None	310 (53.7)	186 (56.5)	124 (49.4)
	Past	181 (33.3)	99 (32.2)	82 (34.9)
	Current	66 (13.1)	35 (11.3)	31 (15.7)
Alcohol consumption	None	383 (68.3)	206 (63.6)	177 (75.3)
	1 drink/month–1 drink/week	145 (27.0)	98 (32.6)	47 (18.4)
	≥ 2 drinks/week	29 (4.7)	16 (3.8)	13 (6.3)
Anxiety/depression	No	481 (87.4)	300 (94.2)	181 (77.0)
	Yes	76 (12.6)	20 (5.8)	56 (23.0)
BMI (kg/m^2)	< 18.5	12 (2.8)	6 (1.8)	6 (4.4)
	18.5–24.9	298 (54.4)	175 (56.0)	123 (52.0)
	≥ 25.0	247 (42.7)	139 (42.2)	108 (43.6)
No. of comorbidities	0	109 (21.3)	81 (27.0)	28 (12.7)
	1	177 (30.5)	102 (29.8)	75 (31.6)
	2	135 (23.8)	75 (22.7)	60 (25.6)
	3	79 (14.1)	36 (11.9)	43 (17.3)
	≥ 4	57 (10.3)	26 (8.6)	31 (12.7)
eGFR (mL/min/1.73 m^2)		42.3 ± 6.9	42.6 ± 4.8	41.7 ± 5.3
	30–59	505 (90.7)	302 (94.3)	203 (85.6)
	15–29	38 (5.9)	17 (5.3)	21 (8.8)
	< 14	14 (2.5)	1 (0.4)	13 (5.6)
Compliance with dietary therapy	Yes	163 (27.5)	81 (24.2)	82 (32.4)
	No	394 (72.5)	239 (75.8)	155(67.6)
Restriction on eating out	Less than once per week	252 (49.6)	154 (48.1)	98 (41.3)
	More than once per week	305 (50.4)	166 (51.9)	139 (58.7)
Physical activity (minute/week)		235 ± 280	270 ± 270	166 ± 188
	≥ 150	143 (27.8)	96 (31.6)	47 (21.9)
	< 150	414 (72.2)	224 (68.4)	190 (78.1)

Percentages are weighted values; BMI = body mass index; eGFR = estimated glomerular filtration rate; M = mean; SD = standard deviation.

https://doi.org/10.7475/kjan.2025.0308

Table 2. Related Factors for Self-Rated Health in People with Chronic Kidney Disease, Using Univariate and Multivariate Logistic Regression

Variables	Unadjusted		Adjusted	
	OR (95% CI)	*p*	OR (95% CI)	*p*
Demographic factors				
Sex				
Female	1		1	
Male	1.42 (0.96–2.11)	.081	2.64 (1.28–5.45)	.015
Age (year)				
< 60	1		1	
60–69	1.64 (0.73–3.67)	.237	1.81 (0.68–4.81)	.234
70–79	2.51 (1.24–5.09)	.014	4.75 (1.70–13.30)	.003
≥ 80	2.79 (1.32–5.88)	.013	5.36 (1.81–15.87)	.005
Income ($)				
< 785	1		1	
786–2,355	1.89 (1.23–2.90)	.001	1.73 (1.00–3.00)	.051
> 2,355	1.51 (0.82–2.78)	.191	1.64 (0.74–3.62)	.223
Education				
≤ Middle school	1		1	
High school	0.82 (0.49–1.35)	.433	0.71 (0.38–1.33)	.291
≥ College	1.62 (0.87–3.04)	.133	1.02 (0.46–2.28)	.964
Marital status				
Single	1		1	
Married	1.33 (0.88–2.02)	.187	1.33 (0.70–2.52)	.385
Household members				
1	1		1	
2	1.68 (1.04–2.71)	.046	0.87 (0.42–1.77)	.691
≥ 3	1.66 (1.01–2.72)	.051	1.03 (0.49–2.18)	.932
Clinical factors				
Smoking				
None	1		1	
Past	0.63 (0.33–1.20)	.161	0.25 (0.12–0.53)	.007
Current	0.81 (0.52–1.27)	.367	0.28 (0.12–0.65)	.002
Alcohol consumption				
None	1		1	
1 drink/month–1 drink/week	0.71 (0.29–1.70)	.447	1.72 (0.99–2.97)	.061
≥ 2 drinks/week	2.09 (1.30–3.38)	.004	0.79 (0.26–2.39)	.685
Anxiety/depression				
No	1		1	
Yes	0.21 (0.11–0.38)	.006	0.17 (0.08–0.35)	.008
BMI (kg/m^2)				
< 18.5	1		1	
18.5–24.9	2.70 (0.77–9.46)	.125	0.99 (0.25–3.88)	.997
≥ 25.0	2.42 (0.72–8.17)	.157	0.91 (0.24–3.46)	.893
No. of comorbidities				
0	1		1	
1	0.44 (0.23–0.85)	.025	0.33 (0.16–0.66)	.003
2	0.42 (0.21–0.81)	.017	0.37 (0.18–0.73)	.015
3	0.32 (0.15–0.67)	.006	0.27 (0.12–0.60)	.004
≥ 4	0.32 (0.14–0.72)	.013	0.31 (0.12–0.77)	.017

(Continued on the next page)

Table 2. Continued

Variables	Unadjusted		Adjusted	
	OR (95% CI)	*p*	OR (95% CI)	*p*
eGFR (mL/min/1.73 m^2)				
30–59	56.87 (7.76–416.77)	.004	16.12 (1.75–148.43)	.014
15–29	21.56 (2.89–160.67)	.006	40.55 (4.25–386.78)	.007
< 14	1		1	
Dietary adherence				
Compliance with dietary therapy				
Yes	0.67 (0.44–1.01)	.061	0.91 (0.56–1.47)	.702
No	1		1	
Restriction on eating out				
Less than once per week	0.83 (0.55–1.23)	.351	0.69 (0.41–1.18)	.188
More than once per week	1		1	
Physical activity (minute/week)				
≥ 150	1.68 (1.05–2.72)	.044	1.88 (1.09–3.37)	.046
< 150	1		1	

BMI = body mass index; Cl = confidence interval; eGFR = estimated glomerular filtration rate; OR = odds ratio.

relationship between SRH and age. In older adults, SRH may align more closely with actual health changes, whereas younger people may exhibit greater variability due to diverse experiences and evolving perceptions [27]. These findings underscore the need for further research to clarify the mechanisms influencing SRH across age groups.

In this study, participants in the middle household income group were 1.73 times more likely to report good SRH compared to those in the low-income group. Similarly, Lee and Suh [10] reported a 2.25-fold increase, and Yoo et al. [28] found a 1.19-fold increase, reinforcing the impact of income level on SRH. This can be explained by the fact that higher income improves access to healthcare and promotes healthier behaviors, leading to better SRH, whereas lower income is associated with neglect of health checkups and unhealthy habits [10].

We found that smoking was negatively associated with better SRH, consistent with other studies [7,28]. Smoking is known to aggravate the progression of CKD and impair renal hemodynamics, which may influence how people with CKD perceive their health [7,29]. Thus, the adverse health effects of smoking could contribute to a more negative self-perception of health among this population.

We found a negative association between anxiety/depression and SRH among people with CKD. However, few studies have specifically examined depression and anxiety as factors related to SRH in CKD, making direct comparisons difficult. Rantanen et al. (2019) [30] found that people with diabetes were more likely to report poor SRH if they experienced higher levels of anxiety or depression. Similarly, people with CKD often experience worsening symptoms over time, increasing the disease burden and leading to feelings of pressure and overwhelm [31]. These factors can contribute to depressive moods and emotional disturbances, which may negatively affect individuals' perceptions of their health. Therefore, further research is needed to explore the influence of psychiatric factors, such as anxiety and depression, on SRH in this population.

Consistent with previous studies [7,10,12], we found that people with comorbidities were more likely to report poor SRH. Ko et al. [7] showed that the presence of cardiovascular disease (2.68-fold), hypertension (1.29-fold), and diabetes (1.65-fold) increased the likelihood of poor SRH. Likewise, Lee et al. [12] reported that individuals with cardiovascular disease, diabetes, and hypertension were more likely to perceive their health as poor. Furthermore, Lee and Suh [10] found that people without comorbidities were 5.1 times more likely to report positive SRH compared to those with three or more comorbidities. This association may be explained by the increased risk of complications and severe health conditions with longer duration and greater number of diseases, leading to more negative overall health perceptions [10,12]. Consequently, health perception often reflects the illness experience among people with CKD and comorbidities [32].

Increased eGFR was significantly associated with better SRH. Consistent with our findings, Lee et al. [12] identified eGFR as a relevant factor for SRH, along with other hema-

https://doi.org/10.7475/kjan.2025.0308

tological indicators such as albumin, creatinine, and hemoglobin. One possible explanation is that individuals undergoing renal replacement therapies, such as hemodialysis, may experience limitations in daily activities, reduced functional independence, and increased pessimism regarding their health due to physical impairments [4,33]. However, Ko et al. [7] reported that eGFR did not significantly affect SRH, whereas inflammatory markers, including C-reactive protein and white blood cell counts, were significantly associated with SRH. These contrasting findings emphasize the need for further research to clarify the role of hematological factors as objective indicators of SRH.

This study found that engagement in PA was significantly associated with better SRH among people with CKD, in line with findings from research on chronic obstructive pulmonary disease [17]. In our study, individuals who met the PA criteria had 1.88 times higher odds of reporting positive SRH, and similarly, those with chronic obstructive pulmonary disease had 2.22 times higher odds [17]. Previous studies have also identified aerobic exercise, a variable closely related to PA, as a determinant of SRH in people with CKD [28]. A physically active lifestyle has been shown to enhance health perception by improving functional capacity, increasing resilience, and reducing stress-related disease burden [16,34]. Based on our findings, emphasizing the value of increasing PA may help improve health perception among people with CKD.

We found no significant association between dietary adherence and SRH, which contrasts with previous studies. Additionally, prior research has reported conflicting findings regarding this relationship. Monteiro Dos Santos et al. [15] found that people with chronic illnesses who adhered to healthy dietary patterns were more likely to report poor SRH, possibly due to the perceived burden of dietary restrictions. In contrast, Govindaraju et al. [35] reported that greater adherence to the Dietary Approaches to Stop Hypertension diet was associated with better perceived health among people with cardiovascular disease. Adherence to therapeutic diets aimed at preventing disease progression can be perceived either as a psychological burden or as a positive health behavior [11,15]. This variation reflects how SRH evaluations may differ based on an individual's psychological state and socio-cultural context [15,35]. Future research should examine the psychological and socio-cultural factors that affect perceptions of dietary adherence and their impact on SRH in diverse chronic disease populations.

This study provides novel insights into factors associated with SRH, including PA, among people with CKD. Utilizing nationally representative data from the KNHANES, this study offers a comprehensive analysis of clinical and demographic correlates of SRH, contributing to nursing interventions aimed at improving SRH. Although these strengths are notable, several limitations should be acknowledged. First, as this was a cross-sectional study, a definite causal relationship between SRH and related factors cannot be established. Prospective studies are needed to clarify the temporal relationship between SRH and its associated factors among people with CKD. Second, because serum creatinine for calculating eGFR was measured at only one time point in KNHANES, a single eGFR value may not precisely reflect kidney function. Other indicators of kidney function, such as albuminuria or blood urea nitrogen, should be evaluated in people with CKD. Third, some variables associated with SRH, such as symptoms, could not be included because they were not available in the KNHANES dataset. Fourth, only two questions were used to assess dietary adherence, as this was all the KNHANES dataset provided; a structured questionnaire for dietary adherence was not included. These two questions may not fully capture the participants' dietary adherence. Fifth, as PA was evaluated using a questionnaire, participants might have overestimated their usual activity levels. Sixth, because 90% of participants in this study had stage 3 CKD and only a few had stage 4 or stage 5, it is difficult to generalize the findings to those with advanced disease, such as end-stage renal disease.

Despite these limitations, this study highlights key determinants of SRH, emphasizing the role of modifiable factors like PA in improving perceived health. These findings can inform targeted nursing interventions to enhance well-being among people with CKD.

CONCLUSION

A notable proportion of Korean people with CKD perceived their health as poor, especially those with worse kidney function, multiple comorbidities, low levels of PA, or anxiety and depression, suggesting that clinical and behavioral factors play a key role in contributing to SRH. This study highlights the importance of understanding SRH and its associated factors among people with CKD. Based on the findings, the following recommendations are made: First, future research should focus on longitudinal studies to clarify the causal relationships between SRH and its associated factors in CKD patients, providing stronger evidence for interventions. Second, to enhance kidney function assessment, studies should incorporate biomarkers such as albuminuria alongside eGFR, offering a more comprehensive view of kidney health. Third, more detailed methods for assessing dietary adherence are needed, as current assessments may not fully capture participants' behaviors. Future studies should use comprehensive dietary assessments to better understand the role of nutrition in SRH. Fourth, further research should include CKD patients across all stages, especially those with advanced CKD, to improve the generalizability of findings. Lastly, nursing interventions should focus on promoting PA, with tailored exercise programs that address individual health profiles and barriers to exercise, to improve SRH and health outcomes.

This study expands academic understanding of SRH among individuals with CKD. By identifying associated factors within a community setting, it offers important insights into health perceptions in this population. These findings provide a foundation for future research aimed at developing and validating theoretical frameworks and evidence-based interventions. Given the nursing implications, it is essential that future nursing research develops and tests targeted interventions aimed at improving SRH, particularly through patient education, lifestyle counseling, and individualized health management strategies. Moreover, understanding SRH provides nurses with valuable insight into patients’ subjective health perceptions, enabling early identification of those at risk and the provision of more patient-centered, preventive care.

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

Study conception & design acquisition - SKP and JL; analysis and interpretation of the data - SKP and JL; and drafting or critical revision of the manuscript for important intellectual content - SKP and JL.

FUNDING

None.

ACKNOWLEDGEMENT

None.

DATA AVAILABILITY STATEMENT

Data can be obtained from the Korea National Health and Nutrition Examination Survey (KNHANES) database, available from the Korea Disease Control and Prevention Agency (https://knhanes.kdca.go.kr).

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ORIGINAL ARTICLE

Korean J Adult Nurs Vol. 37 No. 3, 257-265, August 2025
eISSN: 2288-338X
https://doi.org/10.7475/kjan.2025.0317

KJAN
Korean Journal of
Adult Nursing

The Relationships among Death Anxiety, Death Attitudes, and Burnout in Nurses Caring for Hemodialysis Patients: A Cross-Sectional Study

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Received: March 17, 2025
Revised: June 11, 2025
Accepted: August 6, 2025

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Purpose: This study aimed to examine the relationships among death anxiety, attitudes toward death, and burnout in nurses working in hemodialysis units. **Methods:** A cross-sectional, self-report questionnaire-based survey was conducted. Eighty-six nurses, each with more than one year of experience in hemodialysis units across six general hospitals, participated. Data were collected from July to December 2021. Statistical analyses included Pearson correlation coefficients and multivariate linear regression. **Results:** The mean death anxiety score was 2.71±0.73 out of 5. Among attitudes toward death, neutral acceptance was most prevalent, with a mean score of 5.48±1.07 out of 7. The average burnout score was 3.94±0.77 out of 7. Death anxiety showed a significant negative correlation with neutral acceptance of death ($r=-.33$, $p=.002$) and a significant positive correlation with fear of death attitudes ($r=.65$, $p<.001$). Multiple regression analysis identified marital status (being married) ($\beta=-.35$, $p=.005$) and the death attitude of escape acceptance ($\beta=.37$, $p=.002$) as significant predictors of burnout, together explaining 22.3% of the variance ($F=2.43$, $p=.005$). **Conclusion:** Attitudes toward death among hemodialysis nurses may be linked to burnout. Burnout management programs for nurses in hemodialysis units should provide opportunities for neutral discussions and emotional expression regarding death, and should address strategies to mitigate escape acceptance attitudes.

Key Words: Attitude; Burnout, psychological; Death; Hemodialysis units, hospital; Nurses

INTRODUCTION

Hemodialysis nurses are specialized healthcare professionals responsible for caring for patients with end-stage renal disease in technically demanding environments that require the operation of dialysis machines. These nurses play a pivotal role in facilitating self-management and adaptation in maintenance hemodialysis patients by providing ongoing education and encouragement. Additionally, the operation of dialysis equipment and the delivery of patient care require substantial training and expertise. Even after comprehensive training, hemodialysis units are recognized as high-intensity workplaces due to their unique challenges, including the management of patients with multiple chronic comorbidities, rigorous infection control measures to prevent bloodborne exposures, and the rising prevalence of older hemodialysis patients [1].

The unique and demanding responsibilities of a hemodialysis nurse extend well beyond the physical aspects of patient care. Notably, the cumulative exposure to patients' disease progression and death within the context of dialysis can, over time, affect nurses' emotional well-being, professional performance, and the overall quality of care delivered. Patients with end-stage renal disease often experience high mortality rates, primarily due to cardiovascular complications or infections, even after initiating dialysis [2]. This elevated mortality among end-stage patients can be a significant source of emotional distress and trauma for healthcare workers, including nurses [3]. Hemodialysis nurses face considerable psychological stress, manifesting as death anxiety, compassion fatigue, and ethical dilemmas stemming from the unique challenges of caring for this population [4]. Conceptually and practically, death anxiety is closely related to death fear [5], and emotional responses to the prospect of one's own death or the death of others can detrimentally affect psychological health and overall quality of life [6]. For nurses, managing patient death can become deeply personal, and their emotional responses are not always supportive—either for themselves or for their patients [7].

According to Grandey's emotional regulation model [8], work environments or specific occupational events can evoke emotional responses such as anger, sadness, and anxiety in employees. Individuals then employ a variety of emotional regulation strategies to sustain job performance and adapt within their organizations. However, this process of emotional regulation can result in both positive and negative outcomes for nurses, including increased stress, the risk of burnout, or, conversely, enhanced job satisfaction [9]. As death is an unavoidable aspect of life, death anxiety constitutes a normal emotional response to stress [5]. Nevertheless, excessive death anxiety in nurses may foster negative attitudes toward end-of-life care, resulting in emotional distancing from patients and diminished patient relationships [3]. In hemodialysis settings, death anxiety and fear of dying can undermine therapeutic interactions between nurses and patients, ultimately compromising job satisfaction and the quality of care provided [10].

Nonetheless, attitudes toward death can be influenced by existential perspectives [11]. Individuals may develop a coexistence-oriented attitude toward death, shaped by their personal meanings of life and death, leading either to despair and fear or, alternatively, to acceptance. Within this context, as a strategy to support the sustainability of the nursing workforce for hemodialysis patients with severe chronic illnesses, it is crucial to investigate and identify emotional burdens that may often be overlooked, such as death anxiety and attitudes toward death. In cultures or environments where open discussion of death is challenging, these attitudes may further impact both the quality of care for hemodialysis patients and nurses' job satisfaction [4,7]. Thus, addressing accumulated experiences of loss and negative attitudes toward death within hemodialysis units could serve as a strategic approach to improving both patient outcomes and job satisfaction among nurses.

Hemodialysis nurses are especially vulnerable to burnout due to their recurrent exposure to patient suffering, end-of-life care, and frequent patient deaths. This heightened vulnerability may result in lower job satisfaction and declining standards of nursing care. Although death-related attitudes and anxiety are likely to substantially affect nurses' well-being and the quality of care they provide, these factors have not been sufficiently explored within the context of hemodialysis nursing. This gap in the literature underscores the need for further empirical investigation. Therefore, the present study aimed to assess the levels of death anxiety, attitudes toward death, and burnout among nurses caring for hemodialysis patients, as well as to explore the relationships among these variables.

METHODS

1. Study Design

This study employed a cross-sectional design.

2. Setting and Samples

Participants were nurses working in hemodialysis units at hospitals located in Seoul and Gyeonggi-do, South Korea, each with over one year of experience in their current role. Data were collected using a convenience sampling method from six hemodialysis units. Each hospital employed 12 to 17 hemodialysis nurses, and most participated in the survey. Using G*Power 3.1.9.7, the required sample size was calculated to be 84 participants, based on a significance level of .05, a statistical power of 0.80, and a medium effect size of 0.30. To allow for an anticipated 10% dropout rate, 93 nurses were recruited. After excluding individuals with missing data, 86 participants were included in the final analysis.

The methods for estimating effect size and calculating sample size, as recommended by Cohen [12], include: 1) estimation based on existing similar studies; 2) conducting a pilot study if no similar studies are available; and 3) when

https://doi.org/10.7475/kjan.2025.0317

neither is feasible, predicting the effect size as large, medium, or small and applying the corresponding value. Previous studies have reported correlations between nurses' anxiety and attitudes toward death ranging from 0.126 to 0.315 [13], and hazard ratios for the effect of nurses' death anxiety on burnout ranging from 0.96 to 1.05 [14]. Therefore, a medium effect size was assumed for this study's sample size calculation.

3. Instruments

1) General characteristics

The formal survey questionnaire consisted of four sections: general characteristics, death anxiety, attitudes toward death, and burnout, comprising a total of 70 items. The general characteristics section included 11 items such as sex, age, educational background, religion, marital status, total nursing experience, years working in a hemodialysis unit, and experience with patient deaths within the past year.

2) Death anxiety

Death anxiety refers to emotional reactions such as discomfort, worry, anxiety, and fear experienced when thinking about or anticipating aspects of death [15]. In this study, death anxiety was measured using a scale developed to reflect South Korean culture and based on Templer's Death Anxiety Scale [16]. The scale comprises 14 items: 8 items assess anxiety about one's own death, three items assess anxiety regarding God and afterlife judgment, and three items assess anxiety concerning surviving family members. Responses are measured on a 5-point scale (1 = not at all, 5 = strongly agree), with a total possible score ranging from 14 to 90. Higher scores indicate greater death anxiety. Cronbach's α was .88 at the time of scale development [16], and .90 in the current study.

3) Death attitudes

Attitudes toward death were measured using the Korean-adapted version [17] of the Multidimensional Attitudes Toward Death Scale developed by Wong et al. [11]. The scale includes 32 items rated on a 7-point scale (1 = not at all, 7 = very strongly agree) and is organized into five dimensions: fear of death, avoidance of death, approach acceptance, escape acceptance, and neutral acceptance. These dimensions are broadly classified into two categories of attitudes toward death: negative and accepting. The negative attitude component includes 7 items assessing fear of death and five items assessing avoidance as a defense mechanism. The accepting attitude component includes 10 items reflecting the view of death as a gateway to a happy afterlife, five items reflecting death as an escape from a painful existence, and five items reflecting the view of death as a natural reality that is neither feared nor welcomed. Higher scores reflect stronger endorsement of each death attitude. For the Korean version, Cronbach's α ranged from .81 to .90 across the five dimensions [17], and from .85 to .95 in this study.

4) Burnout

Burnout is a syndrome characterized by emotional exhaustion and cynicism, commonly observed in service-oriented professions [18]. Burnout was assessed using the Maslach Burnout Inventory™ (MBI), which evaluates three domains: emotional exhaustion, reduced personal accomplishment, and depersonalization. Emotional exhaustion, the core aspect of burnout, refers to feelings of being emotionally drained and overwhelmed. Reduced personal accomplishment involves negative self-evaluation of work performance and achievements. Depersonalization is characterized by negative, cynical, or excessively detached attitudes toward those being cared for [19]. These subcomponents function independently; depersonalization, in particular, is not simply the inverse of emotional exhaustion or reduced personal accomplishment [20]. The MBI comprises 22 items rated on a 7-point scale (1 = not at all, 7 = very strongly agree), with higher scores indicating greater burnout. The Cronbach's α was .82 for the Korean version used with nurses [20], and .92 in this study.

4. Data Collection and Ethical Considerations

This research was approved by the Research Ethics Committee of Namseoul University (No. 1041479-HR-202105-002) prior to data collection. Approval was obtained from the head of the nursing department before recruiting participants. The principal investigator visited each hemodialysis unit to explain the study's purpose, procedures, the voluntary nature of participation, and confidentiality assurances. Only nurses who provided written informed consent were included in the study and were offered a $10 coffee voucher as compensation. All data were anonymized and will be destroyed after three years. Data collection took place from July to December 2021.

5. Data Analysis

Data were analyzed using IBM SPSS Win 21.0 (IBM Corp., Armonk, NY, USA). General characteristics of participants were summarized as frequencies (percentages) and means (standard deviations). The reliability of each measurement tool was assessed using Cronbach's α. Differences in burnout according to general characteristics were examined using the independent t-test and analysis of variance (ANOVA), with the Bonferroni post-hoc test as appropriate. Relationships among death anxiety, death attitudes, and burnout were analyzed using Pearson's correlation coefficients. Additionally, multiple regression analysis (simultaneous entry method) was performed to evaluate the unique contribution of each predictor variable to the dependent variable.

RESULTS

1. Differences in Burnout According to General Characteristics

There were no significant differences in burnout based on any general characteristics. All 86 participants were female, with a mean age of 35.4 ± 9.07 years. Among the participants, 54 (62.8%) had less than 5 years of overall nursing experience, and 78 (90.7%) had less than 5 years of dialysis-specific experience. Sixty-eight participants (79.1%) had experienced the death of a dialysis patient within the past year, yet only 27 (31.4%) had received formal education on death (Table 1).

2. Death Anxiety, Death Attitudes, and Burnout Scores

The mean death anxiety score among participants was 2.71 ± 0.73. Attitudes toward death were ranked in the following order: neutral acceptance, escape acceptance, fear of death, death avoidance, and approach acceptance. The mean burnout score was 3.94 ± 0.77. Of the burnout subscales, emotional exhaustion had the highest mean score, followed by reduced personal accomplishment and depersonalization (Table 2).

Table 1. Differences in Burnout According to General Characteristics ($N = 86$)

Characteristics	Categories	n (%)	Burnout t or F (*p*)
Sex	Female	86 (100.0)	-
Age (year)	20s	30 (34.9)	87.89
	30s	32 (37.2)	(.658)
	Over 40s	24 (27.9)	
Education	College	71 (82.6)	53.59
	Graduate school	15 (17.4)	(.236)
Religion	Yes	39 (45.4)	54.26
	No	47 (54.6)	(.216)
Marital status	Married	37 (43.1)	53.23
	Unmarried	49 (56.9)	(.247)
Nurse career (year)	< 5	54 (62.8)	38.37
	≥ 5	32 (37.2)	(.811)
Hemodialysis unit career (year)	< 5	78 (90.7)	42.15
	≥ 5	8 (9.3)	(.673)
Patients' death within a year	Yes	68 (79.1)	40.88
	No	18 (20.9)	(.723)
Family/friends' death within a year	Yes	32 (37.2)	43.41
	No	54 (62.8)	(.622)
Experience of death education	Yes	27 (31.4)	47.08
	No	59 (68.6)	(.469)
Intention to participate in death education	Yes	20 (23.3)	99.09
	Unsure	41 (47.7)	(.075)
	No	25 (29.0)	

https://doi.org/10.7475/kjan.2025.0317

3. Relationships Among Death Anxiety, Death Attitudes, and Burnout

Death anxiety was found to correlate with specific attitudes toward death. There was a significant positive correlation between death anxiety and both fear of death ($r=.65$, $p<.001$) and death avoidance ($r=.35$, $p=.001$). In contrast, death anxiety demonstrated a significant negative correlation with the neutral acceptance attitude toward death ($r=-.33$, $p=.002$).

Additionally, certain attitudes toward death were significantly associated with burnout. Specifically, higher levels of escape acceptance were associated with increased emotional exhaustion ($r=.36$, $p=.001$) and reduced personal accomplishment ($r=.37$, $p<.001$). Conversely, as neutral acceptance of death increased, levels of depersonalization decreased ($r=-.24$, $p=.027$) (Table 3).

4. Factors Influencing Burnout

Assumptions of homoscedasticity and normality of residuals were tested and confirmed prior to regression analysis. To identify factors influencing burnout, multiple regression analysis was performed, including general characteristics—such as age, educational background, religion, marital status, length of nursing career, experience in hemodialysis units, and experience with patient deaths within the past year—as well as death anxiety and the five attitudes toward death. All tolerance values were ≥0.1 (range=.41–.80), and all variance inflation factor values were below 10 (range=1.28–2.43), indicating no multicollinearity. The Durbin-Watson statistic was 1.71, close to the ideal value of 2, confirming the absence of autocorrelation. The overall regression model was statistically significant. The regression equation was as follows: $Y=3.02-0.68X_1+0.23\ X_2$

Table 2. Scores for Death Anxiety, Death Attitudes, and Burnout

Variables	Possible range	M±SD	Cronbach's α
Death anxiety	1–5	2.71±0.73	.90
Death attitudes	1–7		
Neutral acceptance		5.48±1.07	.85
Escape acceptance		3.09±1.58	.95
Fear of death		3.05±.1.41	.92
Death avoidance		2.99±1.34	.86
Approach acceptance		2.84±1.52	.95
Burnout	1–7	3.94±0.77	.92
Emotional exhaustion		4.01±1.42	.94
Reduced personal accomplishment		3.28±1.21	.90
Depersonalization		2.59±1.21	.77

M=mean; SD=standard deviation.

Table 3. Relationships among Death Anxiety, Death Attitudes, and Burnout

Variables	Death anxiety	Burnout	Subdomain of burnout		
			EE	PA	DP
			r (p)		
Death attitudes					
Fear of death	.65 (<.001)	.02 (.891)	.02 (.878)	−.06 (.581)	.08 (.485)
Avoidance of death	.35 (.001)	.05 (.640)	.08 (.449)	−.06 (.611)	.08 (.457)
Neutral acceptance	−.33 (.002)	−.16 (.144)	−.02 (.881)	−.13 (.251)	−.24 (.027)
Escape acceptance	.09 (.402)	.41 (<.001)	.36 (.001)	.37 (<.001)	.19 (.073)
Approach acceptance	.16 (.144)	−.13 (.223)	−.14 (.206)	−.10 (.369)	−.06 (.585)

DP=depersonalization; EE=emotional exhaustion; PA=reduced personal accomplishment.

(Y = burnout; X_1 = marital status [married]; X_2 = escape acceptance attitude toward death).

This multiple regression analysis revealed that marital status (being married) (β = –.35, p = .005) and the escape acceptance attitude toward death (β = .37, p = .002) were significant predictors of burnout. Being married was associated with lower levels of burnout, whereas higher levels of escape acceptance were associated with increased burnout (Table 4).

DISCUSSION

This study examined whether burnout was associated with death anxiety or attitudes toward death among nurses working in hemodialysis units. Significant correlations were observed between death anxiety, attitudes toward death, and burnout. Due to fear or avoidance of death, some clinical nurses distance themselves from patients or avoid forming close relationships [7]. These behaviors can contribute to feelings of helplessness and emotional projection [21], which in turn may lead to decreased job performance, increased stress, deteriorating health, and higher turnover rates [14]. Nurses are healthcare professionals who frequently encounter death in clinical practice. The present findings are particularly important because negative perceptions or attitudes toward death among nurses caring for patients with chronic and severe conditions, such as those undergoing hemodialysis, may affect both their job satisfaction and the quality of nursing care provided.

In this study, participants reported the highest scores for neutral acceptance of death (5.48 ± 1.07), which was negatively associated with death anxiety. Consistent with these findings, previous research in Turkey has similarly demonstrated that nurses tend to exhibit a high level of neutral acceptance (5.14 ± 0.76), especially those who have received education on death [13]. Neutral acceptance refers to recognizing death as a natural part of life [22]. This attitude helps mitigate fear and avoidance of death by encouraging individuals to accept life's finiteness, acknowledge personal limitations, and transcend existential boundaries [23]. While it remains unclear whether neutral acceptance is the most desirable attitude, it may be suggested as one potential approach to reducing death-related burnout in nurses.

Similarly, Greek nurses showed the highest levels of neutral acceptance of death (5.25 ± 0.89), which was significantly associated with burnout, including emotional exhaustion [24]. Taipei nurses exhibited the highest levels of death acceptance through approach attitudes, which were linked to Christian beliefs emphasizing a positive view of the afterlife [14]. Perceptions of death are influenced by sociocultural experiences and may evolve over time [25]. Therefore, the relationship between nurses' neutral acceptance of death and death anxiety in hemodialysis settings may reflect unique characteristics shaped by Korean cultural contexts.

The results of this study also indicated that the death attitude of escape acceptance was a key factor associated with burnout among hemodialysis nurses. Escape acceptance views death as a desirable means of relief from pain and suffering [22]. Because this attitude is grounded in life's hardships rather than the value of death itself, it may emerge when individuals are unable to effectively cope with pain and existential challenges [11]. Nursing is founded on the ethical obligation to uphold the dignity and integrity of individuals and to provide holistic patient care [26]. Hemodialysis nurses, acutely aware of their patients' suffering, may experience feelings of guilt due to their inability to fully relieve this suffering. This can lead to a sense of inadequacy or helplessness when responding to patients' emotions, hopes, and expectations. While caring for patients with end-stage renal disease who require complex treatment, nurses may experience illness subjectively and adopt escape acceptance attitudes toward death as an existential reflection on serving the patient's best interests.

A concern highlighted by these results is that as the tendency to view death as an escape from suffering increased,

Table 4. Factors Affecting Burnout in Nurses Caring for Hemodialysis Patients

Variables	B	SE	β	t	*p*
Constant	3.02	1.08		2.79	.007
Marital status (married)	–0.68	0.24	–.35	–2.88	.005
Death attitudes (escape acceptance)	0.23	0.07	.37	3.28	.002
Adjusted R^2 = .22, F = 2.43, p = .005					

SE = standard error.

https://doi.org/10.7475/kjan.2025.0317

so did emotional exhaustion. Nurses who strongly fear death or see it as an escape from pain were more likely to experience heightened emotional exhaustion, depersonalization, and reduced personal accomplishment [27]. Depersonalization, a core component of burnout, is characterized by emotional detachment, indifference, and a sense of coldness toward patients. It can also be understood as cynicism, which is linked to job satisfaction and professional commitment [28]. A significant portion of nursing work involves direct patient interaction, and emotional exhaustion resulting from depersonalization or cynicism can exacerbate burnout, lower job satisfaction, worsen mental health, and increase turnover intentions [29]. However, burnout itself may also influence the development of an escape acceptance attitude toward death. Thus, further research is needed to examine how burnout may alter nurses' emotional responses and interactions with patients.

Although hemodialysis nurses recognize the importance of discussing end-of-life issues with patients early in the course of maintenance hemodialysis [30], they often lack knowledge in the psychosocial, spiritual, and philosophical aspects of end-of-life care [31]. In this study, only 31.4% of participants had received formal education about death, highlighting the need to expand educational programs that support nurses in developing appropriate attitudes toward death. Death education aims to foster a deeper understanding of death, promote open discussion, and encourage individuals to appreciate and make the most of their remaining life [32]. For hemodialysis nurses, education on death preparation may help reduce anxiety and fear of death, establish healthier attitudes toward death, and ultimately prevent burnout [33]. As marital status was found to be associated with reduced burnout, death education programs should consider demographic characteristics. Given that most participants had less than 5 years of hemodialysis experience, it is necessary to tailor educational content to address diverse cultural and religious perspectives and to reflect on death according to nurses' levels of experience.

Cultural background and corresponding perceptions of death—whether positive or negative—may shape nurses' professional roles and the broader organizational context. Negative attitudes toward death have been associated with reluctance among nurses to provide end-of-life care [34]. In Korean society, death and dying are sometimes viewed as failures or are otherwise negatively perceived; however, the extent to which Korean culture influences the development of neutral attitudes toward death remains unclear. Nevertheless, the strength of this study lies in its ongoing exploration of death-related factors among hemodialysis nurses. By investigating the relationships among death anxiety, negative attitudes toward death, and burnout, this study proposes the development of educational programs aimed at reducing death anxiety and negative attitudes. Such systems might include regular death-related education, emotional labor management programs, peer support networks, stress management workshops, and counseling services tailored for hemodialysis nurses. Future research should strive to include more diverse samples, such as male nurses, those working in rural or smaller healthcare settings, and individuals from varied sociocultural backgrounds. In addition, future studies should employ intervention research (e.g., death acceptance training, burnout prevention programs) and qualitative investigations to further explore nurses' in-depth experiences and to guide the creation of evidence-based support strategies.

It is important to note, however, that the data for this study were collected during the coronavirus disease 2019 pandemic, which may limit the generalizability of findings regarding death anxiety, attitudes toward death, and burnout among hemodialysis nurses. Furthermore, the sample consisted entirely of female nurses—most with less than 5 years of dialysis experience—selected via convenience sampling, which may introduce selection bias. Statistically, fear of death and death avoidance are often highly correlated and may jointly reflect negative attitudes toward death. As a result, their unique contributions to explanatory models may be diminished, potentially leading to their exclusion from the regression analysis in this study. Therefore, interpretations of these results should also take into account the limitations of self-reported data and the potential for overfitting in the statistical analyses.

CONCLUSION

In clinical environments such as hemodialysis units, where life and death are closely intertwined, ethical and professional decision-making is required continuously. To sustain a highly trained hemodialysis nursing workforce and ensure high-quality care, it is essential to establish organizational support systems that go beyond individual efforts to acknowledge personal feelings about death and to cultivate appropriate attitudes toward it. To address death-related burnout among hemodialysis nurses, it may be effective to reduce negative attitudes toward death and to create opportunities for open, neutral discussions and emotional expression about death, both among nurses themselves and with patients and their families.

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

Study conception and/or design acquisition - SK; analysis - SK; interpretation of the data - SK and KK; and drafting or critical revision of the manuscript for important intellectual content - SK and KK.

FUNDING

This work was supported by the National Research Foundation of Korea (NRF-2021R1G1A1003370).

ACKNOWLEDGEMENT

None.

DATA AVAILABILITY STATEMENT

The data can be obtained from the corresponding authors.

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ORIGINAL ARTICLE

Korean J Adult Nurs Vol. 37 No. 3, 266-275, August 2025
eISSN: 2288-338X
https://doi.org/10.7475/kjan.2025.0319

KJAN
Korean Journal of
Adult Nursing

The Mediating Effects of Negative Affect and Cancer Coping in the Relationship between Perceived Stress and Health-Related Quality of Life among Gynecological Cancer Survivors: A Cross-Sectional Study

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Received: March 19, 2025
Revised: May 8, 2025
Accepted: June 12, 2025

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Purpose: The incidence of gynecological cancers is increasing, presenting significant challenges for patient care and outcomes. Perceived stress and negative affect can impede self-care behaviors and reduce health-related quality of life (HRQoL). This study examined the mediating effects of negative affect and cancer coping on the relationship between perceived hospital stress and HRQoL among patients with gynecological cancer. **Methods:** A cross-sectional mediation analysis was conducted with 118 gynecological cancer patients recruited from the outpatient clinic of a university hospital (October 2023 to February 2024). Participants completed validated instruments assessing perceived stress, negative affect, cancer coping, and HRQoL. Data were analyzed using Spearman's correlations and the PROCESS macro (Model 4) with 95% bootstrap confidence intervals (CIs). **Results:** Perceived stress was significantly correlated with negative affect ($r = .58$, $p < .001$), cancer coping ($r = .23$, $p = .012$), and HRQoL ($r = -.45$, $p < .001$). Negative affect was correlated with HRQoL ($r = -.59$, $p < .001$). Furthermore, negative affect and cancer coping mediated the relationship between stress and HRQoL ($B = -0.18$, 95% $CI = -0.27$ to -0.11 and $B = 0.04$, 95% $CI = 0.01$ to 0.08, respectively). **Conclusion:** Negative affect and cancer coping significantly mediated the relationship between hospital stress and HRQoL. Targeted interventions aiming to reduce stress and strengthen emotional and coping strategies could enhance HRQoL among gynecological cancer patients.

Key Words: Uterine neoplasms; Stress, physiological; Psychological distress; Coping skills; Quality of life

INTRODUCTION

According to GLOBOCAN 2022, the incidence of cancers, including gynecological cancers, is increasing worldwide [1]. Advances in early detection and treatment have substantially improved survival rates, with over 80% of cervical and endometrial cancer patients and 65.1% of ovarian cancer patients surviving beyond 5 years in Korea [2]. These improvements in cancer management underscore the necessity of focusing not only on survival but also on enhancing quality of life among gynecological cancer survivors [1,2].

Despite improved prognoses, many survivors continue to experience persistent psychological and emotional challenges, particularly related to perceived stress, negative affect, and coping mechanisms [3-6]. Such emotional difficulties often arise from the initial cancer diagnosis, side effects related to treatment, and daily stressors including fatigue, anxiety, and altered body image [4-6]. Additionally, the loss of reproductive organs may exacerbate concerns about sexual identity and body image, thereby increasing perceived stress and diminishing health-related quality of life (HRQoL) [7]. Recent evidence indicates perceived stress is significantly associated with higher symptom burden, regardless of cancer type or treatment modality, explaining a substantial proportion of variance in symptom severity and distress among survivors [8]. Thus, patient-centered care plans are crucial for alleviating perceived stress and improving HRQoL in gynecological cancer survivors [5,7].

Given these challenges, it is important to understand how emotional responses and coping behaviors influence well-being among gynecological cancer survivors. According to the transactional model of stress and coping [9], individuals cognitively appraise cancer-related stress and adopt various coping strategies that directly influence psychological adjustment. Negative affect—including emotions such as fear, sadness, and anger—is commonly experienced, especially during diagnosis and treatment phases [4,6]. Conversely, positive affect can emerge during recovery, promoting emotional balance and resilience [9,10].

Cancer coping involves mobilizing personal and social resources to manage perceived cancer-related stress. Such strategies include planning, positive reframing, seeking support, emotional expression, and asking for help [11]. Positive coping strategies foster psychological and physical adaptation, potentially enhancing engagement in treatment and facilitating recovery [12,13]. These mechanisms suggest that how patients manage emotional distress and stress critically influences their overall quality of life.

Previous studies have identified predictors of HRQoL in gynecological cancer patients, including social support, coping strategies, perceived stress, marital status [13], body image [3], abdominal complaints, activity levels, depression [2], and changes in physical, mental, and sexual health [14]. Unlike prior research focusing on individual factors, this study examines the combined mediating roles of negative affect and coping strategies within the transactional model of stress and coping [9]. By systematically evaluating their joint impact on HRQoL, this study offers deeper insights into perceived stress adaptation mechanisms and actionable guidance for tailored nursing interventions. Therefore, the present study aims to investigate the mediating effects of negative affect and cancer coping in the relationship between perceived stress and HRQoL. A parallel multiple mediation model (PROCESS Macro) was applied, simultaneously entering both mediators to assess their individual and combined indirect effects. The research hypotheses are as follows: (1) Perceived stress would be correlated with negative affect, cancer coping, and HRQoL; (2) Negative affect and cancer coping would affect HRQoL; (3) Perceived stress would influence HRQoL; and (4) Negative affect and cancer coping would mediate the relationship between perceived stress and HRQoL.

METHODS

1. Study Design

This cross-sectional study utilized quantitative mediation analysis to investigate the mediating roles of negative affect and cancer coping in the relationship between perceived stress and HRQoL among gynecological cancer patients.

2. Setting and Samples

Participants were recruited from a university-affiliated gynecological outpatient clinic in Seoul, South Korea. The eligibility criteria included age ≥18 years, a diagnosis of gynecological cancer (cervical, endometrial, or ovarian), the ability to complete the questionnaire independently, and voluntary participation. Exclusion criteria were a previous diagnosis of another cancer or current psychotherapy treatment. The sample size was calculated using G*Power 3.1.7 for linear regression analysis ($\alpha=.05$, power = .80, $f^2=.15$), suitable for detecting medium-sized effects. According to Hayes [15], approximately 100 to 150 participants are sufficient for simple and parallel multiple mediation analyses employing bootstrapping. Of the 150 individuals initially screened, 118 participants (n = 63 cervical, n = 32 endometrial, n = 23 ovarian cancer) met the eligibility criteria and completed the study without missing data, negating the need for data imputation. Efforts were made to include participants from diverse demographic backgrounds to minimize selection bias.

3. Instruments

1) General characteristics

Participants' general characteristics were assessed using an 11-item questionnaire derived from previous research [6]. These items included age, spouse status (presence or absence), educational level, employment status, religion, presence of a primary family caregiver, medical payment methods, responsibility for housework or childcare, type of gynecological cancer, disease duration, and treatment modalities.

2) Perceived stress

Perceived stress was measured using the validated Korean Hospital Stress Rating Scale (K-HSRS) [16], originally developed by Volicer and Bohannon [17]. The scale comprises 13 items, each rated on a 5-point Likert scale (1 = not at all, 5 = very severe), with total scores ranging from 13 to 65. Higher scores indicate greater perceived stress. Cronbach's α values were .93 in Volicer and Bohannon's study [17], .93 in Kang's validation [16], and .89 in this study.

3) Negative affect

Negative affect was assessed using the validated Korean version of the Positive Affect and Negative Affect Scale (K-PANAS) [18], following written approval for its use. The original questionnaire was developed and validated by Watson et al. [19]. Negative affect was measured by 10 items rated on a 5-point Likert scale (1 = very slightly or not at all, 5 = extremely), yielding total scores ranging from 10 to 50, with higher scores indicating greater negative affect. Cronbach's α was .85 in the study of Watson et al. [19], .87 in the Korean validation study by Lee et al. [18], and .91 in this study.

4) Cancer coping

Cancer coping was evaluated using the validated Korean Cancer Coping Questionnaire (K-CCQ), administered after obtaining written approval [20]. The Cancer Coping Questionnaire (CCQ) was originally developed by Moorey et al. [11]. The K-CCQ consists of two subscales: individual coping (14 items) and interpersonal coping (9 items). Items were rated on a 4-point Likert scale (1 = not at all, 4 = very frequently), with total scores ranging from 23 to 92. Higher scores indicate stronger coping abilities. Cronbach's α values for individual and interpersonal coping ranged from .72 to .90 in the original K-CCQ validation [20] and were .94 and .91, respectively, in this study.

5) Health-related quality of life

HRQoL was assessed using the 27-item Korean version of the Functional Assessment of Cancer Therapy-General (FACT-G), which measures four domains of HRQoL in cancer patients: physical (7 items), social (7 items), emotional (6 items), and functional well-being (7 items). The FACT-G was initially developed and validated by Cella et al. [21]. The Korean version was approved and obtained from https://www.facit.org/measures/fact-g. Each item was rated on a 5-point Likert scale (0 = not at all, 4 = very much), with a total score range of 0 to 108. Higher scores reflect better HRQoL. Cronbach's α was .89 in Cella et al.'s validation [21] and .86 in this study.

4. Data Collection

Data were collected from October 10, 2023, to February 28, 2024. Approval from the chief directors of medical and nursing departments was first obtained after explaining the study's purpose. Subsequently, a recruitment notice was displayed in the gynecological outpatient clinic. Participants who expressed interest were provided detailed information regarding the study's objectives, procedures, confidentiality and anonymity assurances, the non-collection of personally identifiable information, and their right to withdraw at any time without penalty. Completing the questionnaire required approximately 20 minutes, and participants received a small incentive of $5 upon completion.

5. Ethical Considerations

This study adhered strictly to the principles outlined in the Declaration of Helsinki and received approval from the institutional review board (IRB No: GCI 2023-07-014-002). All participants provided written informed consent before enrollment.

6. Data Analysis

Data were analyzed using IBM SPSS version 23.0 software (IBM Corp., Armonk, NY, USA) to explore participant characteristics and evaluate perceived stress, negative affect, cancer coping, and HRQoL. Descriptive statistics and frequency analysis were conducted, and the internal consistency reliability of all scales was verified using Cronbach's α coefficients. Due to partial violations of normality assumptions (as assessed by the Shapiro-Wilk test), non-parametric tests—including the Mann-Whitney U test and Kruskal-Wallis test with Bonferroni post hoc adjustments—were applied to compare group differences.

Spearman's correlation analysis was used to examine relationships among perceived stress, negative affect, cancer coping, and HRQoL. Mediating effects of negative affect (mediator 1) and cancer coping (mediator 2) on the relationship between perceived stress (independent variable) and HRQoL (dependent variable) were evaluated using Hayes' PROCESS macro (Model 4), employing 5,000 bootstrap samples to test indirect effects for significance. All statistical analyses were rigorously conducted to ensure the validity and reliability of the mediation model.

RESULTS

1. Mean Scores of Perceived Stress, Negative Affect, Cancer Coping, and HRQoL

The mean scores for perceived stress, negative affect, cancer coping, and HRQoL were 2.76±0.75, 2.19±0.85, 2.28±0.60, and 2.80±0.50, respectively. Within cancer coping, the subscale mean scores were 2.35±0.61 for individual coping and 2.18±0.80 for interpersonal coping. The HRQoL domain scores were as follows: physical well-being (3.19±0.75), social well-being (2.16±0.79), emotional well-being (2.86±0.78), and functional well-being (2.99±0.69) (Table 1).

2. Participants' Characteristics

Regarding participants' characteristics, the mean age was 43.92±9.39 years, with 32.2% aged 18 to 39 years and 53.4% aged 40 to 54 years. In terms of marital status, 67.8% lived with their spouse. Primary caregivers provided care for 84.7% of participants. Additionally, 78.0% reported being employed, 49.2% identified as religious, and 76.3% had attained college-level education or higher. Regarding medical fee payment methods, 70.3% used support from public or private cancer insurance. Furthermore, 71.2% experienced concurrent burdens related to housework or childcare responsibilities. Concerning cancer types, 53.4% of participants were diagnosed with cervical cancer, 27.1% with endometrial cancer, and 19.5% with ovarian cancer. The mean disease duration was 39.41±29.83 months. Regarding treatment modalities, 82.2% received single-modality cancer treatments (e.g., surgery, chemotherapy, or radiation therapy) (Table 2).

3. Differences in Perceived Stress, Negative Affect, Cancer Coping, and HRQoL According to Participants' Characteristics

The results of the Mann–Whitney U test or Kruskal–Wallis test with Bonferroni multiple comparison showed that perceived stress was significantly higher among ovarian cancer patients compared to cervical cancer patients ($z=10.51$, $p=.005$). Negative affect was significantly higher among participants who were religious ($z=-1.97$, $p=.049$) and paid their medical fees themselves ($z=-2.00$, $p=.045$). Moreover, cancer coping was significantly higher among those who lived with their spouses ($z=-3.26$, $p=.001$), and who were cared for by their primary caregivers ($z=-2.35$, $p=.019$). HRQoL was lower among participants without primary caregivers ($z=-2.48$, $p=.013$) and those who received combination cancer therapy ($z=-3.04$, $p=.002$) (Table 2).

Table 1. Mean Scores of Perceived Stress, Negative Affect, Cancer Coping, and HRQoL ($N=118$)

Variables/Sub-dimensions	Score range	No. of items	M±SD	Range (min–max)	Cronbach's α	Normality Shapiro-Wilk's *p*
Perceived stress	1–5	13	2.76±0.75	1.00–4.31	.89	.310
Negative affect	1–5	10	2.19±0.85	1.00–4.80	.91	<.001
Cancer coping	1–4	23	2.28±0.60	1.00–3.96	.94	.318
Individual	1–4	14	2.35±0.61	1.00–4.00	.91	
Interpersonal	1–4	9	2.18±0.80	1.00–4.00	.94	
HRQoL	0–4	27	2.80±0.50	1.00–3.81	.86	.560
Physical	0–4	7	3.19±0.75	1.00–4.00	.84	
Social	0–4	7	2.16±0.79	1.00–3.71	.80	
Emotional	0–4	6	2.86±0.78	1.00–4.00	.78	
Functional	0–4	7	2.99±0.69	1.00–4.00	.84	

HRQoL=health-related quality of life; M=mean; SD=standard deviation.

Table 2. Differences in Perceived Stress, Negative Affect, Cancer Coping, and HRQoL According to Participants' Characteristics (N=118)

Characteristics	Categories	n (%) or M±SD	Perceived stress		Negative affect		Cancer coping		HRQoL	
			M±SD	z or χ^2 (p)	M±SD	z or χ^2 (p)	M±SD	z or χ^2 (p)	M±SD	z or χ^2 (p)
Age (year)		43.92±9.39								
	18–39	38 (32.2)	2.89±0.88	2.05	2.07±0.81	3.07	2.22±0.69	1.08	2.86±0.40	1.00
	40–54	63 (53.4)	2.72±0.68	(.359)	2.17±0.88	(.215)	2.31±0.54	(.582)	2.78±0.53	(.608)
	≥55	17 (14.4)	2.61±0.70		2.51±0.80		2.33±0.64		2.74±0.62	
Spouse	Yes	80 (67.8)	2.81±0.70	−0.97	2.24±0.89	−0.75	2.39±0.56	−3.26	2.80±0.48	−0.10
	No	38 (32.2)	2.66±0.84	(.330)	2.07±0.77	(.454)	2.05±0.64	(.001)	2.79±0.55	(.922)
Primary family caregiver	Yes	100 (84.7)	2.77±0.76	−0.23	2.16±0.85	−0.67	2.33±0.61	−2.35	2.86±0.48	−2.48
	No	18 (15.3)	2.73±0.73	(.745)	2.31±0.85	(.505)	1.99±0.50	(.019)	2.48±0.54	(.013)
Educational level	≤High school	28 (23.7)	2.68±0.69	−0.89	2.33±0.81	−1.17	2.16±0.66	−0.97	2.77±0.50	−0.22
	≥College	90 (76.3)	2.79±0.77	(.374)	2.14±0.86	(.241)	2.32±0.58	(.333)	2.81±0.51	(.825)
Employment	Yes	92 (78.0)	2.72±0.79	−1.15	2.15±0.87	−0.97	2.30±0.63	−0.35	2.83±0.50	−1.43
	No	26 (22.0)	2.91±0.57	(.251)	2.30±0.79	(.331)	2.24±0.50	(.723)	2.68±0.50	(.154)
Religion	Yes	58 (49.2)	2.86±0.70	−1.46	2.33±0.84	−1.97	2.34±0.58	−1.14	2.79±0.53	−0.31
	No	60 (50.8)	2.66±0.79	(.144)	2.04±0.84	(.049)	2.22±0.62	(.256)	2.81±0.50	(.757)
Person who paid medical fees	Patient herself	83 (70.3)	2.68±0.79	−1.55	2.08±0.80	−2.00	2.21±0.61	−1.67	2.80±0.50	−0.02
	Others	35 (29.7)	2.94±0.61	(.120)	2.43±0.92	(.045)	2.45±0.56	(.094)	2.80±0.51	(.981)
Housework/childcare burdens	Yes	84 (71.2)	2.72±0.79	−0.54	2.13±0.88	−1.44	2.22±0.62	−1.44	2.83±0.51	−1.13
	No	34 (28.8)	2.86±0.63	(.590)	2.32±0.76	(.150)	2.43±0.55	(.151)	2.72±0.48	(.260)
Disease duration (month)		39.41±29.83								
	≤12	38 (32.2)	2.81±0.90	0.15	2.29±0.95	1.02	2.23±0.51	0.77	2.69±0.50	1.36
	13–60	63 (53.4)	2.73±0.71	(.927)	2.11±0.79	(.601)	2.29±0.63	(.680)	2.84±0.50	(.507)
	≥61	17 (14.4)	2.80±0.68		2.36±0.95		2.35±0.66		2.79±0.53	
Type of gynecologic cancer	Endometrial[a]	32 (27.1)	2.84±0.78	10.51	3.81±0.80	0.56	2.31±0.52	0.60	2.80±0.48	0.89
	Ovarian[b]	23 (19.5)	3.16±0.65	(.005)	3.74±0.77	(.756)	2.22±0.46	(.742)	2.70±0.52	(.642)
	Cervical[c]	63 (53.4)	2.57±0.71	b>c	3.84±0.91		2.29±0.69		2.83±0.51	
Treatment modality	Single	97 (82.2)	2.70±0.80	−1.93	2.13±0.88	−1.90	2.24±0.64	−1.37	2.86±0.50	−3.04
	Combination	21 (17.8)	3.01±0.41	(.054)	2.45±0.68	(.058)	2.45±0.35	(.171)	2.50±0.37	(.002)

χ^2 calculated using the Kruskal-Wallis test; z-score calculated using the Mann-Whitney U test; Letters (a, b, c) present for Bonferroni multiple comparison; a, b, c: the same letters are not statistically significant; HRQoL=health-related quality of life; M=mean; SD=standard deviation.

4. Relationship between Perceived Stress, Negative Affect, Cancer Coping, and HRQoL

Spearman correlation analysis showed that perceived stress was significantly correlated with negative affect (r=.58, p<.001), cancer coping (r=.23, p=.012), and HRQoL (r=–.45, p<.001). Additionally, negative affect was correlated with HRQoL (r=–.59, p<.001) (Table 3). Therefore, Hypothesis 1 ("Perceived stress would be correlated with negative affect, cancer coping, and HRQoL") was accepted (Table 3).

5. Mediating Effects of Negative Affect and Cancer Coping in the Relationship between Perceived Stress and HRQoL

The mediation analysis using Hayes' PROCESS macro confirmed significant mediating roles of negative affect and cancer coping in the relationship between perceived stress and HRQoL. The regression model demonstrated appropriate goodness-of-fit after controlling for covariates, including spouse status, religion, primary caregiver presence, housework or childcare burden, medical fee payment method, and cancer treatment modality.

Perceived stress significantly affected negative affect (B=0.63, p<.001), and negative affect affected HRQoL

Table 3. Relationship between Perceived Stress, Negative Affect, Cancer Coping, and HRQoL ($N=118$)

Variables	Perceived stress	Negative affect	Cancer coping	HRQoL
	r (p)			
Perceived stress	-			
Negative affect	.58 (<.001)	-		
Cancer coping	.23 (.012)	.11 (.222)	-	
HRQoL	–.45 (<.001)	–.59 (<.001)	.12 (.191)	-

HRQoL=health-related quality of life; r=Spearman's correlation analysis.

(B=–0.29, $p<.001$). Furthermore, perceived stress significantly affected cancer coping (B=0.22, $p=.002$), and cancer coping affected HRQoL (B=0.17, $p=.007$). Bootstrapping analysis demonstrated two significant indirect effects between perceived stress and HRQoL, with the mediating effects of negative affect and cancer coping (B=–0.18, 95% confidence interval=–0.27 to –0.11; B=0.04, 95% confidence interval=0.01 to 0.08). Therefore, hypotheses 2 (negative affect and cancer coping would influence HRQoL), 3 (perceived stress would influence HRQoL), and 4 (negative affect and cancer coping would mediate the relationship between perceived stress and HRQoL) were supported. The final model accounted for 41% of the variance in HRQoL (F=26.17, $p<.001$).

These results exhibited acceptable goodness-of-fit, with no multicollinearity between the independent variables (range of variance inflation factor=1.032–1.393), the presence of a normal distribution of residuals (Kolmogorov-Smirnov's $p>.05$), no autocorrelation (Durbin–Watson's range: $D_L<$ Durbin–Watson's index $<4-D_L$), and the presence of equal variance (Breusch-Pagan test, $p>.05$) (Table 4, Figure 1).

DISCUSSION

This study confirmed that lower perceived stress levels, fewer negative emotions, and stronger cancer coping skills are associated with better HRQoL among patients with gynecological cancer. Notably, the significant mediating effects of negative emotions and cancer coping on the relationship between perceived stress and HRQoL emphasize their critical roles in patient outcomes. These findings underline the importance of addressing both psychological states and coping mechanisms to enhance the quality of life in this patient population.

The mean HRQoL score observed in this study was 2.80, with subscale scores of 3.19 for physical well-being, 2.99 for functional well-being, 2.86 for emotional well-being, and 2.16 for social well-being. These results align with previous studies using the same measurement tool among gynecological cancer patients [6]. HRQoL was notably lower among patients lacking a primary family caregiver, particularly within the social domain. This aligns with a systematic review identifying unmet support needs in gynecological cancer patients [22]. Similarly, another study reported inadequate physical, psychological, and informational support for Korean women with gynecological cancer [23]. In the Korean context, cultural norms promoting emotional suppression and traditional caregiving expectations of women may exacerbate perceived stress. Married women often feel anxious about burdening their spouses, while single women may hesitate to engage in relationships due to illness-related insecurities [24].

Negative affect was strongly associated with poorer HRQoL in this study, consistent with prior research linking negative emotions to decreased quality of life in cancer patients [19]. Additionally, higher negative affect was observed among patients facing greater treatment costs, highlighting the critical need for financial and emotional support interventions to improve patient outcomes [25]. Besides financial considerations, cultural factors in Korean society may influence emotional responses and coping strategies. Specifically, the cultural tendency to suppress negative emotional expression could heighten perceived stress and depressive symptoms [24]. Furthermore, religious beliefs demonstrated a complex relationship with emotional responses; patients identifying as religious experienced higher negative affect. This finding contrasts with systematic reviews that generally associate religious engagement with lower depression, anxiety, and improved life satisfaction [26]. This discrepancy might reflect cultural variations in how religiosity influences coping with illness. Intrinsic religiosity tends to encourage positive reframing of stressful experiences, whereas extrinsic religiosity may foster self-blame and exacerbate emotional distress [27]. Thus, culturally sensitive, faith-based psychological inter-

Table 4. Mediating Effects of Negative affect and Cancer Coping between Perceived Stress and HRQoL (*N*=118)

Variables	Effect (B)	SE	t	*p*	95% CI		R^2	F (*p*)
					Lower	Upper		
Model of mediating variable (dependent variable: negative affect, M1)								
(Constant)	0.44	.25	1.76	.082	–0.06	0.93	.31	52.76 (< .001)
Perceived stress	0.63	.08	7.26	< .001	0.46	0.71		
Model of mediating variable (dependent variable: cancer coping, M2)								
(Constant)	1.67	.20	8.17	< .001	1.27	2.08	.08	9.59 (.003)
Perceived stress	0.22	.07	3.10	.002	0.08	0.36		
Model of mediating variable (dependent variable: HRQoL, Y)								
(Constant)	3.43	.18	19.53	< .001	3.09	3.78	.41	26.17 (< .001)
Perceived stress	–0.14	.06	–2.36	.020	–0.26	–0.02		
Negative affect	–0.29	.05	–5.67	< .001	–0.39	–0.19		
Cancer coping	0.17	.06	2.77	.007	0.05	0.30		

Type	Path	Effect (B)	SE	T	*p*	95% CI		95% CI		
						Lower	Upper	BootSE	Boot lower	Boot upper
Indirect effect	Total	–0.15						0.05	–0.24	–0.06
	X→M1→Y	–0.18						0.04	–0.27	–0.11
	X→M2→Y	0.04						0.02	0.01	0.08
Direct effect	X→Y	–0.14	.06	–2.36	.020	–0.26	–0.02			
Total effect	X→Y	–0.29	.06	–5.15	< .001	–0.40	–0.18			

CI = confidence interval; HRQoL = health-related quality of life; M1 = mediating variable, negative affect; M2 = mediating variable, cancer coping; SE = standard error; X = independent variable, perceived stress; Y = dependent variable, health-related quality of life.

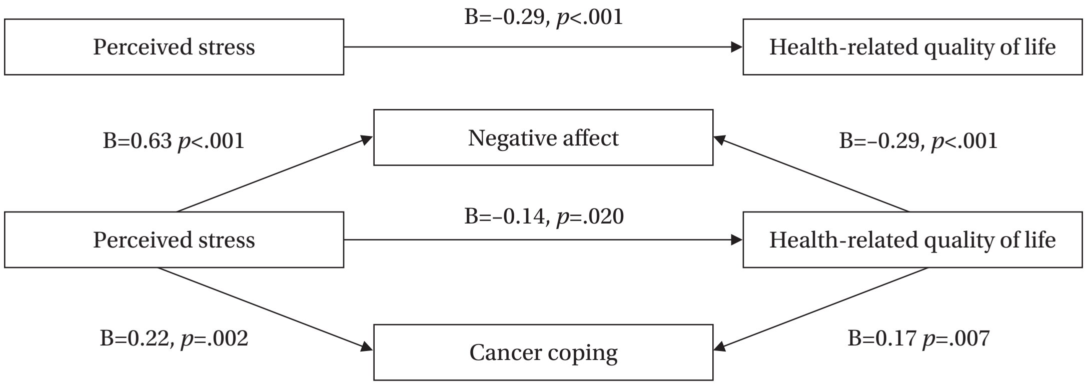

Figure 1. Mediating effects of negative affect and cancer coping in the relationship between perceived stress and health-related quality of life.

ventions tailored to patients' beliefs could significantly improve emotional coping and overall quality of life.

The average perceived stress score in this study was 2.76 and negatively correlated with HRQoL. This score is lower compared to another study employing the same tool (3.08 among colorectal, lung, and breast cancer patients) [28], potentially reflecting differences in disease severity, metastasis rates, or recurrence among more diverse cancer populations. Additionally, ovarian cancer patients reported significantly higher perceived stress compared to cervical cancer patients. This finding aligns with previous research demonstrating persistent emotional distress, fatigue, and physical function decline among ovarian cancer survivors, even during remission, which substantially affects their long-term quality of life [29,30]. Therefore, ongoing psychological support and targeted stress management interventions are particularly vital for ovarian cancer survivors to alleviate chronic psychological burdens and sustainably enhance their HRQoL.

The overall mean cancer coping score in this study was 2.28, with subscale scores of 2.35 for individual coping and 2.18 for interpersonal coping. These scores are lower than those reported in previous research among ovarian cancer survivors (overall coping = 2.57, individual = 2.63, interpersonal = 2.46) [7]. This discrepancy may result from differences in cancer types studied (cervical, endometrial, and ovarian cancer). Across various cultures, cancer patients frequently experience appearance changes, such as hair loss, and lifestyle adjustments that limit their social interactions. These effects might be more pronounced in Korean society due to significant sociocultural emphasis on appearance and interpersonal harmony [24].

The present study found that negative affect and cancer coping significantly mediated the relationship between perceived stress and HRQoL. Previous research consistently emphasizes perceived stress and coping strategies' pivotal roles in mediating stress-related health outcomes. For instance, Tungtong et al. [10] showed that mindfulness promoted adaptive coping, enhanced positive affect via positive reappraisal, and reduced negative affect through decreased rumination. Yeh et al. [13] also found acceptance coping mediated the stress–quality-of-life relationship among gynecological cancer survivors, reinforcing the importance of acceptance-based coping interventions.

Moreover, the current study revealed a stronger indirect effect through negative affect compared to cancer coping, suggesting emotional responses may have a more immediate and pronounced impact on quality-of-life outcomes. This aligns with prior studies emphasizing the central role of affective responses in stress adaptation, particularly among cancer populations coping with uncertainty [4,9]. Although cancer coping also played a meaningful mediating role, its relatively smaller effect might stem from individual differences in available coping resources or support systems. Examining both mediators concurrently provides a comprehensive understanding of the complex psychological mechanisms underlying HRQoL in gynecological cancer survivors. Thus, personalized interventions targeting emotional regulation and coping strategies could significantly enhance patients' physical, emotional, functional, and social well-being. Nevertheless, the study's cross-sectional design limits causal interpretations, and findings should be interpreted with caution. While the sample size was appropriately determined using G*Power for parallel multiple mediation analysis to detect medium-sized effects, future studies with larger and more diverse samples are recommended to improve generalizability. Additionally, convenience sampling from a single clinic potentially limits external validity.

CONCLUSION

This study demonstrated that negative affect and cancer coping significantly mediate the relationship between perceived stress and HRQoL among patients diagnosed with gynecological cancer. The findings highlight the critical importance of developing interventions that integrate perceived stress management, emotional regulation, and coping strategies to enhance patients' overall quality of life. Future research employing longitudinal designs could provide deeper insights into the evolving relationships between stress, emotions, and coping mechanisms over time. Furthermore, practical intervention programs specifically targeting the reduction of negative emotions, particularly among emotionally vulnerable groups such as ovarian cancer survivors, should be developed and rigorously evaluated.

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

Study conception and design acquisition - YWK, SK, and HJP; analysis - YWK, SK, and HJP; interpretation of the data - HJP; and drafting or critical revision of the manuscript for important intellectual content - YWK, SK, and HJP.

FUNDING

None.

ACKNOWLEDGEMENT

The authors would like to express their gratitude to all the gynecological cancer patients who participated in this study.

This article is a revision of the first author's master's thesis (dissertation) from CHA University.

DATA AVAILABILITY STATEMENT

The data can be obtained from the corresponding authors.

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ORIGINAL ARTICLE

Korean J Adult Nurs Vol. 37 No. 3, 276-286, August 2025
eISSN: 2288-338X
https://doi.org/10.7475/kjan.2025.0321

KJAN
Korean Journal of
Adult Nursing

Experiences of Nurse Managers in Clinical Nursing Education during Emerging Infectious Disease Outbreaks: A Qualitative Study

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Received: March 21, 2025
Revised: May 22, 2025
Accepted: August 6, 2025

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Purpose: The purpose of this study was to examine the experiences of nurse managers in clinical nursing education during an emerging infectious disease outbreak. **Methods:** Individual semi-structured interviews were conducted with 12 nurse managers from seven general or tertiary hospitals, each with 300 or more beds, in South Korea. Data were collected between February 17 and June 10, 2023, and analyzed using qualitative content analysis. **Results:** Four themes and 11 subthemes were identified. Nurse managers faced significant challenges in departmental management during the infectious disease outbreak, encountered a wide range of student attitudes toward learning, adapted their teaching methods flexibly in response to changing infectious disease conditions, and ultimately found meaning in the irreplaceable value of clinical practice education. **Conclusion:** During the emerging infectious disease outbreak, nurse managers not only encountered substantial difficulties but also experienced professional growth as clinical nursing educators. To enhance clinical nursing education in such challenging environments, it is essential to minimize uncertainty caused by infectious diseases and foster positive perceptions among nursing students regarding clinical practice education under restrictive circumstances. Institutional support is also necessary to reduce the work burden on nurse managers.

Key Words: Communicable diseases, emerging; Qualitative research; Nurse administrators; Education, nursing

INTRODUCTION

Clinical practice education is a fundamental component of nursing education, functioning as a critical link between theoretical learning and actual patient care. It allows nursing students to observe and participate in the roles of professional nurses, develop a deeper understanding of nursing practice, and build professional competence [1-3]. To maintain the quality of clinical education, the Korean Accreditation Board of Nursing Education sets standards for clinical practice sites and educator qualifications [4]. In South Korea, clinical educators include both university faculty and nurse managers, who supervise students directly in clinical settings [5]. Nurse managers, also known as head nurses, typically oversee student orientation, provide guidance throughout the practicum, and facilitate communication between nursing schools and clinical institutions. Drawing on extensive clinical expertise, they help foster students' clinical reasoning and judgment [5,6].

Previous studies have predominantly focused on the experiences of nursing students during the coronavirus disease 2019 (COVID-19) pandemic, as well as the challenges faced by university faculty involved in clinical education. For example, research has indicated that students suffered decreased quality of education due to reduced clinical exposure and limited patient interaction [3,7], while educators reported that infection control measures often took priority over student training during the crisis [8]. However, there is limited research centered on nurse managers, who directly supervise students in clinical settings. Despite their vital role in coordinating practice sites and mentoring students, their experiences and perspectives as clinical educators have not been sufficiently explored. Furthermore, nurse managers are known to experience greater job stress than general staff nurses, as they are responsible for both patient care and the education of students from multiple institutions [9]. Yet, there is little information regarding how they perceived and addressed their educational responsibilities during public health emergencies.

The emergence of novel infectious diseases has highlighted the critical need to manage the quality of clinical nursing education. Simultaneously, the necessity to strengthen the competencies of clinical educators who guide nursing students has become increasingly apparent [10]. In particular, nurse managers were required to move beyond their routine administrative duties and take on expanded roles as educators, actively leading clinical training during such crises [11]. Despite these heightened responsibilities, little research has addressed how nurse managers experienced their roles as educators in the context of emerging infectious disease outbreaks.

This study sought to explore the experiences of nurse managers as educators in clinical practice education during an emerging infectious disease outbreak. By focusing on their perspectives, this research aims to offer foundational insights to inform the development of effective training strategies and support systems for educators during future public health emergencies.

Given the unprecedented and emotionally complex nature of the COVID-19 pandemic, it is likely that nurse managers' experiences in clinical education encompass personal, institutional, and ethical dimensions that cannot be fully captured through quantitative methods. Therefore, a qualitative research approach was selected to explore these multifaceted, context-dependent experiences in depth. The findings of this study are expected to provide meaningful implications for enhancing the quality of nursing education and strengthening educator preparedness in times of crisis.

METHODS

1. Study Design

This qualitative study applied the methods of Hsieh and Shannon [12] to explore nurse managers' experiences as educators during emerging infectious disease outbreaks in nursing clinical practice.

2. Participants

Participants were recruited using a combination of purposive and snowball sampling, and all had at least one semester of experience providing nursing student practice education during the COVID-19 outbreak. Nurse managers who volunteered and met the eligibility criteria were included, while additional participants were referred by those who had already completed interviews. Recruitment continued until data saturation was achieved, resulting in a total of 12 participants.

All participants were female, with a mean age of 49.92±3.52 years. Most were married, and all held at least a bachelor's degree. Eight participants were employed at general hospitals and four at tertiary hospitals, working mainly in internal medicine and surgical wards, as well as in emergency departments, intensive care units, and health screening centers. The mean clinical experience was 27.50±3.48 years, and the average duration of managerial experience was 8.48±5.61 years. The period spent supervising nursing clinical practice education during the pandemic ranged from one to five semesters (Table 1).

3. Data Collection

Data collection occurred between February 17 and June 10, 2023, and qualitative content analysis was used for data interpretation. Individual semi-structured interviews were conducted with 12 nurse managers employed at seven general or tertiary hospitals, each with 300 or more beds in South Korea. All interviews were conducted by a researcher (JYP) who has seven years of clinical experience and prior publication experience in qualitative research. A semi-

Table 1. General Characteristics of the Participants ($N=12$)

No.	Sex	Age (year)	Educational level	Marital status	Type of hospital	Department	Clinical experience	Managerial experience	Duration of service as clinical practice educators during the pandemic (semesters)
1	F	46	Graduate student or higher	Single	Tertiary hospital	Medical ward	23 years and 4 months	1 year and 10 months	3
2	F	52	Graduate student or higher	Married	General hospital	Surgical ward	30 years	3 years	1
3	F	47	Graduate student or higher	Married	Tertiary hospital	Intensive care unit	23 years and 10 months	7 years and 9 months	2
4	F	56	Bachelor's degree	Married	General hospital	Medical ward	33 years and 5 months	20 years and 9 months	1
5	F	47	Bachelor's degree	Married	Tertiary hospital	Health screening center	25 years and 11 months	7 years and 10 months	4
6	F	53	Graduate student or higher	Married	General hospital	Surgical ward	31 years and 2 months	3 years and 4 months	3
7	F	54	Graduate student or higher	Married	General hospital	Surgical ward	31 years and 2 months	8 years	2
8	F	46	Graduate student or higher	Married	General hospital	Medical ward	24 years	1 year and 10 months	3
9	F	54	Graduate student or higher	Married	General hospital	Medical ward	31 years and 9 months	13 years and 5 months	3
10	F	49	Graduate student or higher	Married	General hospital	Surgical ward	25 years and 11 months	15 years	4
11	F	46	Bachelor's degree	Married	General hospital	Emergency room	25 years and 2 months	12 years	5
12	F	49	Graduate student or higher	Married	Tertiary hospital	Medical ward	25 years	7 years	3

F = female.

structured interview guide, developed by the research team through a review of relevant literature and previous studies [3,9,13] on clinical practice education during the pandemic, was used to facilitate the interviews. During each session, the researcher also observed and recorded participants' non-verbal expressions in field notes. Interviews began with the prompt: "Please tell us about your experience as an educator in nursing clinical practice education during the emerging infectious disease outbreak." Key questions included: "Tell me about how the emerging infectious disease outbreak has changed your approach as an educator in nursing clinical practice education," "Tell me about the benefits and challenges of being a clinical practice educator for nursing students during the emerging infectious disease outbreak," and "Tell me about what it means to you to be an educator in nursing clinical practice education during the emerging infectious disease outbreak."

Each interview lasted between 36 and 70 minutes, depending on the participant. The interviewer repeatedly reviewed the recordings and transcribed them verbatim, resulting in a total of 227 A4 pages. Three participants who were available for a second interview were asked to review and provide feedback on the data analysis.

4. Ethical Considerations

This study was approved by the Institutional Review Board of Kunsan College of Nursing (KCN2022-0829-01-3). Researchers explained the study procedures to all participants in person, informed them of their right to withdraw at any time, and guaranteed anonymity and confidentiality. Interviews were conducted only with participants who voluntarily agreed and provided written informed consent online. All personally identifiable information was coded alphabetically and numerically (e.g., Hospital A, Participant 1) to ensure anonymity. Each participant received an online gift card as a token of appreciation.

5. Data Analysis

Data were analyzed using conventional content analysis, employing an inductive approach based on the methods described by Hsieh and Shannon [12]. First, all investigators read the transcripts several times to gain an overall understanding of the data. SC and JL then independently reviewed the transcripts to extract and code semantic units, which were used to derive subthemes. Each identified subtheme was compared and grouped to generate and name abstract themes. When discrepancies arose, the two researchers discussed their findings until consensus was reached. Field notes were also reviewed during the analysis. The results were further reviewed by a nursing school professor with expertise in qualitative research.

6. Rigor

The rigor of the study was maintained using the criteria of credibility, fittingness, auditability, and confirmability, as outlined by Sandelowski [14]. To ensure credibility, open-ended questions were employed during interviews, allowing participants to freely share their experiences and perspectives. All recorded interviews were transcribed verbatim and systematically analyzed, and three participants who were available for a second interview reviewed the results for confirmation and feedback. To ensure fittingness, representative participant statements were presented, and participant demographics were described to facilitate the evaluation of findings for their relevance and applicability to other populations or contexts. Auditability was addressed by providing a detailed account of the study process to enable replication or follow-up research. The analysis included direct quotations from participants so that readers could verify the investigators' interpretations. Confirmability was ensured through collaborative data analysis by two investigators and independent review of the findings by a nursing school professor with experience in qualitative research. All research team members were nursing faculty, trained in qualitative research, experienced in educating nursing students, and familiar with collaboration with nurse managers in clinical settings.

RESULTS

A total of 247 meaningful statements describing the experiences of nurse managers as educators in clinical practice education during an emerging infectious disease outbreak were extracted and categorized into 70 codes, which were further organized into 11 subthemes and four overarching themes by grouping similar items. The identified themes were: “Challenges in managing the department during the infectious disease outbreak,” “Navigating student learning attitudes during the pandemic,” “Having the flexibility in teaching to adapt to changing epidemic conditions,” and “Discovering the meaning of irreplaceable clinical practice education” (Table 2).

1. Challenges in Managing the Department during the Infectious Disease Outbreak

Nurse managers were concerned about the spread of infection among patients, healthcare providers, and students in their departments during the outbreak, dealt with infec-

Table 2. Themes and Subthemes in the Findings

Themes	Subthemes
Challenges in managing the department during the infectious disease outbreak	Balancing infection risks and educational responsibilities
	Managing infection control amid increased patient scrutiny
	Increased pressure and responsibility as a clinical practice educator
Navigating student learning attitudes during the pandemic	Seeing students take advantage of valuable clinical practice opportunities
	Seeing students being intimidated by the unfamiliarity of clinical practice
Having the flexibility in teaching to adapt to changing epidemic conditions	Imparting limited clinical practice education
	Reinforcing hands-on infection control training
	Increased use of educational materials to supplement the limited clinical practice
Discovering the meaning of irreplaceable clinical practice education	Rediscovering the importance of clinical practice education in a clinical setting
	Feeling confident and rewarded as a clinical practice educator
	Professional growth with students during an infectious disease outbreak

tion-related complaints from inpatients or their guardians; and felt overwhelmed and responsible for supervising nursing clinical practice education.

1) Balancing infection risks and educational responsibilities

Participants described persistent worries about outbreaks and the risk of infection transmission among patients, students, and healthcare staff during nursing clinical practice education. They expressed concerns about students being exposed to infectious diseases while commuting as well as through contact with hospital patients.

> Patient infection control and stuff like that was a little bit of a challenge. I was worried about patients and students, about infections and outbreaks... I was very concerned about a lot of these things. (Participant 1)
>
> I was worried about the students being a source of infection for us. On the other hand, they took a risk by coming to the hospital. We could also be a source of infection for them. So, it was a situation where everyone had to be careful. (Participant 9)

2) Managing infection control amid increased patient scrutiny

Participants reported that, despite adhering to infection control guidelines, hospitalized patients and their caregivers frequently voiced concerns and complaints about infection risks during the outbreak. Nurse managers had to address these concerns directly. Some patients, highly sensitive to infection risk, closely observed the infection control practices of healthcare staff and nursing students. There were occasions when patients complained about students' hand hygiene, perceiving it as inadequate. In response to heightened patient vigilance and anxiety about infection spread, nurse managers emphasized to students the necessity of consistently performing proper infection control, especially in the presence of patients.

> The students were a little reluctant to get in contact (for fear of infection) and reacted that way... When there were confirmed cases (of COVID-19), although we tried our best to control the infection, the patients blamed the healthcare workers for it, which was difficult. (Participant 1)
>
> Patients are becoming too sensitive these days. They suspect us of reusing equipment; hence, we have to wipe [it down] while they watch us. We have to wash our hands in front of patients to reduce the complaints. I used to tell this to the students... Regarding infections... (Participant 2)

3) Increased pressure and responsibility as a clinical practice educator

In addition to their existing duties as nurse managers, participants reported increased anxiety regarding the prevention of infections in their departments during outbreaks. They described feeling burdened and stressed as they had to monitor respiratory symptoms, check COVID-19 test results, enforce infection control measures, and explain movement restrictions, all while supervising students. Nonetheless, they strove to fulfill these responsibilities diligently.

> I was under a lot of pressure (to manage clinical practice education during the epidemic)... I felt pressured, but I still had to do it well. They are our invaluable students who come for clinical practice. We will have new students coming soon, I will do my best. (Participant 4)
>
> Managing the students was a bit stressful, to be honest. It was hard enough to manage the patients and their guardians. When the students came for their clinical practice, even if they came in with a (negative) PCR test result for COVID-19 at the beginning, their behavioral patterns and living radius did not include only the hospital and their home... It was stressful to manage all that. When COVID-19 spread from one individual to patients, it caused the greatest stress. (Participant 5)

2. Navigating Student Learning Attitudes during the Pandemic

Nurse managers observed a broad spectrum of learning attitudes among nursing students during clinical practice amid the emerging infectious disease outbreak. Some students, who had previously participated mainly in online classes, viewed in-person clinical training as highly valuable and were eager to engage actively. In contrast, other students appeared passive, hesitant, or lacking in confidence within the clinical environment. While nurse managers expressed satisfaction when students demonstrated proactive engagement, they also reported disappointment from an educator's perspective when encountering students with passive or withdrawn behaviors.

1) Seeing students take advantage of valuable clinical practice opportunities

Participants reported that, during the height of the COVID-19 pandemic, many universities were unable to provide in-person clinical practice education, instead relying on online or on-campus training. Students who anticipated hospital-based clinical practice viewed it as a rare and valuable opportunity and approached it with eagerness.

> When the pandemic was at its peak, I heard that they seldom practiced face-to-face and did everything online. Last fall, when the students came (for clinical practice), they were really eager, with sparkling eyes. They actively participated in the training. I really appreciated it. (Participant 1)
>
> Now, the students ... I had served as an educator in other hospitals as well. As there were a lot fewer opportunities for clinical practice than before, I saw more students trying really hard to learn a lot from the clinical practice. They were much more eager. (Participant 7)

2) Seeing students being intimidated by the unfamiliarity of clinical practice

Conversely, some students, accustomed to virtual and non-face-to-face classes, focused primarily on completing assignments rather than actively observing nurses' work in the clinical setting. Others appeared intimidated by the context of infectious disease.

> I told them to observe closely what treatment was administered; however, they just sat at the computer and did assignments, which was rather disappointing. (Participant 1)
>
> The students were a little bit... shall we say, unmotivated? ... They were not there to learn something. Rather, they were there because they had to. I do not know what kind of students I am getting this time, but I think it is getting worse... They seem to just try to fill the clinical practice period because it is part of the curriculum. (Participant 4)

3. Having the Flexibility in Teaching to Adapt to Changing Epidemic Conditions

Nurse managers described being flexible in supervising clinical practice education in response to evolving infectious disease conditions. They adjusted clinical education according to infection control guidelines, restricting department access to minimize student exposure to infected patients, controlling the number and movement of students within clinical settings, and limiting direct contact with certain patients. Given the inevitable risk of hospital-acquired infections, nurse managers also reinforced infection control training for students, emphasizing the use of personal protective equipment (PPE). Additionally, to compensate for restricted opportunities to observe or perform clinical procedures, they provided supplementary explanations and educational materials to ensure students gained as much practical understanding as possible under the circumstances.

1) Imparting limited clinical practice education

Participants reported limited student-patient interaction due to concerns about infectious disease transmission. Students were only allowed in certain hospital areas, were not permitted to care for patients in isolation rooms, and were restricted from entering clinical laboratories. Most training was observation-based, with hands-on experience reduced. These measures were implemented in accordance with institutional infection control policies, recognizing that students are not healthcare employees and are more vulnerable to infection.

> We cannot really expect 100% compliance from student nurses. I mean, we need to protect the students... We could not afford for them to come into contact with patients, and it was not appropriate to keep them out of the areas where patients were. We decided to keep them away from the isolation rooms. (Participant 3)
>
> This led to fewer opportunities to manage the patients, and the students could not practice many of the nursing techniques in dealing with patients, which could have been different from before COVID-19... Before COVID-19, they could interact with patients, share laughter, monitor vital signs, and administer shots—all during 2 weeks. During the pandemic, they could not talk to patients as much, the clinical practice period was reduced, and the clinical practice was stopped when anyone was infected. (Participant 10)

2) Reinforcing hands-on infection control training

Participants noted that while infection control guidelines had always been present, the COVID-19 pandemic led to even stricter protocols through infection control departments. The importance of using PPE and receiving improved infection control training was heavily emphasized for both healthcare workers and students.

> Before 2020, hand washing was not strictly practiced even by nurses. It was not really emphasized to nursing students. It was just part of the orientation for the clinical practice education. Amid the epidemic, last year, I kept asking them, 'Did you wash your hands?' or 'When will you wash your hands?' as I would do with our nurses. I really watched out for it. It definitely made me focus a lot on hand hygiene... (Participant 9)
>
> We used to simply have maybe one volunteer try on personal protective equipment, like a face shield, gloves, and a mask when performing suction... When infected patients have a fever and we are concerned about it, we ask the students to continue wearing the four pieces of personal protective equipment, at least the gloves and the gown. They had a lot of such experiences. We ensured that they experienced it and paid attention to it. (Participant 12)

3) Increased use of educational materials to supplement the limited clinical practice

Participants reported making efforts to compensate for the inevitable limitations of hands-on learning during clinical practice. They utilized diverse teaching strategies, relying heavily on additional educational materials to reinforce key concepts about disease characteristics and inpatient care.

> For the things that they could not experience themselves, I provided verbal education while presenting educational videos. It was the least I could do. They could not come into contact with patients. There should have been something they learned from here. (Participant 2)
>
> There are some sets of education we do... We explain to them the tasks and characteristics of each department. During the COVID-19 pandemic, a couple of things were added to our usual education. I did. I felt sorry that students had less experience getting close to patients and just observed them from afar. I developed a couple of chapters to give them more education (on inpatient care). (Participant 5)

4. Discovering the Meaning of Irreplaceable Clinical Practice Education

Even amid the challenges posed by emerging infectious diseases, nurse managers reaffirmed the necessity of clinical practice education. While providing the same level of experience as before the COVID-19 outbreak was difficult, they believed that clinical exposure was crucial for nursing students to translate theoretical learning into real-world practice. As the pandemic continued and infection control protocols became standard, nurse managers gained experience and confidence in their ability to supervise clinical education under such conditions. Drawing on this, they felt prepared to overcome similar situations in the future and to foster infection control competence in both students and nurses.

1) Rediscovering the importance of clinical practice education in a clinical setting

Participants emphasized the value of students directly experiencing patient care, nursing tasks, and interdisciplinary collaboration—not merely acquiring knowledge in the classroom but engaging with the realities of the clinical environment. They believed that new nurses who missed these opportunities faced greater challenges in adjusting to practice after graduation. Therefore, despite unavoidable limitations during outbreaks, nurse managers stressed the continued importance of exposing students to authentic clinical settings.

> For nurses, caring for and responding to patients are also important... There's a difference between simply reading text materials and seeing real patients. how nurses explain things to patients and what to pay attention to... (Participant 2)
>
> It is also important for students to acquire theoretical knowledge in clinical practice but I think it is actually a major goal of the clinical practice education to get a feel for the clinical environment of this hospital, to adapt a little bit. (Participant 7)

2) Feeling confident and rewarded as a clinical practice educator

Participants stated that as time passed after the initial COVID-19 outbreak and as prevention guidelines became established, their experience caring for patients during the pandemic strengthened their expertise. This, in turn, in-

https://doi.org/10.7475/kjan.2025.0321

creased their confidence as educators in clinical practice education. They found it especially rewarding to educate students on up-to-date infection control practices. Positive feedback from students regarding their clinical practice experiences was also highly motivating, giving nurse managers a sense of achievement and reinforcing their commitment to quality education.

> Now, I have gained a lot of experience in supervising students, and I naturally know how to deal with situations. Based on this experience, I feel like I know where to pay more attention and to what extent I should provide education. (Participant 11)
>
> The students left with a high level of satisfaction, saying that it was really helpful. When I saw the students after a long while, I allowed them into the endoscopy room and other areas, and they genuinely seemed to appreciate it. It was really rewarding. (Participant 4)

3) Professional growth with students during an infectious disease outbreak

Participants did not view the experience of guiding clinical practice during the outbreak solely as a crisis or challenge. Instead, they saw it as an opportunity to provide students with real-world learning, reflect on their own practices, and grow as educators through mentoring. Although the COVID-19 pandemic posed unprecedented difficulties, participants believed that offering clinical training under institutional guidelines prepared students for their future roles as nurses in meaningful ways. The pandemic also prompted nurse managers to re-examine and improve infection control practices, promoting growth through mutual observation and feedback between students and nurses. Drawing on their frontline experience, nurse managers were able to share practical, real-life insights, enriching students' learning beyond what could be taught in the classroom.

> As it was a first for me too, it felt like we were going through it together. My students and I went through it together. However, when you think about it, what we did during the pandemic, hand hygiene, and things like that, were things that we should have been doing all along when we were interacting with patients, right? Now we realize that we have been too careless and that we have missed a lot of things... (Participant 8)
>
> I was happy to tell the stories of my firsthand experience to my students... I told them what we had experienced, what happened over the two years, how this hospital was used and how it operated, how the place where we were doing the clinical practice had been used, how the patients were moved, how things were managed, what we needed to pay attention to, and how the things were managed there now. My students really enjoyed listening to these stories. (Participant 7)

DISCUSSION

This study explores and describes the experiences of nurse managers as educators in nursing clinical practice education during an emerging infectious disease outbreak in a Korean healthcare setting. Four themes were identified: "challenges in managing the department during the infectious disease," "facing diverse student attitudes toward learning," "having the flexibility in teaching to adapt to changing epidemic conditions," and "finding the meaning of irreplaceable clinical practice education."

Nurse managers reported that members of their department were deeply concerned about infectious disease transmission among patients, students, and staff. They struggled to address patient dissatisfaction and complaints, all while ensuring that both nurses and nursing students complied with hospital infection control guidelines. Despite these challenges, nurse managers remained responsible for supervising students in infection control, including suspected cases. They also served as liaisons between patients and families and managed infection control for employees and visitors [15]. During the pandemic, nurse managers faced additional burdens beyond their standard managerial roles [16]. Previous studies, such as those conducted following the Middle East Respiratory Syndrome outbreak, have reported that nurse managers experienced psychological strain as they balanced their primary duties with supervising nursing clinical practice education [9]. These findings suggest that nurse managers are subject to excessive workloads during emerging infectious disease events. Therefore, organizations should support nurse managers by streamlining non-essential tasks or hiring additional staff.

Nurse managers also noted considerable variation in student learning attitudes during the pandemic. While they valued students who viewed the crisis as a learning opportunity and engaged actively in clinical practice, they were discouraged by students who avoided patient contact and relied primarily on electronic records. The prevalence of virtual classrooms during COVID-19 [17] may have caused some students to feel intimidated by real clinical settings, a finding that aligns with other research showing preferences for virtual learning due to fears related to epidemics [18]. Even outside pandemic periods, some nursing students have focused solely on assignments that affect their grades, missing out on genuine patient interaction [6]. Thus, it is necessary to address and shift students' perceptions so that they view challenging clinical practice as a valuable opportunity, especially during emerging infectious disease situations.

To protect students, nurse managers sometimes reduced certain clinical activities or intensified infection control training. Even when hands-on practice was limited, nurse managers provided students with educational materials on up-to-date infection control guidelines, exposed them to real hospital environments where these guidelines were implemented, and ensured that students had opportunities to wear PPE with verbal explanations as needed. During the COVID-19 pandemic, nurse managers conducted ongoing staff training on the proper use of PPE and managed essential educational programs in response to changing circumstances [3,15]. In this way, they played a pivotal role in addressing the challenges brought about by the COVID-19 pandemic [15]. Their experiences enabled them to supply students with authentic infection control resources and deliver appropriate clinical practice education, even during times of crisis. For more effective clinical education, universities and hospitals should coordinate key learning objectives and content in advance. Integrating interactive tools such as simulations and quizzes may further enhance infection control training [19], and these strategies should be considered for adaptation to the Korean clinical context.

Supervising students during an infectious disease outbreak reminded nurse managers of the unique and irreplaceable value of hands-on education. Despite limitations in clinical settings, nurse managers believed it was essential for students to observe nurse-patient interactions and interdisciplinary collaboration. Experiencing clinical practice during crises allows students to redefine their professional identity [10]. Non-face-to-face learning restricts patient interaction and can hinder students' ability to manage real clinical situations [20]. Although students typically value clinical practice during outbreaks [3] and often have positive attitudes toward it [21], they may also experience negative emotions such as fear and anxiety [21-23]. Despite these difficulties, clinical education remains a critical component in the formation of professional identity and career planning [21]. Nurse educators should acknowledge these emotional challenges, provide appropriate support [7,23], and identify the most effective approaches to clinical practice [21].

Nurse managers reported that sharing the expertise and experience they developed during the outbreak not only enhanced their own confidence and fulfillment as educators but also contributed to their professional growth. This is supported by previous research in South Korea and Indonesia, which found that clinical teaching helped nurses re-examine their knowledge, improve practical skills, and foster self-reflection, thus contributing to ongoing professional development [24,25]. Similarly, managing challenges such as infectious disease outbreaks was regarded as a meaningful experience that identified areas for improvement and informed future educational practices [11]. These findings are consistent with the present study and align with reports by Kagan et al. [26] and others [10], which found that nurse managers experienced both an increased sense of burden and professional pride during the COVID-19 pandemic, along with a heightened sense of competence. Overall, the pandemic acted as a catalyst for educator growth, as nurse managers adapted to rapidly changing clinical conditions and shared real-world experiences with students.

This study has several limitations. First, it was conducted after the resumption of clinical practice following the stabilization of the outbreak, rather than during the initial emergence of the infectious disease. Second, due to nationwide restrictions on clinical training during the COVID-19 pandemic, some participants had supervised clinical practice for only one semester. However, considering the study's aim to explore nurse managers' experiences under exceptional circumstances, even brief supervisory experience was deemed meaningful. The diversity in participants' backgrounds contributed to a broader understanding of the clinical education environment during the pandemic. Finally, all participants were female nurse managers, which may limit the inclusion of perspectives from male nurse managers.

CONCLUSION

This qualitative study explored nurse managers' experiences in clinical nursing education during an emerging in-

https://doi.org/10.7475/kjan.2025.0321

fectious disease outbreak, identifying four themes and 11 subthemes. Nurse managers faced significant challenges in department management, encountered diverse student attitudes, flexibly adapted teaching methods to evolving conditions, and discovered the irreplaceable value of clinical practice. To ensure effective clinical nursing education in future pandemics, it will be essential to minimize uncertainty within organizations and foster positive student perceptions, even when circumstances are restrictive. Sufficient educational time and resources are needed to meet curriculum objectives, and institutional support is crucial to alleviate the workload of nurse managers.

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

Conceptualization - SC and JL; formal analysis - SC and JL; methodology - SC and JL; supervision - JL; project administration - SC; resources - SC and JYP; data curation - JYP; investigation - JYP; validation - SC and JL; visualization - JL; and drafting or critical revision of the manuscript for important intellectual content - SC and JL.

FUNDING

None.

ACKNOWLEDGEMENT

None.

DATA AVAILABILITY STATEMENT

The data can be obtained from the corresponding authors.

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ORIGINAL ARTICLE

Korean J Adult Nurs Vol. 37 No. 3, 287-296, August 2025
eISSN: 2288-338X
https://doi.org/10.7475/kjan.2025.0326

KJAN
Korean Journal of
Adult Nursing

Sex-Specific Predictors of Microalbuminuria in Type 2 Diabetes: A Cross-Sectional Study

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Received: March 26, 2025
Revised: July 6, 2025
Accepted: August 6, 2025

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Purpose: This study aimed to identify sex-specific predictors of microalbuminuria in patients with type 2 diabetes mellitus. Recognizing sex-based differences in risk factors may facilitate the early detection and prevention of diabetic kidney disease. **Methods:** A cross-sectional analysis was performed using data from the Korea National Health and Nutrition Examination Survey. Microalbuminuria was defined as a urinary albumin-to-creatinine ratio ≥30 mg/g. Multivariable complex sample logistic regression analyses were conducted separately for male and female. Independent variables included age, duration of diabetes, glycated hemoglobin (HbA1c), fasting blood sugar (FBS), triglyceride to high-density lipoprotein cholesterol ratio (TG/HDL-C), TG, HDL-C, waist circumference, and systolic blood pressure (SBP). **Results:** The prevalence of microalbuminuria was higher in male than in female. In both sexes, longer diabetes duration and elevated SBP were associated with microalbuminuria. Among male, FBS, TG/HDL-C ratio, TG, and low HDL-C were significant predictors. In female, HbA1c showed the strongest association, followed by age and diabetes duration. **Conclusion:** Sex-specific differences were identified in the predictors of microalbuminuria among patients with type 2 diabetes. Incorporating these differences into early screening and individualized care strategies may help improve the prevention of diabetic kidney complications.

Key Words: Diabetes mellitus, type 2; Albuminuria; Glycated hemoglobin; Dyslipidemias

INTRODUCTION

Type 2 diabetes mellitus (T2DM) is one of the most prevalent chronic diseases worldwide and remains a major contributor to serious complications, including cardiovascular disease and chronic kidney disease [1]. In recent years, the management of T2DM has shifted from a sole emphasis on glycemic control to a broader approach that prioritizes patient safety and organ protection. This paradigm shift is intended to prevent life-threatening complications—such as hypoglycemia, cardiovascular events, and diabetic kidney disease—that substantially increase mortality [2].

Among these complications, diabetic nephropathy is one of the most frequent microvascular outcomes of T2DM, with microalbuminuria widely recognized as its earliest clinical marker [3]. The presence of microalbuminuria not only signifies the onset of diabetic kidney injury but also serves as an independent risk factor for cardiovascular morbidity and mortality [4]. As a result, early identification of individuals at risk for microalbuminuria is crucial for timely intervention and improved long-term clinical out-

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comes [5].

Microalbuminuria is highly prevalent among individuals with T2DM and has strong associations with both microvascular and macrovascular complications, including diabetic nephropathy, retinopathy, and cardiovascular disease [6]. The pathogenesis of albuminuria—characterized by tubulointerstitial endothelial dysfunction and small-vessel damage—has been shown to predict both renal failure and cardiovascular mortality [7,8]. For patients in the early stages of diabetes, annual screening for microalbuminuria is recommended, as early detection of renal abnormalities can significantly delay the progression of diabetic kidney disease [9]. Furthermore, prior studies have identified several clinical and biochemical risk factors for microalbuminuria, including poor glycemic control, hypertension, dyslipidemia, and obesity [10,11].

A growing body of evidence suggests that sex-based differences exist in the development and progression of diabetic complications. Specifically, male are more likely to develop microalbuminuria and are at greater risk for diabetic retinopathy and neuropathy, whereas female—especially older female—have a higher prevalence of reduced estimated glomerular filtration rate and diabetic kidney disease [12-14]. Moreover, during the microalbuminuria stage, male are at increased risk for progression to end-stage kidney disease and exhibit higher mortality rates than female [15]. These differences may arise from both biological (e.g., hormonal and genetic) and behavioral influences. Nevertheless, many studies have not sufficiently explored sex-specific differences in the risk factors associated with microalbuminuria.

Therefore, this study aimed to identify sex-specific predictors of microalbuminuria in patients with T2DM using data from the Korea National Health and Nutrition Examination Survey (KNHANES), a nationally representative dataset well-suited for examining chronic disease patterns in Korean adults. With the growing emphasis on personalized care in diabetes management, identifying sex-specific risk factors for early-stage diabetic kidney disease is essential for advancing nursing assessment and intervention strategies. A deeper understanding of these sex-based differences can guide the development of tailored screening, education, and prevention plans, ultimately improving early detection and improving long-term outcomes for patients with T2DM.

METHODS

1. Study Design

This study was conducted as a cross-sectional analysis using raw data from the second year of the seventh cycle (2019) and the first year of the eighth cycle (2020) of the KNHANES, administered by the Korea Disease Control and Prevention Agency and the Ministry of Health and Welfare. KNHANES employs a stratified, multistage, clustered probability sampling design to ensure the national representativeness of households with individuals aged one year or older.

2. Setting and Samples

In accordance with the findings of Xue et al. [16], which demonstrated a significant association between dyslipidemia (defined in terms of the triglyceride to high-density lipoprotein cholesterol ratio [TG/HDL-C] ratio) and early kidney injury (assessed using the albumin-to-creatinine ratio [ACR]) among adults over 40 years of age, this study included individuals aged 40 years or older to enhance clinical relevance and data reliability.

Of the 15,469 total participants, 7,618 non-diabetic individuals; 6,173 individuals with comorbid conditions that could influence microalbuminuria levels (including pre-existing renal disease, cardiovascular disease, or hypertension diagnosed prior to diabetes); 18 individuals with type 1 diabetes; and 63 individuals with macroalbuminuria (ACR >300 mg/g Cr) were excluded. The final analytic sample comprised 1,597 individuals.

T2DM was defined by the presence of at least one of the following criteria: (1) fasting blood sugar (FBS) ≥ 126 mg/dL; (2) glycated hemoglobin (HbA1c) $\geq 6.5\%$; (3) a physician’s diagnosis of diabetes; or (4) current use of glucose-lowering medications.

Type 1 diabetes was excluded based on self-reported information in KNHANES, including diabetes onset before age 10, insulin-only treatment, or a documented history of type 1 diabetes mellitus diagnosis. Non-diabetic individuals were defined as those who had never received a diabetes diagnosis from a healthcare provider and had normal fasting blood glucose and HbA1c levels.

https://doi.org/10.7475/kjan.2025.0326

3. Measurements

1) Microalbuminuria

Microalbuminuria was defined as an ACR of 30 to 300 mg/g Cr, consistent with the guidelines of the Kidney Disease Outcomes Quality Initiative and Kidney Disease: Improving Global Outcomes [17]. Spot urine samples were collected, and urinary albumin and creatinine concentrations were measured to calculate the ACR.

2) General characteristics

General characteristics included age, economic status, smoking status, alcohol consumption, duration of diabetes, and family history of diabetes. Economic status was classified into four quartiles (low, middle-low, middle-high, and high) based on average monthly household income. Smoking status was categorized as never, former, or current smoker. Alcohol consumption was dichotomized as yes or no. The duration of diabetes was grouped into three categories: less than 10 years, 10–20 years, and more than 20 years. Family history of diabetes was classified as either present (yes) or absent (no).

3) Clinical characteristics

Clinical characteristics included anthropometric data, blood pressure, and biochemical measurements. Anthropometric data were collected by trained KNHANES staff, with height, weight, and waist circumference measured using a stadiometer (SECA 200, SECA, Hamburg, Germany), digital scale (GL-6000-20, G-TECH, Uijeongbu, Korea), and tape measure (SECA 200, SECA), respectively. Body mass index was calculated as weight in kilograms divided by height in meters squared (kg/m^2). Blood pressure was measured using a standard sphygmomanometer (Baumanometer Wall Unit 33; Baum, Copiague, NY, USA) after participants had rested for at least five minutes. Both systolic and diastolic blood pressures were recorded.

Biochemical data were obtained from blood and urine samples to reflect participants' physiological and metabolic profiles. Blood samples were collected after at least 8 hours of overnight fasting. FBS, HbA1c, and serum lipids—including total cholesterol, high-density lipoprotein cholesterol (HDL-C), TG, and low-density lipoprotein cholesterol (LDL-C)—as well as serum creatinine were analyzed using the Hitachi Automatic Analyzer 7600-210 (Hitachi, Tokyo, Japan).

Urine tests were performed on random spot urine samples according to the KNHANES protocol. Urinary albumin was measured by the turbidimetric immunoassay method using the Hitachi Automatic Analyzer 7600 (Hitachi), while urinary creatinine was analyzed using the Jaffe rate-blanked and compensated method with the Roche COBAS 8000 C702 (Roche Diagnostics, Mannheim, Germany).

4. Data Collection

Data were collected according to standardized KNHANES protocols. Participants provided demographic and medical history information through structured interviews. Trained personnel conducted anthropometric measurements and blood pressure assessments, and collected fasting blood and random spot urine samples. Laboratory analyses were performed in certified laboratories following established procedures.

5. Ethical Considerations

This study was a secondary analysis of KNHANES data in which no personally identifiable information was included. Approval for use of the raw data was obtained from the Korea Disease Control and Prevention Agency, and the study was exempted from review by the Institutional Review Board of the Public Institution Bioethics Committee (IRB No. P01-202211-01-041). During the original survey, written informed consent was obtained from all participants after they were informed about the purpose of data collection, voluntary participation, and their right to withdraw. Only anonymized data were provided to the researchers.

6. Data Analysis

All analyses accounted for the complex sampling design of KNHANES by incorporating sampling weights, stratification variables (Kstrata), and primary sampling units, as recommended by the Korea Disease Control and Prevention Agency (KDCA). This methodology ensured nationally representative estimates and accurate variance calculations.

Descriptive statistics were used to summarize the general characteristics of the study population. For categorical and binary variables, complex sample chi-square tests were used to compare proportions between groups. For continuous variables, complex sample t-tests were performed to assess mean differences.

To identify risk factors associated with microalbuminuria, complex sample logistic regression analysis was conducted. The dependent variable was the presence of microalbuminuria, defined as a urinary ACR ≥30 mg/g. To assess sex-specific associations, regression analyses were stratified by sex. All independent variables were analyzed as continuous variables without categorization. Odds ratios (ORs) with 95% confidence intervals (CIs), z-statistics, and *p*-values were reported. A two-sided *p*-value of <.05 was considered statistically significant. All statistical analyses were performed using R software version 4.1.1 (R Foundation for Statistical Computing, Vienna, Austria), utilizing the survey and car packages to address the complex sampling design and assess multicollinearity.

RESULTS

1. Sex Differences in Microalbuminuria According to General Characteristics

The prevalence of microalbuminuria was significantly higher in male than in female (10.5% vs. 8.8%, *p*<.001). In both sexes, the highest prevalence was observed among participants aged 70 years or older, those in the low-income group, and individuals with a diabetes duration of less than 10 years. Among male, microalbuminuria was particularly more common in ex-smokers and in those who reported alcohol consumption (Table 1).

2. Sex Differences in Microalbuminuria According to Clinical Characteristics

In particular, significant sex differences in microalbuminuria were observed for age (*p*<.001), hemoglobin (*p*<.001), TG/HDL-C ratio (*p*<.001), TG (p<.001), HDL-C (*p*<.001), serum creatinine (*p*<.001), waist circumference (*p*<.001), and diastolic blood pressure (DBP) (*p*<.001). In the total, microalbuminuria was also significantly associated with age (*p*=.015), diabetes duration (*p*<.001), HbA1c (*p*<.001), FBS (*p*<.001), TG/HDL-C ratio (*p*<.001), TG (*p*=.003), HDL-C (*p*=.002), LDL-C (*p*=.012), serum creatinine (*p*=.008), systolic blood pressure (SBP) (*p*<.001), and waist circumference (*p*=.037) (Table 2).

3. Sex-Specific Factors Associated with Microalbuminuria

Complex sample logistic regression analyses were conducted separately for male and female to examine sex-specific associations between glycemic and lipid markers and the presence of microalbuminuria. The dependent variable was the presence of microalbuminuria, while the independent variables included age, duration of diabetes, HbA1c, fasting blood glucose, TG/HDL-C ratio, TG, HDL-C, waist circumference, and SBP. To evaluate multicollinearity among independent variables, variance inflation factors were computed, and all values were below the threshold of 10, indicating no significant multicollinearity.

The models estimated ORs and corresponding 95% CIs. Z-values and *p*-values were reported to determine statistical significance. All independent variables were analyzed as continuous measures without categorization. Sex-stratified modeling was utilized to identify potential sex-specific risk profiles and to minimize the dilution of differential effects that may arise in pooled analyses.

Table 3 presents the sex-stratified ORs for significant risk factors associated with microalbuminuria. While diabetes duration and SBP were significant predictors in both sexes, other associated factors differed notably between male and Female.

Among male patients, the strongest predictor was the TG/HDL-C ratio (OR=1.33, 95% CI=0.99–1.79, *p*=.048), followed by SBP (OR=1.03, 95% CI=1.02–1.05, *p*<.001), diabetes duration (OR=1.03, 95% CI=1.01–1.05, *p*=.008), FBS (OR=1.01, 95% CI=1.00–1.01, *p*=.015), TG (OR=1.01, 95% CI=1.00–1.01, *p*=.021), and HDL-C (OR=0.96, 95% CI=0.94–0.99, *p*=.006).

In contrast, for female patients, HbA1c was the most influential predictor (OR=1.41, 95% CI=1.15–1.72, *p*=.001), followed by age (OR=1.03, 95% CI=1.01–1.06, *p*=.011), diabetes duration (OR=1.02, 95% CI=1.00–1.05, *p*=.048), and SBP (OR=1.02, 95% CI=1.01–1.04, *p*<.001).

DISCUSSION

This study aimed to identify sex-specific predictors of microalbuminuria in patients with type 2 diabetes using data from KNHANES. The findings demonstrated distinct risk profiles for male and female, underscoring the need for sex-specific strategies in the early detection and prevention of diabetic nephropathy.

Table 1. Sex Differences in Microalbuminuria According to General Characteristics ($N=1,597$)

Variables	Categories	Microalbuminuria (30–300 mg/g Cr)				Normoalbuminuria (< 30 mg/g Cr)				χ^2 (p)
		n (%)			χ^2 (p)	n (%)			χ^2 (p)	
		Total	Male	Female		Total	Male	Female		
Sex	Total	309 (19.3)	168 (10.5)	141 (8.8)	30.90 (< .001)	1,288 (80.6)	644 (40.3)	644 (40.3)	12.88 (< .001)	0.90 (.168)
	Male	-	168 (10.5)	-		-	644 (40.3)	-		
	Female	-	-	141 (8.8)		-	-	644 (40.3)		
Age (year)					18.78 (< .001)				39.26 (< .001)	6.63 (.044)
	40–49	25 (1.6)	21 (1.3)	4 (0.3)		118 (7.4)	83 (5.2)	35 (2.2)		
	50–59	60 (3.8)	38 (2.4)	22 (1.4)		274 (17.2)	156 (9.8)	118 (7.4)		
	60–69	88 (5.5)	51 (3.2)	37 (2.3)		430 (26.9)	213 (13.3)	217 (13.6)		
	≥70	136 (8.5)	58 (3.6)	78 (4.9)		466 (29.2)	192 (12.0)	274 (17.2)		
Economic status					2.20 (.533)				6.81 (.078)	6.16 (.104)
	High	70 (4.4)	33 (2.1)	37 (2.3)		305 (19.1)	166 (10.4)	139 (8.7)		
	Middle-high	59 (3.7)	32 (2.0)	27 (1.7)		296 (18.5)	155 (9.7)	141 (8.8)		
	Middle-low	79 (4.9)	44 (2.8)	35 (2.2)		352 (22.0)	173 (10.8)	179 (11.2)		
	Low	101 (6.3)	59 (3.7)	42 (2.6)		335 (21.0)	150 (9.4)	185 (11.6)		
Smoking status					157.77 (< .001)				771.42 (< .001)	1.17 (.556)
	Never smoker	167 (10.5)	36 (2.3)	131 (8.2)		696 (43.6)	100 (6.3)	596 (37.3)		
	Ex-smoker	82 (5.1)	77 (4.8)	5 (0.3)		371 (23.2)	350 (21.9)	21 (1.31)		
	Current smoker	60 (3.8)	55 (3.4)	5 (0.3)		221 (13.8)	194 (12.2)	27 (1.7)		
Alcohol consumption					81.37 (< .001)				244.58 (< .001)	0.62 (.433)
	Yes	141 (8.8)	116 (7.3)	25 (1.6)		556 (34.8)	417 (26.1)	139 (8.7)		
	No	168 (10.5)	52 (3.3)	116 (7.3)		732 (45.8)	227 (14.2)	505 (31.6)		
Duration of DM (year)					1.62 (.445)				1.26 (.533)	23.44 (< .001)
	< 10	189 (11.8)	106 (6.6)	83 (5.2)		960 (60.1)	483 (30.2)	477 (29.9)		
	10–20	73 (4.6)	35 (2.2)	38 (2.4)		217 (13.6)	102 (6.4)	115 (7.2)		
	> 20	47 (2.9)	27 (1.7)	20 (1.3)		111 (6.9)	59 (3.7)	52 (3.3)		
Family history of DM					0.24 (.626)				2.54 (.111)	0.58 (.445)
	Yes	116 (7.3)	61 (3.8)	55 (3.4)		514 (32.2)	243 (15.2)	271 (17.0)		
	No	193 (12.0)	107 (6.7)	86 (5.4)		774 (48.4)	401 (25.1)	373 (23.4)		

DM = diabetes mellitus.

Table 2. Differences in Microalbuminuria According to Clinical Characteristics

Characteristics	Microalbuminuria (30–300 mg/g Cr)				Normoalbuminuria (< 30 mg/g Cr)				Total t (*p*)
	M ± SD			t (*p*)	M ± SD			t (*p*)	
	Total	Male	Female		Total	Male	Female		
Age (year)	66.24 ± 10.98	63.46 ± 11.14	69.55 ± 9.84	–5.11 (< .001)	64.56 ± 10.14	62.80 ± 10.42	66.32 ± 9.54	–6.31 (< .001)	2.45 (.015)
Duration of DM (year)	8.68 ± 9.70	8.06 ± 9.49	9.43 ± 9.94	–1.23 (.220)	5.95 ± 7.94	5.81 ± 8.04	6.09 ± 7.85	–0.64 (.521)	4.60 (< .001)
Hemoglobin (g/dL)	13.92 ± 1.76	14.75 ± 1.64	12.93 ± 1.35	10.69 (< .001)	13.91 ± 1.56	14.73 ± 1.42	13.09 ± 1.24	22.20 (< .001)	0.11 (.915)
HbA1c (%)	7.65 ± 1.52	7.62 ± 1.49	7.67 ± 1.57	–0.31 (.759)	6.99 ± 1.08	6.98 ± 1.09	7.01 ± 1.08	–0.45 (.656)	7.12 (< .001)
FBS (g/dL)	150.80 ± 50.74	153.49 ± 48.43	147.59 ± 53.36	1.01 (.313)	131.48 ± 33.25	133.58 ± 33.38	129.37 ± 33.02	2.27 (.023)	6.37 (< .001)
BMI (kg/m^2)	25.56 ± 3.61	25.82 ± 3.43	25.24 ± 3.81	1.39 (.165)	25.39 ± 3.54	25.37 ± 3.43	25.40 ± 3.67	-0.15 (.880)	0.75 (.452)
TG/HDL-C ratio	4.44 ± 4.51	5.35 ± 5.56	3.33 ± 2.39	4.25 (< .001)	3.46 ± 3.04	3.86 ± 3.69	3.06 ± 2.14	4.75 (< .001)	3.60 (< .001)
TG (mg/dL)	183.24 ± 193.27	218.46 ± 247.68	141.26 ± 75.74	3.83 (< .001)	148.68 ± 101.90	160.40 ± 121.46	136.95 ± 75.86	4.16 (< .001)	3.04 (.003)
TC (mg/dL)	172.23 ± 46.25	174.80 ± 48.41	169.60 ± 43.53	0.99 (.322)	174.28 ± 42.02	171.83 ± 41.79	176.73 ± 42.13	–2.09 (.036)	-0.64 (.521)
HDL-C (mg/dL)	47.66 ± 11.17	43.25 ± 10.35	47.84 ± 12.77	-3.43 (.001)	45.35 ± 11.73	46.04 ± 11.00	49.29 ± 11.11	–5.28 (< .001)	-3.15 (.002)
LDL-C (mg/dL)	96.88 ± 37.60	87.86 ± 44.53	93.51 ± 36.75	-1.22 (.223)	90.43 ± 41.19	93.71 ± 37.82	100.05 ± 37.14	–3.03 (.002)	-2.51 (.012)
BUN (mg/dL)	17.48 ± 5.83	17.18 ± 5.35	17.83 ± 6.36	–0.96 (.336)	17.14 ± 5.07	17.32 ± 4.91	16.96 ± 5.22	1.28 (.200)	0.94 (.346)
Serum Cr (mg/dL)	0.88 ± 0.29	0.98 ± 0.28	0.77 ± 0.26	6.68 (< .001)	0.83 ± 0.21	0.95 ± 0.18	0.72 ± 0.18	22.41 (< .001)	2.68 (.008)
Waist circumference (cm)	91.45 ± 9.39	93.75 ± 8.79	88.71 ± 9.36	4.85 (< .001)	90.21 ± 9.30	92.13 ± 8.98	88.28 ± 9.22	7.59 (< .001)	2.09 (.037)
SBP (mmHg)	131.88 ± 16.85	131.89 ± 17.48	131.88 ± 16.13	0.00 (.997)	124.73 ± 15.02	123.38 ± 14.43	126.08 ± 15.48	–3.24 (< .001)	6.84 (< .001)
DBP (mmHg)	75.22 ± 12.01	77.42 ± 12.74	72.60 ± 10.53	3.65 (< .001)	74.37 ± 9.72	75.60 ± 9.97	73.15 ± 9.32	4.54 (< .001)	1.15 (.252)

BMI = body mass index; BUN = blood urea nitrogen; DBP = diastolic blood pressure; DM = diabetes mellitus; FBS = fasting blood sugar; HbA1c = glycosylated hemoglobin; HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol; M = mean; SBP = systolic blood pressure; Serum Cr = serum creatinine; SD = standard deviation; TC = total cholesterol; TG = triglyceride.

Table 3. Sex-Specific Adjusted ORs for Microalbuminuria

Variables	Male			Female		
	OR (95% CI)	Z-value	*p*-value	OR (95% CI)	Z-value	*p*-value
Age (year)	1.01 (0.99–1.03)	1.08	.282	1.03 (1.01–1.06)	2.53	.011*
Duration of DM (year)	1.03 (1.01–1.05)	2.67	.008*	1.02 (1.00–1.05)	1.97	.048*
HbA1c (%)	1.20 (0.98–1.47)	1.73	.083	1.41 (1.15–1.72)	3.34	.001*
FBS (g/dL)	1.01 (1.00–1.01)	2.43	.015*	1.00 (1.00–1.01)	1.26	.206
TG/HDL-C ratio	1.33 (0.99–1.79)	1.93	.048*	0.80 (0.62–0.98)	–1.98	.054
TG (mg/dL)	1.01 (1.00–1.01)	2.30	.021*	0.99 (0.99–1.00)	–1.78	.075
HDL-C (mg/dL)	0.96 (0.94–0.99)	–2.75	.006*	1.01 (0.99–1.03)	0.75	.455
Waist circumference (cm)	1.02 (0.98–1.04)	1.67	.096	1.00 (0.98–1.02)	–0.01	.995
SBP (mmHg)	1.03 (1.02–1.05)	5.52	<.001*	1.02 (1.01–1.04)	3.61	<.001*

CI = confidence interval; DM = diabetes mellitus; FBS = fasting blood sugar; HbA1c = glycosylated hemoglobin; HDL-C = high-density lipoprotein cholesterol; OR = odds ratio; SBP = systolic blood pressure; TG = triglyceride; *$p < 0.05$.

Consistent with previous research [10,11], the prevalence of microalbuminuria was higher in male than in female. In both sexes, the highest prevalence was seen among older adults, individuals in the low-income group, and those with a diabetes duration of less than 10 years. Notably, in male, microalbuminuria was significantly more common among ex-smokers and individuals who reported alcohol consumption, highlighting the impact of modifiable behavioral risk factors.

Longer diabetes duration and elevated SBP were significantly associated with microalbuminuria in both male and Female. These findings suggest that chronic hyperglycemia and persistent hypertension contribute to early renal impairment regardless of sex. Sustained high glucose levels can cause endothelial dysfunction, oxidative stress, and glomerular hyperfiltration, all of which promote microvascular injury within the kidneys. Similarly, elevated SBP increases intraglomerular pressure, which accelerates albumin leakage into the urine.

These pathophysiological mechanisms are consistent with previous findings. Kundu et al. [18] reported that microalbuminuria was positively correlated with both the duration of diabetes and HbA1c levels among patients with T2DM, reflecting the cumulative renal burden of prolonged poor glycemic control. Likewise, Maiti et al. [19] found that the prevalence of microalbuminuria increased with longer diabetes duration, underscoring the progressive nature of diabetic nephropathy.

However, sex differences emerged in other associated clinical variables. Among males, dyslipidemia-related indicators—such as the TG/HDL-C ratio, TG, and low HDL-C—were significant. The TG/HDL-C ratio is a well-established marker of insulin resistance and is strongly linked to both cardiovascular and renal complications in diabetes [20,21]. Prior studies have shown that a higher TG/HDL-C ratio is associated with the presence and progression of microalbuminuria, as well as with declines in glomerular filtration rate among individuals with T2DM [16,22]. In line with previous research [23], this study found that lower HDL-C levels were related to a higher prevalence of microalbuminuria in male, possibly due to HDL-C's protective effects on endothelial integrity and renal function [24]. Thus, dyslipidemia may play a significant role in the early pathogenesis of diabetic kidney disease in male.

In contrast, among females, HbA1c was the most influential predictor, followed by age, diabetes duration, and SBP. This finding is consistent with earlier reports suggesting that glycemic burden has a greater impact on renal complications in female [25], potentially due to hormonal changes and metabolic alterations after menopause [26]. HbA1c, as a marker of long-term glycemic control, is closely associated with the development of diabetic complications [27]. Chronic hyperglycemia promotes vascular damage through tissue hypoxia, which is a key mechanism in diabetic nephropathy [28]. Multiple studies have demonstrated a significant association between elevated HbA1c levels and microalbuminuria in T2DM [18,19,28,29].

Taken together, these findings underscore the importance of integrating sex-stratified risk assessments into nursing care for patients with T2DM. The predictors of microalbuminuria differed by sex, highlighting the need for tailored preventive strategies. Among males, dyslipidemia-related variables were significantly associated with microalbuminuria, suggesting that lipid management may play a key role in reducing early renal risk. Prior studies have shown that dyslipidemia contributes to glomerular injury via mechanisms such as endothelial dysfunction and insulin resistance, with the TG/HDL-C ratio serving as a reliable indicator of these processes [20-22]. Among females, poor glycemic control—reflected by elevated HbA1c—was the most prominent factor associated with microalbuminuria, followed by age. This sex-specific pattern may be attributable to hormonal and metabolic changes after menopause, which may amplify the renal impact of hyperglycemia [25-28]. These findings suggest that male patients may benefit from more aggressive lipid management, while improved glycemic control and age-specific interventions may be particularly effective for female patients.

This study has several strengths, including the use of a large, nationally representative sample and analytic methods that accounted for the complex sampling design of KNHANES. Nonetheless, certain limitations should be acknowledged. The cross-sectional design precludes causal inference. In addition, potential confounders such as medication use, dietary intake, physical activity, and hormonal status were not included and may have influenced the observed associations.

In conclusion, this study highlights the importance of recognizing sex-specific patterns in the predictors of microalbuminuria among patients with T2DM. Incorporating these differences into individualized prevention and treatment strategies may improve early detection and improve patient outcomes.

From a nursing perspective, these findings reinforce the need to consider sex-specific risk factors in routine assessments and patient education. Nurses are ideally positioned to detect early signs of renal complications and deliver tailored care plans that include lifestyle counseling and support for self-management. Sex-based nursing interventions have the potential to increase treatment adherence and improve long-term outcomes.

CONCLUSION

This study demonstrated that the predictors of microalbuminuria in patients with type 2 diabetes differ by sex. In both males and females, longer diabetes duration and elevated SBP were commonly associated with microalbuminuria. However, additional risk factors varied by sex. In males, FBS and dyslipidemia-related markers—including TG/HDL-C ratio, TG, and HDL-C—were significantly associated with microalbuminuria. In contrast, among females, HbA1c showed a stronger association, along with age and diabetes duration.

These findings suggest that the pathophysiology of diabetic kidney complications may differ by sex, requiring differentiated prevention and management strategies. Incorporating sex-specific risk factors into clinical practice may enhance early detection and support more personalized interventions. Future research should focus on developing and validating sex-stratified care models to improve long-term renal outcomes in individuals with type 2 diabetes.

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CONFLICTS OF INTEREST

The authors declared that there is no conflict of interest.

AUTHORSHIP

Study conception and/or design acquisition - ESB and HSK; analysis - interpretation of the data- ESB and HSK; and drafting or critical revision of the manuscript for important intellectual content - ESB and HSK.

FUNDING

This research was supported by "Regional Innovation Strategy (RIS)" Through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (MOE) (2022RIS-005).

ACKNOWLEDGEMENT

None.

DATA AVAILABILITY STATEMENT

The data can be obtained from the corresponding authors.

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ORIGINAL ARTICLE

Korean J Adult Nurs Vol. 37 No. 3, 297-306, August 2025
eISSN: 2288-338X
https://doi.org/10.7475/kjan.2025.0327_2

KJAN
Korean Journal of
Adult Nursing

Associations between Skipping Meals, Eating Alone, and Overweight or Obesity: A Secondary Data Analysis of the Korea National Health and Nutrition Examination Survey

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Received: March 27, 2025
Revised: June 28, 2025
Accepted: August 14, 2025

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Purpose: Emerging evidence indicates that eating patterns—particularly skipping meals and eating alone—are associated with excess body weight. However, few studies have assessed whether these behaviors contribute to weight gain across different age groups. This study examined the associations of skipping breakfast or dinner, and of eating those meals alone, with overweight or obesity among Korean adults compared to children and adolescents. **Methods:** This cross-sectional secondary analysis used data from the 2019 Korea National Health and Nutrition Examination Survey. Information on skipping meals, eating alone, and sociodemographic characteristics was obtained via self-report for adults and proxy report for participants under 12 years of age. Overweight or obesity was determined from measured height and weight. Multivariable logistic regression analyses were performed separately by age group. **Results:** Among adults, eating dinner alone was associated with higher odds of obesity (odds ratio [OR] = 1.27, 95% confidence interval [CI] = 1.06–1.52). Among adolescents, skipping dinner three or more times per week was associated with higher odds of obesity (OR = 2.60, 95% CI = 1.04–6.54). No significant associations were observed in children. Skipping breakfast or eating breakfast alone was not significantly associated with overweight or obesity in any age group. **Conclusion:** Although the cross-sectional design precludes causal inference, the findings suggest age-specific links between eating behaviors and weight status. For adults, reducing solitary dinners may help prevent obesity, whereas for adolescents, preventing frequent dinner skipping could be beneficial. Nursing strategies promoting shared mealtimes in adults and regular dinners in adolescents may help address obesity in Korea.

Key Words: Feeding behavior; Nutrition surveys; Overweight

INTRODUCTION

Obesity is a major global public health challenge, contributing to chronic disease and rising healthcare costs [1-3]. In South Korea, 39% of adults and 19% of children are classified as overweight or obese [4,5], with rates increasing since 1998 [6,7]. Government-supported obesity prevention programs have targeted lifestyle behaviors, often through nutrition education. While these interventions have yielded some benefits, their effects have generally been minimal to modest [8,9], possibly due to limited consideration of broader eating behavior contexts such as meal skipping and eating alone. With changing work environments and household dynamics [10,11], these behaviors are becoming more common. Although they likely influence dietary intake and weight status, research specifically examining skipping meals or eating alone remains limited [12].

Meal skipping is often used as a weight-control strategy despite evidence linking it to weight gain [13]. Meta-analyses have shown that skipping breakfast is associated with an increased risk of overweight or obesity [14,15]. Skipping dinner has also been linked to weight gain in adults, potentially due to increased appetite and compensatory overeating later in the day [16]. These patterns and their effects may differ by age group because of variations in daily routines and family roles. Few studies have examined breakfast or dinner skipping across multiple age groups, despite its potential to inform age-specific public health interventions.

Eating alone is another behavior linked to obesity risk that may vary by age. In South Korea, it is increasingly common among adults—due to the rise in single-person households—and among children and adolescents, driven in part by dual-earner parents [10,11]. Older adults may eat alone due to living alone, while adolescents may do so because of after-school activities or a lack of family meals. Eating alone can lower diet quality and increase the likelihood of overconsumption; those who eat alone tend to consume higher-calorie, nutrient-poor meals and spend less time eating [12,17]. In contrast, shared meals are associated with greater fruit and vegetable intake and lower sugar-sweetened beverage consumption [18,19]. These differences suggest that eating alone could promote weight gain by compromising diet quality and encouraging excessive energy intake. However, few studies have examined its impact on weight across different age groups. Understanding how eating alone interacts with age-related factors is essential for developing effective, targeted dietary interventions.

In summary, while the adverse health consequences of poor dietary intake are well established, few studies have examined how the timing (meal skipping) and social context (eating alone) of meals influence weight status. By exploring the associations between meal skipping, eating alone, and overweight or obesity—particularly across different age groups—this study seeks to address a critical gap in the literature. Therefore, the objectives of the current study are to: a) describe the frequency of skipping meals (i.e., breakfast or dinner) and eating meals alone by age group, and b) examine the associations between these behaviors and overweight or obesity status among adults (≥19 years), compared to children (2–11 years) and adolescents (12–18 years) in South Korea. Clarifying the roles of meal skipping and eating alone in obesity will inform the development of age-specific nursing interventions targeting these modifiable eating behaviors and enhance the effectiveness of obesity prevention programs.

METHODS

1. Data Source and Data Collection

This study employed a cross-sectional secondary analysis of the 2019 Korea National Health and Nutrition Examination Survey (KNHANES) using de-identified, publicly available data. This annual national surveillance system is conducted with approval from the Research Ethics Review Committee of the Korea Disease Control and Prevention Agency. Each year, the KNHANES survey collects data from approximately 10,000 individuals across 4,800 households, selected using stratified multistage cluster sampling methods. In the first sampling stage, 192 survey districts were chosen based on local government level (county, city, or town) and housing type (house or apartment). Within each district, 25 households were randomly selected and invited to participate.

For data collection, trained staff conducted a health interview and physical examination in a designated mobile vehicle. One week after these assessments, dietitians administered a nutrition survey at the participants' homes. Sociodemographic characteristics, including sex, education level, and household income quartile, were collected during the health interview. The health examination included measurements of height and weight. For children under 12 years, a parent or guardian provided proxy responses for health and eating behaviors. Children younger than two years were excluded from the study because body mass index (BMI) percentile data were not available for this age group. The nutrition survey assessed eating behaviors such as meal frequency, meal companionship, and meal consumption outside the home. Food intake was also evaluated using a single 24-hour dietary recall. The latest versions of the 2019 KNHANES data were used (health interview and examination data, version September 13, 2022; nutrition survey data, version August 12, 2022). Data were obtained from the KNHANES website (https://knhanes.kdca.go.kr/knhanes/main.do) following completion of the data user consent form and compliance statement.

2. Analytic Sample

From all participants in the 2019 KNHANES, a total of 7,596 individuals, including 875 children, 489 adolescents, and 6,232 adults, had BMI percentile or both height and weight information available. These correspond to an estimated weighted population of approximately 50,582,797 people: 4,561,049 children, 3,358,197 adolescents, and 42,663,551 adults. Individuals with missing values for any age-specific covariates were excluded from the regression analysis to maintain sampling weights and ensure representative estimates from the complex survey data.

3. Study Variables

1) Independent variables

Eating behaviors in this study were defined by meal skipping and eating alone, using relevant questions from the nutrition survey. To determine the frequency of meal skipping, participants were asked: "In the past year, how many times have you had breakfast per week?" and "In the past year, how many times have you had dinner per week?" Response options were "5–7 times/week," "3–4 times/week," "1–2 times/week," and "not at all (0 time/week)." To address the skewed distribution of responses, the frequencies were reverse-coded and dichotomized as "<3 times/week" and "≥3 times/week," in line with prior meta-analytic evidence using this cutoff to define meal skipping and its link to overweight and obesity [15].

Eating breakfast or dinner alone was evaluated with the questions: "In the past year, when you had breakfast, have you usually eaten with other people?" and "In the past year, when you had dinner, have you usually eaten with other people?" with yes/no response options. These questions were only posed to those who reported eating breakfast or dinner at least three times per week. Thus, participants who ate these meals fewer than three times per week were excluded from the eating alone analysis.

2) Dependent variables

Overweight or obesity was determined by BMI for adults and BMI percentile for children and adolescents. BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2). Adults with a BMI of 23 kg/m^2 or higher were classified as overweight or obese, according to the BMI classification for Asians established by the World Health Organization Regional Office for the Western Pacific Region [20]. The dataset provided BMI percentiles for children and adolescents in four categories: less than 5th percentile (<5th), 5th to less than 85th percentile (5th≤BMI percentile<85th), 85th to less than 95th percentile (85th≤BMI percentile<95th), and 95th percentile or greater (≥95th percentile). Children and adolescents at or above the 85th percentile were considered overweight or obese.

3) Covariates

Participant characteristics assessed consistently across all age groups included sex, household income quartile, and daily energy intake. Adults and adolescents self-reported biological sex at birth (male or female), while parents provided this information for children. Household income quartiles were based on self- or proxy-reported average monthly household income, adjusted for household size. The first through third quartiles corresponded to $909.93 (KRW 1,060,700), $1,733.47 (KRW 2,020,700), and $2,727.64 (KRW 3,179,600) according to the 2019 average won-dollar exchange rate ($1=1,165.697 KRW) [21]. For analysis, the first and second quartiles were combined as less than 50% income level. Daily energy intake was estimated using one 24-hour dietary recall and dichotomized as within or outside the recommended daily intake for age and sex [22].

Additional covariates included in the regression models differed by age group. In the child model, the child's energy intake, mother's weight status, and mother's working hours were controlled for. The adolescent model included both parents' weight statuses. For adults, covariates comprised sex, marital status, education level, daytime work schedule (working between 6 am and 6 pm), weekly working hours (>40 hours), and frequency of eating meals not prepared at home (such as takeout, delivery, or prepackaged foods).

4. Ethical Considerations

This study was exempted from institutional review board review (IRB No: INJE 2021-11-042), as it was a secondary analysis of publicly available data with no direct contact or additional data collection from participants.

5. Statistical Analysis

All statistical analyses were performed by age group using SAS statistical software, version 9.4 (SAS Institute, Cary, NC, USA). All results were estimated with SAS survey procedures incorporating sampling weights. These weights, provided by KNHANES, improve the representativeness and accuracy of population estimates by adjusting for unequal sampling probabilities and non-response bias [23].

The PROC SURVEYFREQ procedure was used to estimate proportions of sociodemographic characteristics by age group. The Rao-Scott chi-square test was used to determine whether sociodemographic characteristics differed by weight status. Any characteristics showing statistically significant differences by weight status ($p<.05$) were included as covariates in the regression models.

Multiple logistic regression models were conducted using PROC SURVEYLOGISTIC to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for associations between skipping breakfast or dinner, eating alone, and overweight or obesity within each age group. Selection of covariates for each model was guided by age-specific characteristics and statistically significant differences observed in bivariate analyses for each age group.

RESULTS

1. Characteristics of Study Participants

The characteristics of study participants are summarized in Table 1 for children and adolescents, and in Table 2 for adults.

1) Children

Among children, 51.4% were boys. and approximately 39.1% belonged to households in the lower half of the income distribution. Nearly half (48.2%) consumed more calories than the age-specific recommended intake. Most children did not skip dinner three or more times per week

Table 1. Characteristics of Children and Adolescents and Their Parent

Variables	Weighted n (weighted %)	
	Children (2–11 years)	Adolescents (12–18 years)
Participant characteristics		
Male sex	2,343,334 (51.4)	1,784,453 (53.1)
Household income quartile (<50%[†])	1,782,310 (39.1)	1,324,838 (39.7)
Daily energy intake (>recommended level[‡])	2,078,805 (48.2)	1,111,269 (35.2)
Skipping meals (≥3 times/week)		
Breakfast	752,376 (17.4)	1,368,937 (43.4)
Dinner	15,561 (0.4)	194,441 (6.2)
Eating alone		
Breakfast	434,309 (11.1)	871,121 (39.8)
Dinner	72,913 (1.7)	455,908 (14.6)
Non-home-cooked food consumption[§] (≥5 times/week)	4,192,090 (97.1)	2,919,181 (92.5)
Parental characteristics		
Parents' education level (≤high school)		
Father	1,032,576 (31.6)	810,842 (38.9)
Mother	1,139,867 (27.8)	1,340,278 (44.4)
Parents' not being daytime workers (6 am–6 pm)		
Father	485,075 (15.1)	286,478 (13.8)
Mother	233,233 (9.5)	391,874 (17.1)
Parents' working hours (>40 hours/week)		
Father	1,860,256 (40.8)	1,189,601 (35.4)
Mother	483,879 (10.6)	581,137 (17.3)
Parents' overweight or obesity[‖]		
Father	2,570,211 (59.6)	1,625,995 (51.5)
Mother	1,501,940 (34.8)	1,311,177 (41.6)

[†] Bottom 50% of income level of all households in South Korea; [‡] Recommendation for daily energy intake is based on the Ministry of Health and Welfare of Korea's Dietary Reference Intakes for Koreans 2020 by age group; [§] "Other than home-cooked food" includes delivered food, packaged food, school meals, and food provided by religious groups; [‖] Overweight or obesity was defined as a body mass index (BMI) is 23 kg/m^2 or higher, the BMI classification for Asians established by the World Health Organization Regional Office for the Western Pacific.

https://doi.org/10.7475/kjan.2025.0327_2

Table 2. General Characteristics of Adults

Variables	Weighted n (weighted %) Adults (19 years or older)
Male sex	21,373,405 (50.1)
Marital status (married)	32,856,271 (77.0)
Education level (≤ high school)	22,681,134 (56.4)
Not a daytime worker (6 am–6 pm)	5,255,276 (17.7)
Weekly working hours (> 40 hours/week)	12,030,419 (28.2)
Household income quartile (< 50%[†])	17,286,555 (40.8)
Daily energy intake (> recommended level[‡])	14,237,159 (35.6)
Weight status (overweight or obese[§])	22,702,042 (56.9)
Skipping meals (≥ 3 times/week)	
Breakfast	16,966,965 (42.4)
Dinner	4,018,396 (10.0)
Eating alone	
Breakfast	12,399,905 (45.1)
Dinner	8,958,915 (23.0)
Non-home-cooked food consumption[‖] (≥ 5 times/week)	18,106,498 (45.3)

[†]Bottom 50% of income level of all households in South Korea; [‡]Recommendation for daily energy intake is based on the Ministry of Health and Welfare of Korea's Dietary Reference Intakes for Koreans 2020 by age group; [§]Overweight or obesity was defined as a body mass index (BMI) of 23 kg/m^2 or higher, the BMI classification for Asians established by the World Health Organization Regional Office for the Western Pacific; [‖]"Other than home-cooked food" includes delivered food, packaged food, school meals, and food provided by religious groups.

(0.4%), while 17.4% reported skipping breakfast at least three times weekly. Eating breakfast alone was reported by 11.1%, whereas only 1.7% ate dinner alone. Consumption of non-home-cooked food five or more times per week was reported by 97.1% of children.

With respect to parental characteristics, 31.6% of fathers and 27.8% of mothers had a high school education or less. Non-daytime work (after 6 pm or before 6 am) was reported by 15.1% of fathers and 9.5% of mothers. Additionally, 40.8% of fathers and 10.6% of mothers worked more than 40 hours per week. The prevalence of overweight or obesity was 59.6% among fathers and 34.8% among mothers.

2) Adolescents

Among adolescents, 53.1% were male, and a total of 39.7% were in the lower half of the household income distribution. About one-third (35.2%) exceeded the recommended daily energy intake. Skipping breakfast three or more times per week was common (43.4%), whereas frequent dinner skipping was less prevalent (6.2%). Eating breakfast alone was reported by 39.8%, and eating dinner alone by 14.6%. Frequent consumption (≥ 5 times per week) of non-home-cooked foods was reported by 92.5% of adolescents.

Regarding parental characteristics, 38.9% of fathers and 44.4% of mothers had a high school education or less. Non-daytime work was reported by 13.8% of fathers and 17.1% of mothers. A total of 35.4% of fathers and 17.3% of mothers worked more than 40 hours per week. The prevalence of overweight or obesity was 51.5% among fathers and 41.6% among mothers.

3) Adults

Among adults, 50.1% were men and 77.0% were married. More than half (56.4%) had a high school education or less. In terms of employment, 28.2% worked more than 40 hours per week, and 82.3% were employed during daytime hours (between 6 am and 6 pm). A total of 40.8% belonged to the lower half of the household income distribution.

Regarding dietary patterns, 35.6% of adults consumed more calories than recommended by national dietary guidelines. The prevalence of overweight or obesity was 56.9%. Skipping breakfast three or more times per week was reported by 42.4% of adults, while dinner skipping was less common (10.0%). Eating breakfast alone was reported by 45.1%, and 23.0% reported eating dinner alone. Frequent consumption (≥ 5 times per week) of non-home-cooked foods—including delivered meals, packaged foods, or meals provided by religious groups or schools—was reported by 45.3% of adults.

2. Association between Skipping Meals or Eating Alone and Being Overweight/Obese

The associations between eating behaviors and overweight or obesity were analyzed separately for each age group.

1) Children

Skipping breakfast three or more times per week was not significantly associated with overweight or obesity (OR = 0.66, 95% CI = 0.30–1.47). Eating breakfast alone was also not significantly associated with overweight or obesity in children (OR = 1.21, 95% CI = 0.63–2.31) (Table 3).

2) Adolescents

Table 4 presents the associations between eating behaviors and overweight or obesity among adolescents. Skipping breakfast three or more times per week was not sig-

Table 3. Association between Skipping Breakfast or Eating Alone and Children's Obesity Status

Variables	Categories	Children's overweight or obesity[†]	
		OR	95% CI
Skipping meals			
Breakfast	≥ 3 times/week	0.66	0.30–1.47
	< 3 times/week (ref.)		
Eating alone			
Breakfast	Yes	1.21	0.63–2.31
	No (ref.)		
Mother's weight status	Overweight or obese[‡]	2.23	1.30–3.82
	Normal or underweight (ref.)		
Mother's weekly working hours	> 40 hours/week	1.85	0.91–3.75
	≤ 40 hours/week (ref.)		
Daily energy intake	> Recommended level	1.63	1.10–2.41
	≤ Recommended level (ref.)		

CI = confidence interval; OR = odds ratio; ref. = reference; [†]Children whose body mass index (BMI) percentile was at or above the 85th percentile were classified as overweight or obese; [‡]Parental overweight or obesity was defined as a BMI is 23 kg/m^2 or higher, the BMI classification for Asians established by the World Health Organization Regional Office for the Western Pacific.

Table 4. Association between Skipping Meals or Eating Alone and Adolescents' Obesity Status

Variables	Categories	Adolescents' overweight or obesity[†]			
		OR	95% CI	OR	95% CI
Skipping meals					
Breakfast	≥ 3 times/week	0.80	0.39–1.66		
	< 3 times/week (ref.)	1.00			
Dinner	≥ 3 times/week			2.60	1.04–6.54
	< 3 times/week (ref.)			1.00	
Eating alone					
Breakfast	Yes	0.99	0.51–1.92		
	No (ref.)	1.00			
Dinner	Yes			1.43	0.77–2.65
	No (ref.)			1.00	
Father's weight status	Overweight or obese[‡]	3.38	1.70–6.70	2.69	1.53–4.71
	Normal or underweight (ref.)	1.00		1.00	
Mother's weight status	Overweight or obese[§]	2.60	1.37–4.94	2.35	1.34–4.11
	Normal or underweight (ref.)	1.00		1.00	

CI = confidence interval; OR = odds ratio; ref. = reference; [†]Adolescents whose body mass index (BMI) percentile was at or above the 85th percentile were classified as overweight or obese; [‡,§]Parental overweight or obesity was defined as a BMI is 23 kg/m^2 or higher, the BMI classification for Asians established by the World Health Organization Regional Office for the Western Pacific.

nificantly associated with overweight or obesity (OR = 0.80, 95% CI = 0.39–1.66), nor was eating breakfast alone (OR = 0.99, 95% CI = 0.51–1.92). However, adolescents who skipped dinner at least three times per week were significantly more likely to be overweight or obese than those who skipped dinner less frequently (OR = 2.60, 95% CI = 1.04–6.54). Eating dinner alone was not significantly associated with overweight or obesity in adolescents (OR = 1.43, 95% CI = 0.77–2.65).

3) Adults

Among adults, there was no significant association between skipping breakfast (OR = 1.23, 95% CI = 0.93–1.63), eating breakfast alone (OR = 0.86, 95% CI = 0.70–1.05), or skipping dinner (OR = 1.02, 95% CI = 0.74–1.42) and being overweight or obese (Table 5). However, adults who ate dinner alone were significantly more likely to be overweight or obese compared to those who ate dinner with others (OR = 1.27, 95% CI = 1.06–1.52).

DISCUSSION

In this secondary analysis of a nationally representative dataset from South Korea, eating dinner alone was significantly associated with overweight or obesity among South Korean adults. We suspect this association may arise because adults are more likely to prepare and serve healthier foods during family meals to support family members' well-being [24]. In contrast, when eating alone, individuals often prioritize convenience over nutrition. Those who frequently eat alone not only skip meals 2.7 to 5.4 times more often, but also report lower overall diet quality and fruit and vegetable intake, regardless of sex or living arrangement [17,25]. In post hoc analysis, interactions between eating alone and skipping breakfast (*p* = .904) or dinner (*p* = .635) were not statistically significant, suggesting that eating alone independently affects overweight or obesity risk in adults. The likely mechanism underlying this association is the reduced diet quality observed in individuals who eat alone. Future studies should explore whether diet quality mediates the relationship between eating alone and

Table 5. Association between Skipping Meals or Eating Alone and Adults' Obesity Status

Variables	Categories	Adults' overweight or obesity[†]			
		OR	95% CI	OR	95% CI
Skipping meals					
Breakfast	≥ 3 times/week	1.23	0.93–1.63		
	< 3 times/week (ref.)	1.00			
Dinner	≥ 3 times/week			1.02	0.74–1.42
	< 3 times/week (ref.)			1.00	
Eating alone					
Breakfast	Yes	0.86	0.70–1.05		
	No (ref.)	1.00			
Dinner	Yes			1.27	1.06–1.52
	No (ref.)			1.00	
Sex	Male	2.33	1.89–2.88	2.70	2.23–3.27
	Female (ref.)	1.00		1.00	
Marital status	Married	2.07	1.53–2.80	1.94	1.58–2.37
	Not married (ref.)	1.00		1.00	
Education level	≤ High school	1.40	1.15–1.71	1.30	1.10–1.54
	> High school (ref.)	1.00		1.00	
Daytime worker	No	0.98	0.75–1.27	0.88	0.71–1.09
	Yes (ref.)	1.00		1.00	
Weekly working hours	> 40 hours	1.48	1.20–1.82	1.30	1.09–1.56
	≤ 40 hours (ref.)	1.00		1.00	
Non-home-cooked food consumption	≥ 5 times/week	0.88	0.72–1.08	1.00	0.84–1.19
	< 5 times/week (ref.)	1.00		1.00	

CI = confidence interval; OR = odds ratio; ref. = reference; [†]Overweight or obesity was defined as a body mass index (BMI) is 23 kg/m^2 or higher, the BMI classification for Asians established by the World Health Organization Regional Office for the Western Pacific.

adult weight status.

A noteworthy finding was that, in adolescents, skipping dinner, rather than eating alone, was a significant risk factor for overweight or obesity. While our analysis of eating alone excluded those who skipped three or more meals per week, potentially limiting our ability to assess these associations fully, several explanations are possible. The influence of eating alone on adolescent diet quality may be attenuated if parents or caregivers prepare meals in advance. By contrast, skipping dinner could contribute directly to energy imbalance and subsequent weight gain in adolescents. In a retrospective cohort study of young college students (65% of whom were 18 years old and classified as adolescents in our study), those who skipped dinner had more irregular evening energy intake and experienced greater weight gain than those who ate dinner daily [16]. Additionally, it is possible that meal skipping among overweight or obese adolescents reflects attempts at weight control, introducing the potential for reverse causality.

Contrary to expectations, neither eating breakfast alone nor skipping breakfast was associated with overweight or obesity in any age group. This differs from previous studies reporting significant associations between breakfast skipping and overweight or obesity [14,26]. One possible explanation is that the value of eating breakfast together may be diminished when the meal itself is frequently skipped. In our sample, roughly 40% of adults and adolescents skipped breakfast three or more times per week—a higher rate than reported in the United States [27]. Another consideration is that the survey may have defined breakfast as a “morning meal,” and individuals consuming grab-and-go items such as cereal bars or fruit may have reported not having a “meal.” Prior research found that consuming ready-to-eat cereal or other breakfast foods was associated with higher diet quality than skipping breakfast altogether [28]. Thus, use of the term “meal” in the survey may have led to an overestimation of breakfast skipping and diluted observed associations with diet quality and weight status. Further research should examine not only the frequency of breakfast consumption but also the types of foods eaten at breakfast.

This study has several strengths and limitations. It is among the first to investigate the roles of meal skipping and eating alone in overweight or obesity using a nationally representative sample spanning children, adolescents, and adults in South Korea. This broad age range enabled us to identify which eating contexts are more critical for specific meals or age groups, providing a foundation for tailored intervention development. An additional strength was the use of measured height and weight to assess overweight and obesity. Limitations include the cross-sectional design and the focus on breakfast and dinner, dictated by the structure of the secondary dataset. Longitudinal cohort studies or ecological momentary assessment methods could clarify directionality by examining changes in diet quality and weight relative to eating environment, including eating alone, food source, and preparation method. Another limitation is that questions about eating alone were posed only to individuals consuming breakfast or dinner at least three times per week, which may have introduced selection bias. Although we adjusted for demographic differences—such as education and weekly working hours—between those asked and not asked about eating alone, the importance of shared meals may be diminished when a meal is skipped frequently. Moreover, we were unable to account for additional factors that contextualize eating alone, such as the types, timing, and locations of foods consumed. Future research should incorporate more detailed assessments of food consumption throughout the day.

The current study’s findings have important implications for nursing practice. For adolescents, school-based nursing interventions should focus on monitoring meal skipping—especially dinner—as it may indicate irregular routines or intentional weight control efforts. Nurses should promote regular, healthy eating habits and address underlying reasons for meal skipping by offering counseling or referrals as needed. For adults, nurses in primary care or community settings could screen for eating alone during routine health assessments and encourage shared mealtimes or participation in social meal programs. Promoting these behaviors in adults who frequently eat alone may help improve dietary quality and prevent obesity.

CONCLUSION

In conclusion, this study found that eating dinner alone was significantly associated with higher odds of overweight or obesity among South Korean adults, while skipping dinner—but not eating alone—was associated with overweight or obesity in adolescents. These findings indicate that specific eating behaviors are linked to weight outcomes in age-dependent ways, underscoring the need for age-tailored interventions. For adults, primary care and community-based strategies that promote shared evening meals

https://doi.org/10.7475/kjan.2025.0327_2

may help mitigate the negative impact of eating alone on diet quality and weight. For adolescents, school-based nursing interventions should focus on preventing dinner skipping and fostering regular evening meals to support obesity prevention. Future longitudinal research is needed to clarify the causal pathways connecting eating behaviors and weight status and to inform the design of targeted dietary interventions that consider age, meal type, and social eating context.

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

Study conception and/or design acquisition - YJC and JL; analysis - YJC; interpretation of the data - YJC and JL; drafting and critical revision of the manuscript for important intellectual content - YJC and JL.

FUNDING

This work was supported by a career development award from the Eunice Kennedy Shriver National Institute of Child Health & Human Development of the National Institutes of Health (1K23HD107179-01, PI: Lee) and by the 2023 Inje University research grant (PI: Choi).

ACKNOWLEDGEMENT

None.

DATA AVAILABILITY STATEMENT

Data can be obtained from KNHANES repository source (https://knhanes.kdca.go.kr/knhanes/main.do).

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ORIGINAL ARTICLE

Korean J Adult Nurs Vol. 37 No. 3, 307-320, August 2025
eISSN: 2288-338X
https://doi.org/10.7475/kjan.2025.0331

KJAN
Korean Journal of
Adult Nursing

Effectiveness of a Self-Management Program for Patients Undergoing Lumbar Spinal Stenosis Surgery: A Quasi-Experimental Study

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Received: March 31, 2025
Revised: May 18, 2025
Accepted: July 4, 2025

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Purpose: This study developed a self-management program for patients undergoing lumbar spinal stenosis surgery utilizing the information-motivation-behavioral skills (IMB) model. **Methods:** This study employed a quasi-experimental design with a nonequivalent control group and pretest–posttest design. Data were collected from August 11, 2022, to March 31, 2023, at a general hospital in South Korea. A total of 58 patients participated in the study (30 experimental, 28 control group). The experimental group received a six-session self-management program based on the IBM model, whereas the control group received usual education and information. Data were analyzed with SPSS/WIN 23.0 using the independent t-test, chi-square test, Fisher's exact test, Shapiro-Wilk test, and Mann-Whitney U test. **Results:** Significant differences were observed in self-management information ($p < .001$), personal motivation ($p = .002$), social motivation ($p = .002$), behavioral skills ($p = .002$), behaviors ($p = .003$), health-related quality of life ($p < .001$), and disc height ($p = .006$) in the experimental group following program implementation, compared to the control group. However, no significant differences were found in lower extremity muscular strength, lumbar lordotic angle, or the visual analog scores for low back pain and leg pain between the two groups. **Conclusion:** The self-management program developed in this study, based on the IMB model, was effective in improving self-management information, motivation, behavioral skills, behaviors, health-related quality of life, and self-management health outcomes in patients undergoing lumbar spinal stenosis surgery. Nevertheless, future research should aim to verify the long-term effects of such self-management programs by extending the intervention period.

Key Words: Spinal stenosis; Self-management; Information motivation behavioral skills model; Health-related quality of life

INTRODUCTION

Lumbar spinal stenosis surgery is the second most frequently performed spinal surgery in South Korea, with the number of patients increasing by 30% over the past 5 years [1]. As the population continues to age, this trend is expected to accelerate, highlighting the importance of prevention and ongoing management. Therefore, ongoing postoperative self-management is essential for maintaining spinal health.

The treatment for lumbar spinal stenosis includes a range of approaches, from conservative therapies such as medication, physical therapy, and injections to surgical intervention. Posterior lumbar fusion surgery is recognized as an effective option; however, postoperative complications such as pain recurrence and diminished physical function remain possible [2]. Previous research has indicated that 14% of patients require reoperation within 5 years [3], leading to physical and psychological challenges as well as decreased quality of life [4]. Furthermore, after a certain period post-surgery, disc height and lumbar lordosis may decline due to weight-bearing forces [5], potentially resulting in issues such as reduced lower limb strength and impaired gait [6].

Patients undergoing lumbar spinal stenosis surgery often need substantial time to recover functional abilities and reintegrate into daily life [7]. This underscores the critical importance of postoperative patient education and effective self-management. While surgical intervention typically alleviates physical burdens, pain, and gait disturbances [8], sustaining long-term health without continued self-management remains a challenge. Currently, hospitals tend to offer only medication and basic care education [9], and structured self-management education programs to support post-discharge health maintenance are lacking. Therefore, the development of self-management programs is vital to empower patients to actively manage their spinal health and adopt health-promoting behaviors.

The effectiveness of such a program was evaluated using clinical indicators relevant to patients after lumbar spinal stenosis surgery, including lower limb strength, pain levels, intervertebral disc height, and lumbar lordosis. These variables were chosen because they represent primary postoperative concerns, such as pain recurrence, reduced mobility, and structural changes in the spine, which, if unaddressed, can negatively affect recovery and long-term quality of life. Thus, these outcomes served as meaningful metrics for assessing the practical impact of the self-management program.

The present study aimed to develop and evaluate a self-management program for patients undergoing lumbar spinal stenosis surgery, grounded in the information-motivation-behavioral skills (IMB) model [10]. The IMB model posits that health behavior change is achieved through information provision, motivation enhancement, and the improvement of behavioral skills, ultimately promoting healthy behaviors. This model has demonstrated effectiveness in encouraging self-management across a range of chronic conditions, including type 1 diabetes, hypertension, heart failure, coronary artery disease, chronic obstructive pulmonary disease, inflammatory bowel disease, and knee osteoarthritis [11]. It suggests that health behaviors are influenced by the interplay of information, motivation, and behavioral skills. Nevertheless, most existing studies have focused on exercise interventions, and few have applied the IMB model to self-management education specifically for patients undergoing lumbar spinal stenosis surgery.

Accordingly, this study aimed to apply the IMB model within a self-management program to improve patients' disease-related knowledge, motivation, and behavioral skills, with the goal of enhancing self-management practices and quality of life. The program was systematically structured based on the IMB model and designed to help patients sustain long-term health-promoting behaviors.

Program effectiveness was evaluated by examining improvements in lower limb strength, pain reduction, and the maintenance of disc height and lumbar lordosis—outcomes that are clinically relevant after lumbar spinal stenosis surgery. Decreases in disc height, reduced lumbar lordosis, lower limb weakness, and recurrent pain may result in secondary problems if not managed appropriately. Therefore, these indicators were regarded as key measures of program effectiveness. By addressing the current gap in postoperative self-management education for patients with lumbar spinal stenosis, this study aimed to promote improved long-term health and quality of life.

METHODS

1. Study Design

This study employed a quasi-experimental design utilizing a non-equivalent control group and a non-synchronized design.

2. Setting and Samples

The target population of this study was patients diagnosed with lumbar spinal stenosis who underwent their first laminectomy and posterior lumbar fusion surgery at a general hospital in South Korea. The inclusion criteria were: (1) adults aged 19 years or older with the ability to communicate, (2) no history of previous spinal surgery, (3) diagnosis of lumbar spinal stenosis, (4) scheduled for laminectomy and posterior lumbar fusion surgery for the first time, and (5) ability to read and understand Korean and willingness to provide informed consent. The exclusion criteria were patients with (1) other neurological or musculoskeletal disorders that could affect functional outcomes, (2) cognitive impairment or psychiatric illness that could interfere with participation, or (3) refusal to participate in the study.

The required sample size was calculated using G*Power 3.1.9.4 software. According to a previous study [12], an independent t-test required a sample size based on an effect size of 0.80, a significance level (α) of 0.05, and a power (1–β) of 0.80, yielding a total sample size of 52 participants (26 per group). Considering a potential dropout rate of 20%, 30 participants were recruited for each group. Participants were assigned to the experimental or control group according to the order of admission to the hospital, without randomization. However, two participants from the control group declined to participate, resulting in a final sample of 30 participants in the experimental group and 28 in the control group (total: 58 participants).

This study was reported in accordance with the Transparent Reporting of Evaluations with Nonrandomized Designs (TREND) guidelines.

3. Measurements

The self-management knowledge measurement tool 1) self-management knowledge, 2) personal motivation for self-management, 3) social motivation for self-management, 4) self-management behavioral skills, 5) health-related quality of life (HRQoL), 6) lower limb strength, 7) lower back pain, 8) intervertebral disc height, 9) the lumbar lordosis angle used in this study was adapted from the disease-related knowledge assessment developed by Jeong and Lee [13] for patients undergoing spinal surgery. This tool consists of 14 items addressing brace management (two items), medication and treatment (three items), daily activities (six items), harmful lifestyle habits (two items), and exercise management (three items). Each item was scored as “yes” (1 point) or “no/don’t know” (0 points), with higher scores reflecting greater self-management knowledge. The reliability of this tool was shown by a Cronbach’s α value of .91 in Jeong and Lee’s study [13] and a Kuder–Richardson Formula 20 (KR-20) value of .60 in this study.

Personal motivation for self-management was assessed using the Health Attitude Scale developed by Torabi et al. [14] and translated into Korean by Kim [15]. This instrument comprises 15 items categorized into health-related emotions (five items), beliefs about disease prevention and healthy lifestyles (five items), and intention to practice healthier behaviors (five items). Each item was rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree), with higher scores indicating stronger personal motivation. Reliability was shown by Cronbach’s α values of .88 in Kim’s study [15] and .84 in this study.

Social motivation for self-management was measured using the Social Support Scale developed by Zimet et al. [16] and translated into Korean by Shin and Lee [17]. This instrument includes 12 items covering family support (four items), peer support (four items), and medical staff support (four items), each rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). Higher scores indicate greater social motivation. The reliability was shown by Cronbach’s α values of .88 in Shin and Lee’s study [17] and .87 in this study.

Self-management behavioral skills were measured using the Self-Efficacy Scale developed by Marcus et al. [18] and translated into Korean by Lee and Chang [19]. This scale contains five items scored on a 5-point Likert scale (1 = not confident at all to 5 = very confident), with higher scores indicating stronger self-management behavioral skills. The reliability was demonstrated by Cronbach’s α values of .82 in Lee and Chang’s study [19] and .88 in this study.

Self-management behaviors were measured using the Self-Management Behavior Assessment tool developed by Jeong and Lee [13]. This tool comprises 14 items covering brace management (two items), medication and treatment (three items), daily activities (six items), harmful lifestyle habits (two items), and exercise management (three items). Each item was rated on a 5-point Likert scale (1 = never to 5 = always), with higher scores reflecting greater engagement in self-management behaviors. The tool’s reliability was shown by Cronbach’s α values of .95 in Jeong and Lee’s study [13] and .88 in this study.

HRQoL was assessed using the Euro Quality of Life Questionnaire 5-Dimensional Classification (EQ-5D). This instrument includes five items: mobility, self-care, daily activities, pain/discomfort, and anxiety/depression, each rated on a 3-point Likert scale (1 = no problems, 2 = some problems, 3 = severe problems). Final scores were calculated according to the weighting method described by Nam et al. [20].

Lower limb strength was measured using the sit-to-stand-five-times test (STS5 test). Participants were instructed to sit on a chair with armrests, cross their arms over their chest, and stand up and sit down five times. The total time required was recorded, and the test was repeated twice to minimize measurement errors, with the average time used for analysis.

Lower back pain was assessed using the visual analog scale (VAS), in which participants marked their pain on a scale from 0 (no pain) to 10 (worst pain possible). Leg pain was evaluated using the same VAS methodology.

Intervertebral disc height was measured based on the Farfan Index [21], which calculates the ratio of the total anterior and posterior disc height to disc diameter using lateral plain radiographs. Measurements were obtained via the picture archiving and communication system (PACS), and the procedure was repeated twice to reduce measurement error; the average value was used for analysis.

The lumbar lordosis angle was assessed using Cobb's angle, determined by drawing lines across the upper endplates of the first and fifth lumbar vertebrae. Measurements were obtained using PACS, with the average of two measurements recorded to ensure accuracy.

4. Data Collection/Procedure

This study implemented a six-session individualized self-management program over a four-week period for patients undergoing lumbar spinal stenosis surgery. Given the nature of the surgery, the program was delivered one-on-one and encompassed six phases: pre-hospitalization, pre-surgery, surgery day, postoperative day 3, postoperative week 1, and postoperative week 3. Educational sessions were conducted face-to-face using self-management booklets, lumbar health checklists, and videos.

The study was conducted during the coronavirus disease 2019 pandemic; to comply with the Korea Disease Control and Prevention Agency's social distancing guidelines, group education was excluded in favor of individualized education. To minimize the risk of respiratory infection, both researchers and participants wore Korea Filter 94 masks, used hand sanitizers, and followed strict personal hygiene protocols. A pilot study involving three patients scheduled for spinal surgery was conducted to assess the feasibility and applicability of the program.

A spinal center nurse served as a research assistant, supporting participant recruitment and obtaining informed consent. The primary researcher provided the research assistant with training in questionnaire administration and study protocols, ensuring familiarity with the intervention content prior to implementation. The program itself was delivered by the primary researcher, a registered nurse with over 15 years of clinical experience in an orthopedic ward. To maintain consistent and effective program delivery, the educator thoroughly reviewed key concepts related to the IMB model, adult learning theory, and patient-centered communication strategies during program development.

The primary objective of the program was to provide information, enhance motivation, and promote behavioral implementation, with the ultimate goal of improving patients' self-management skills. The intervention emphasized tailored education, continuous feedback from healthcare providers, and social support to increase self-management success rates, optimize post-surgical recovery, and facilitate rehabilitation.

The first session took place prior to hospitalization during an outpatient visit, providing information about spinal disorders and surgical treatments to improve disease understanding. Personal motivation was fostered by setting self-management goals, and patients were encouraged to maintain a lumbar health journal and spinal health checklist. Hospital resources were introduced, and the researcher's contact information was provided to ensure ongoing support. The session was individualized using educational booklets developed by the researcher.

The second session was conducted on the day of admission and included detailed education on preoperative and postoperative procedures, ensuring that patients fully understood the surgical process. Patients were encouraged to continue using their health journals and checklists, and the surgical transfer process was explained to help reduce preoperative anxiety. Social motivation was reinforced with videos showcasing successful self-management cases.

The third session took place on the day of surgery, focusing on postoperative education regarding proper posture, drain management, medication adherence, dietary management, and complication prevention. Patients received personalized education, and their adherence to self-management was assessed to increase their confidence in postoperative self-care. Ongoing medical support and feedback were provided to further strengthen social motivation.

The fourth session occurred on the third day after surgery, once patients could walk with spinal braces. Education was reiterated regarding postoperative management, including brace use, exercise, diet, and medication adherence. Progress toward individual goals was reviewed, and patients were encouraged to continue maintaining their health journals and checklists. Individualized consultations were provided to allow patients to discuss concerns and receive feedback from healthcare providers.

The fifth session was held one week after surgery, incorporating a true/false quiz to correct misconceptions and reinforce accurate health knowledge. Problem-solving strategies were introduced to improve patients' coping abilities during recovery. Video testimonials of successful rehabilitation cases were provided to offer encouragement and promote family support. Feedback was given to improve self-efficacy and encourage sustained self-management.

The sixth session took place three weeks after surgery at the time of discharge. Comprehensive self-management education was delivered to ensure patients could continue proper care at home. Key topics such as regular exercise, correct posture, and independent daily care were reinforced through booklets and videos. Individual consultations addressed remaining concerns and provided further problem-solving strategies. Patients reviewed personal goals, received encouragement for social reintegration, and were provided with feedback to further support self-efficacy (Table 1).

Patients in the control group received standard postoperative nursing care as provided by the hospital. This included preoperative consultations regarding treatment schedules and general postoperative nursing care, such as medication management and physical therapy guidance. This approach ensured that any observed effects could be attributed specifically to the IMB model–based self-management intervention.

5. IMB Model–Based Self-Management Program

In this study, the IMB model was applied to patients undergoing lumbar spinal stenosis surgery in recognition of the need for continuous self-management following discharge. The IMB model served as a theoretical framework for encouraging behavioral change by systematically delivering information, enhancing motivation, and developing behavioral skills tailored to this patient population. To inform program development, intervention programs and previous studies related to lumbar spinal stenosis were reviewed using electronic databases. In addition, nursing interventions, non-pharmacological treatments, and self-management programs relevant to patient health and nursing care were analyzed.

To further refine the program, focus group interviews were conducted with three patients who had been rehospitalized for pain management after discharge following

Table 1. Self-Management Program for Patients Undergoing Lumbar Spinal Stenosis Surgery Based on the IMB Model

Session	Contents				Strategies	Time (min)
	Information	Motivation		Behavioral skills		
	Disease-related knowledge	Personal	Social	Self-efficacy		
1	Lumbar spinal stenosis	Goal setting	Provide a video of encouraging lumbar spinal stenosis surgery patients	Goal achievement check	Face-to-face† (meeting individually) (1:1)	50
2	Preoperative self-management	Self-management checklist for lumbar spinal stenosis surgery check	Share experiences of lumbar spinal stenosis surgery patients	Practice of program check	Counseling†	50
3	Postoperative self-management		Q&A	Provide feedback	Practices†	50
4	Ambulation and exercise		Help with problem-solving methods	True/false quiz	Multimedia	50
5	Re-education on self-management for lumbar spinal stenosis				Self-management booklet	50
6	Self-management education for hospital discharge					50

IMB = information-motivation-behavioral skills; Q&A = question and answer; †All sessions were conducted by the researcher through face-to-face or multimedia-based instruction.

lumbar spinal stenosis surgery. These interviews provided valuable insights into patients' experiences and nursing needs, which were analyzed and incorporated into the program's design. Additionally, a focus group interview was held with three nurses working in the spinal ward, including two orthopedic nurses with 6 and 7 years of experience, respectively, and one nurse manager with 11 years of experience, to explore needs related to postoperative care and practical considerations. The feedback from these nurses was also integrated into the program structure.

The conceptual framework for this study was based on the IMB model proposed by Fisher and Fisher [10], which aims to facilitate changes in patients' health behaviors by providing disease-related information, strengthening motivation, and enhancing behavioral skills to support long-term health maintenance (Figure 1). Accordingly, the self-management program was structured to systematically deliver information, enhance motivation, and improve behavioral skills.

Specifically, a six-session program was conducted, spanning from the pre-hospitalization stage through post-discharge, integrating the IMB model into all aspects of self-management education. Program content included disease education, recovery exercises, guidance on correct posture, dietary management, medication management, and daily self-care.

The detailed structure of the self-management program is presented in Table 1. Because the accessibility and quality of information can significantly influence health behavior [22], visual aids such as images, illustrations, and videos were used to facilitate patient understanding. Expert opinions were incorporated to ensure the program's sustainability, including the use of checklists and lumbar health journals that provided ongoing feedback. Additionally, educational booklet content was tailored to an estimated reading level equivalent to the 6th grade (approximately age 13 years), using simplified vocabulary, large fonts, and visual aids to ensure accessibility for older adults with varying literacy levels.

The self-management program was delivered as six individual 50-minute sessions over four weeks to patients undergoing lumbar spinal stenosis surgery. To assess effectiveness, post-intervention self-reported surveys, direct physical measurements, and medical record analyses were conducted. Throughout the six-session program, information provision, motivation enhancement, behavioral skill development, and facilitation of behavior change—rooted in the IMB model—were emphasized, covering disease education, recovery exercises, proper posture guidance, dietary management, medication management, and daily

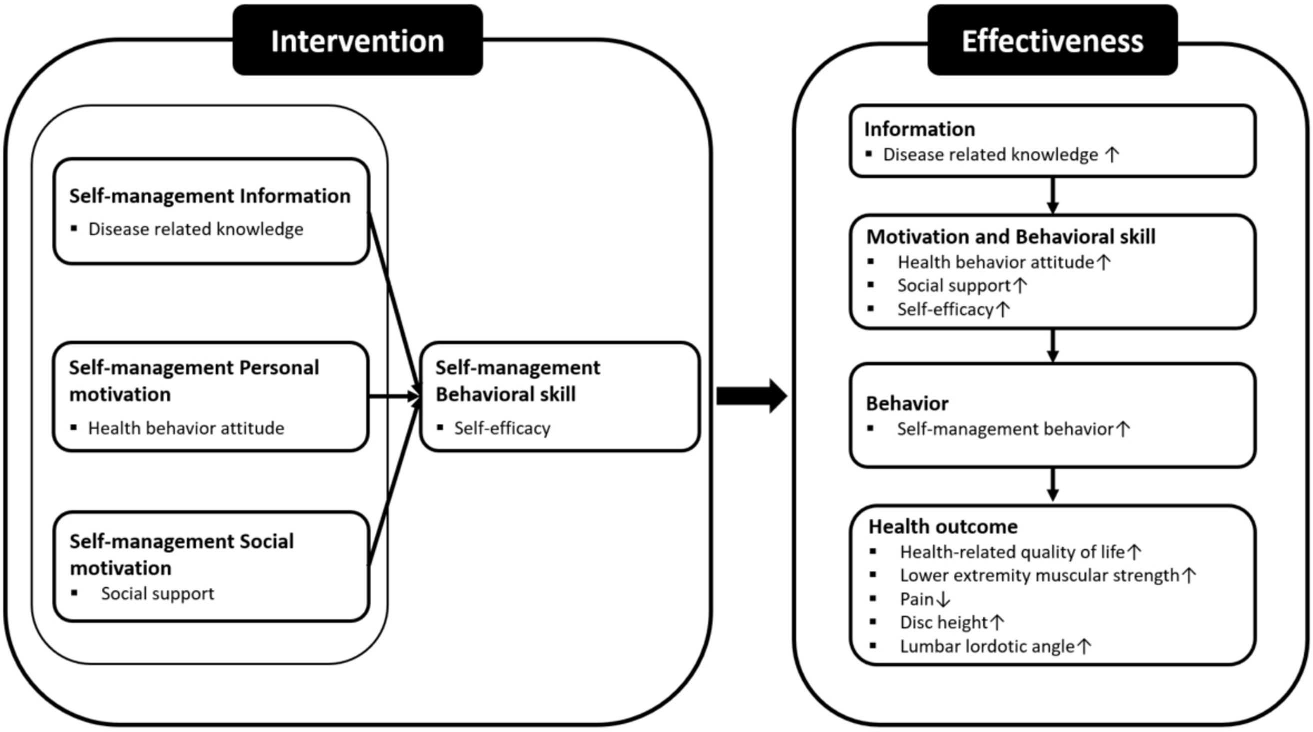

Figure 1. Conceptual framework for this study.

self-care practices.

The primary outcomes of the study included self-management information, motivation (both personal and social), behavioral skills, self-management behaviors, and HRQoL. The secondary outcomes were lower limb muscular strength, pain levels, intervertebral disc height, and lumbar lordosis angle.

The structure of the self-management program is detailed in Table 1. As accessibility and quality of information influence health behavior [22], visual learning tools such as illustrations, photographs, and videos were employed for patient education. Expert recommendations underscored the importance of patient-driven self-management to ensure ongoing engagement in self-care practices. To reinforce long-term adherence, checklists and lumbar health journals were provided to monitor and offer feedback. Furthermore, educational materials were adjusted for patients' age-related needs, including larger font sizes and enhanced visual clarity.

6. Ethical Considerations

This study was approved by the Institutional Review Board (IRB) of the Pukyong National University (No. 1041386-202207-HR-45-02). All measurement tools used were approved prior to the commencement of research.

To ensure ethical protection of participants, the purpose, methodology, and content of the study were fully explained prior to data collection. Participants were informed of their right to withdraw from the study at any time without penalty and were assured that their anonymity and confidentiality would be strictly maintained.

Given that study participants were inpatients and considered a vulnerable population, the self-management program was offered only to those who provided informed consent before hospitalization at the Spine Center outpatient clinic. The potential risks and benefits of participation were described in simple terms suited to each participant's level of understanding. This explanation was provided before, during, and after the study to ensure full comprehension. Additionally, all participants were guaranteed that they would receive appropriate medical care and treatment regardless of their participation status. Those who completed the program received a small token of appreciation. Upon completion of the study, the control group was provided with educational booklets, access to the program, and a gift as an additional ethical consideration.

7. Data Analysis

Data were analyzed using the IBM SPSS version 23.0 (IBM Corp., Armonk, NY, USA). The reliability of the measurement tools was evaluated using Cronbach's α and KR-20. Descriptive statistics, including frequency, percentage, mean, and standard deviation, were used to summarize participants' general characteristics. Normality was assessed with the Shapiro–Wilk test.

Before the intervention, similarities between the experimental and control groups were analyzed using the independent t-test, the chi-square test, and the Fisher exact test. After the intervention, differences between the groups were assessed using the chi-square test, the independent t-test, and the Mann-Whitney U test. The significance level for evaluating the effectiveness of the IMB model–based self-management program for patients with lumbar spinal stenosis surgery was set at $p < .05$.

RESULTS

1. Homogeneity of General and Health Characteristics

A total of 58 participants were included in this study, with 30 in the experimental group and 28 in the control group. The mean age of participants was 66.79 ± 7.21 years, with the experimental group averaging 67.60 ± 6.76 years and the control group 65.93 ± 7.69 years.

The experimental group comprised 11 men (36.7%) and 19 women (63.3%), while the control group included 11 men (39.3%) and 17 women (60.7%). Alcohol consumption was reported by eight participants (26.7%) in the experimental group and 12 participants (42.9%) in the control group. Furthermore, 26 participants (86.7%) in the experimental group and 22 participants (78.6%) in the control group reported maintaining a non-smoking status. Two or fewer comorbidities were present in 25 participants (83.3%) in the experimental group and 18 participants (64.3%) in the control group.

To assess the homogeneity of general characteristics, the chi-square test or Fisher exact test was performed. The results indicated that there were no statistically significant differences between the two groups in terms of age, gender, marital status, family cohabitation, religion, education level, employment status, income level, alcohol consumption, smoking status, or number of comorbidities.

Therefore, the experimental and control groups were considered homogeneous in terms of their general characteristics (Table 2).

2. Homogeneity of Dependent Variables

To assess homogeneity of the dependent variables at baseline, the t-test and Mann-Whitney U test were conducted for each outcome variable, including self-management information, personal and social motivation, behavioral skills, self-management behavior, HRQoL, lower limb strength, pain VAS scores (low back and leg), intervertebral disc height, and lumbar lordosis angle. The results showed no statistically significant differences between the experimental and control groups for any variable, confirming that the two groups were comparable prior to the intervention (Table 3).

3. Comparison of Dependent Variables between the Experimental and Control Groups

Following the intervention, the experimental group demonstrated statistically significant improvements compared to the control group in self-management information ($p<.001$), personal and social motivation ($p=.002$), behavioral skills ($p=.002$), self-management behavior ($p=.003$), and HRQoL ($p<.001$). In addition, a significant increase in intervertebral disc height was observed ($p=.006$). However, no statistically significant differences were found between the groups in lower limb strength, pain VAS scores, or lumbar lordosis angle, although both groups exhibited within-group improvements in these variables (Table 4).

Table 2. Homogeneity of the Participants' General and Health Characteristics (*N*=58)

Characteristics	Categories	Exp. (n=30)	Con. (n=28)	χ^2 or Z	*p*
		n (%) or M±SD			
Age (year)†	50–59	3 (10.0)	5 (17.9)	0.80	.769
	60–69	16 (53.3)	14 (50.0)		
	≥70	11 (36.7)	9 (32.1)		
		67.60±6.76	65.93±7.69		
Sex	Male	11 (36.7)	11 (39.3)	0.04	.837
	Female	19 (63.3)	17 (60.7)		
Marital status†	Married	26 (86.7)	26 (92.9)	0.60	.671
	Single	4 (13.3)	2 (7.1)		
Living with†	Spouse	5 (16.7)	12 (42.9)	5.99	.116
	Family	17 (56.7)	9 (32.1)		
	Child	4 (13.3)	5 (17.9)		
	Alone	4 (13.3)	2 (7.1)		
Religion	Yes	20 (66.7)	16 (57.1)	0.56	.455
	No	10 (33.3)	12 (42.9)		
Education	≤Middle school	19 (63.4)	14 (50.0)	1.06	.306
	≥High school diploma	11 (36.6)	14 (50.0)		
Employed	Yes	12 (40.0)	10 (35.7)	0.11	.737
	No	18 (60.0)	18 (64.3)		
Income (10,000 won/months)	<200	20 (66.7)	13 (46.4)	2.42	.120
	≥200	10 (33.3)	15 (53.6)		
Alcohol	Yes	8 (26.7)	12 (42.9)	1.68	.195
	No	22 (73.3)	16 (57.1)		
Smoking†	Yes	4 (13.3)	6 (21.4)	0.67	.499
	No	26 (86.7)	22 (78.6)		
No. of comorbidities‡	≤2	25 (83.3)	18 (64.3)	2.70	.098
	≥3	5 (16.7)	10 (35.7)		

Con.=control group; Exp.=experimental group; M=mean; SD=standard deviation; †Fisher exact test; ‡Mann-Whitney U test.

https://doi.org/10.7475/kjan.2025.0331

Table 3. Homogeneity of Dependent Variables of Participants ($N=58$)

Variables	Exp. (n = 30)	Con. (n = 28)	t or Z	*p*
	n (%) or M ± SD			
Information†	9.00 ± 1.55	9.07 ± 2.43	−0.42	.678
Motivation				
Personal	3.37 ± 0.23	3.38 ± 0.32	−0.17	.865
Social	3.36 ± 0.73	3.53 ± 0.56	−0.98	.331
Behavioral skills	3.03 ± 0.76	2.85 ± 0.78	0.91	.368
Behaviors†	3.41 ± 0.62	3.26 ± 0.48	−0.51	.612
HRQoL†	0.53 ± 0.28	0.64 ± 0.21	−1.09	.276
Lower extremity muscular strength	41.98 ± 11.41	41.02 ± 9.42	0.35	.730
VAS score of LBP†	7.70 ± 0.84	7.54 ± 1.07	−0.20	.779
VAS score of leg pain†	5.17 ± 1.26	5.79 ± 1.55	−1.41	.147
Disc height†	0.56 ± 0.11	0.51 ± 0.13	−1.01	.315
Lumbar lordotic angle†	66.73 ± 5.95	62.36 ± 8.59	−1.87	.062

Con. = control group; Exp. = experimental group; HRQoL = health-related quality of life; LBP = low back pain; M = mean; SD = standard deviation; VAS = visual analog scale; †Mann-Whitney U test.

DISCUSSION

This study applied the IMB model proposed by Fisher and Fisher [10] to develop and implement a six-session self-management program for patients undergoing lumbar spinal stenosis surgery. The results demonstrated that patients who participated in the program showed greater improvements in self-management information, motivation, behavioral skills, self-management behaviors, HRQoL, and intervertebral disc height than those who did not participate.

The findings showed a significant increase in self-management information scores in the experimental group after the intervention. This is consistent with studies by Kang and Kim [23], who applied a knee osteoarthritis prevention program based on the IMB model, as well as Kim and Park [24], who studied self-management programs for patients. Tsamlag et al. [25] also identified improvement in information as a key factor for enhancing self-management behaviors in patients with osteoporosis. The increase in self-management information observed in this study is attributed to the use of easily understandable educational materials that incorporated images and illustrations explaining the definition, symptoms, and treatment process of lumbar spinal stenosis. Individualized education tailored to the participants' cognitive levels, along with repeated sessions that combined theory, practice, and demonstration, contributed to reinforcing and correcting prior misconceptions. Given that most patients with lumbar spinal stenosis are older adults with long-standing habits and beliefs, the provision of accurate and accessible information is essential for promoting spinal health and sustaining disease-related knowledge.

This study also confirmed a significant effect of the program on self-management motivation, particularly personal motivation, measured through health beliefs and attitudes. In this study, personal motivation was assessed based on participants' health beliefs and attitudes. The experimental group was encouraged to either write down or verbally express weekly self-management goals and actively work toward achieving them. This process of setting and accomplishing goals likely fostered a sense of achievement, which positively influenced participants' health beliefs and attitudes after surgery. Additionally, the intervention was paced according to each patient's readiness, and participants were guided to set realistic, personalized goals. These strategies contributed to enhancing motivation by promoting achievable progress tailored to each participant's condition.

Self-management behavioral skills (self-efficacy) in the experimental group also increased significantly after the intervention. This result is consistent with findings by Jeong and Lee [13], who focused on lumbar discectomy patients; Robinson [26], who studied patients with hepatitis C; and Ameri et al. [27], who examined patients with human immunodeficiency virus/acquired immune deficiency syndrome. The structured self-management program played a crucial role in enhancing self-efficacy by providing hands-on practice and continuous feedback, enabling patients to perform appropriate exercises. Kim and Hyun [28] similar-

Table 4. Comparison of Dependent Variables between the Experimental and Control Groups (*N*=58)

Variables	Categories		Pretest	Posttest	Differences	t or Z	*p*
			M±SD				
Information		Exp.	9.00±1.55	12.10±0.66	3.10±1.69	4.01	<.001
		Con.	9.07±2.43	9.68±1.39	0.61±2.60		
Motivation	Personal	Exp.	3.37±0.23	3.77±0.61	0.40±0.56	3.34	.002
		Con.	3.38±0.32	3.40±0.25	0.02±0.24		
	Social	Exp.	3.36±0.73	3.96±0.40	0.60±0.58	3.29	.002
		Con.	3.53±0.56	3.69±0.45	0.16±0.41		
Behavior skills†		Exp.	3.03±0.76	4.09±0.68	1.06±0.70	3.32	.002
		Con.	2.85±0.78	3.58±0.78	0.73±0.92		
Behaviors		Exp.	3.41±0.62	4.17±0.39	0.76±0.55	2.94	.003
		Con.	3.26±0.48	3.75±0.57	0.49±0.69		
HRQoL†		Exp.	0.53±0.28	0.92±0.09	0.39±0.29	3.79	<.001
		Con.	0.64±0.21	0.78±0.11	0.14±0.22		
Lower extremity muscular strength		Exp.	41.98±11.41	30.10±6.26	–11.89±9.83	–1.19	.239
		Con.	41.02±9.42	32.09±6.45	–8.93±9.03		
VAS score of LBP†		Exp.	7.70±0.84	2.33±0.76	-5.37±1.19	–1.55	.122
		Con.	7.54±1.07	2.82±1.06	–4.71±1.33		
VAS score of leg pain†		Exp.	5.17±1.26	2.47±0.78	–2.70±1.21	–1.96	.050
		Con.	5.79±1.55	2.32±0.91	–3.46±1.37		
Disc height†		Exp.	0.56±0.11	0.66±0.13	0.10±0.11	2.75	.006
		Con.	0.51±0.13	0.56±0.12	0.05±0.11		
Lumbar lordotic angle†		Exp.	66.73±5.95	67.51±7.13	0.59±6.35	–0.18	.858
		Con.	56.76±9.45	57.47±9.83	0.64±3.77		

Con.=control group; Exp.=experimental group; HRQoL=health-related quality of life; LBP=low back pain; M=mean; SD=standard deviation; VAS=visual analog scale; †Mann-Whitney U test.

ly reported that regular exercise enhances quality of life and psychological health, supporting the results of this study.

A significant increase in self-management behaviors was also observed in the experimental group after the intervention. These findings are in line with previous studies, including Jeong and Lee [13], Kim and Park [24], Ameri et al. [27], and Wu et al. [11]. The IMB model–based self-management program in this study effectively promoted positive changes in spinal health behaviors by providing self-management information, motivation, and self-efficacy improvement. These findings support the theoretical framework of the IMB model [10], which posits that health behavior change and maintenance are facilitated when individuals acquire sufficient knowledge, motivation, and behavioral skills.

Lower limb strength, assessed using the STS5 test, did not show a statistically significant change after the intervention. Although the STS5 time in the experimental group decreased, the difference was not sufficient to support the hypothesis. This finding contrasts with previous studies that reported improvements in STS5 performance following resistance exercise programs for orthopedic patients [29,30], but aligns with research involving older surgical patients who received minimal physical intervention [31,32]. Additional evidence suggests that strength training enhances balance and helps prevent pain in older adults [33]. The absence of a statistically significant improvement in this study may be related to age-related declines in muscle strength among patients with degenerative conditions such as lumbar spinal stenosis, which can lead to impaired balance and delayed sit-to-stand performance. These results underscore the need for ongoing physical activity and self-management to maintain functional mobility and prevent further deterioration.

Although VAS pain scores in the experimental group improved after the intervention, the difference did not reach statistical significance. Previous studies have reported reductions in low back pain through structured exercise programs for spinal surgery patients; however, this study did not include such targeted physical therapy components. Moreover, patients with lumbar spinal stenosis often expect complete relief from pain following surgery, yet persistent postoperative pain is common. This ongoing discomfort may influence patients' subjective perceptions of pain and negatively affect their quality of life. These factors may have contributed to the lack of statistically significant findings related to pain in this study.

A statistically significant improvement in HRQoL was observed in the experimental group. This result is consistent with those of Kim and Kim [12] and Kim et al. [34], supporting the IMB model's effectiveness in predicting behavioral changes related to disease prevention and improvements in HRQoL. In this study, sustained individualized education provided accurate disease information and goal-setting strategies, enabling participants to actively engage in self-care behaviors. However, as HRQoL is influenced by multiple factors, further interventions that enhance information, motivation, and behavioral skills should be explored [6].

This study also found a statistically significant increase in intervertebral disc height in the experimental group. This result is consistent with the findings of Cho et al. [5], who examined patients undergoing posterior lumbar interbody fusion surgery and found that disc height was maintained or increased postoperatively. Similarly, the study by Kim et al. [35] demonstrated changes in disc height among patients with degenerative spinal diseases, further supporting the results of this study. While improvements in disc-related outcomes were observed, the effects on functional and symptomatic indicators were less clear. Although the experimental group showed improvements in lower limb strength and pain scores, these changes did not reach statistical significance. This may be due to the lack of intensive physical interventions, such as repeated resistance training or lumbar strengthening exercises using assistive devices, which have shown effectiveness in previous studies involving older adults in Korea. Additionally, the lack of prior studies on self-management programs specifically designed for patients after lumbar spinal stenosis surgery limits direct comparisons.

The IMB model–based self-management program developed in this study has several distinct features. It was designed to address the increasing number of older adults with lumbar spinal stenosis and to facilitate behavioral changes and long-term self-management. The program emphasized postoperative self-management and provided individualized education to enhance learning.

Unlike general self-management programs that primarily aim to promote overall health, this program systematically guided behavioral changes through the IMB model by combining disease-related information, counseling, and repeated interventions. The effectiveness of the program was objectively verified by evaluating not only self-management adherence but also objective physiological indicators, such as lower limb strength, intervertebral disc height, and lumbar lordosis angle.

This study had several limitations. First, it utilized a convenience sample of patients admitted to the orthopedic ward of a general hospital in Busan, which limits the generalizability of the findings. Second, some participants were hospitalized in the ward where the researcher was employed, which may have introduced potential bias. However, participation decisions were made prior to hospitalization, and the self-management program commenced in the outpatient spinal center. Therefore, it was not possible to predict which participants would later be admitted to the researcher's ward. To minimize the risk of perceived coercion, informed consent was obtained, ensuring voluntary participation. Third, the intervention period was relatively short, restricting the ability to assess the long-term effects of the self-management program. Fourth, the study sample included only patients who had undergone surgery for lumbar spinal stenosis, thereby limiting the applicability of the findings to non-surgical populations. Fifth, no statistically significant improvements were observed in physiological indicators such as lower limb strength and functional movement. This may be attributed to age-related physical limitations and the absence of structured physical training within the intervention.

Future research should assess the long-term effects of self-management behaviors and consider developing similar interventions for non-surgical patients with lumbar spinal stenosis. As decreased muscle strength in older adults may pose a potential risk, further studies are also needed to examine the effectiveness of self-management programs in improving lower limb strength and functional mobility.

CONCLUSION

This study implemented a six-session self-management program based on the IMB model for patients undergoing lumbar spinal stenosis surgery and confirmed its effectiveness. The program significantly improved self-management information, motivation, behavioral skills, self-management behaviors, HRQoL, and intervertebral disc height in the experimental group.

Following the program, participants demonstrated behavioral changes such as posture correction, brace management, regular exercise, and lifestyle modifications. Furthermore, repeated education and demonstrations played a key role in enhancing learning outcomes and patient satisfaction.

The IMB model-based self-management program developed in this study could serve as an effective nursing intervention to improve the HRQoL of patients undergoing lumbar spinal stenosis surgery by integrating information, motivation, and behavioral skill strategies to promote sustainable self-management behaviors.

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

Study conception and/or design acquisition - GYC and MKS; analysis and interpretation of the data - MKS; interpretation of the data - MKS; drafting or critical revision of the manuscript for important intellectual content - GYC and MKS.

FUNDING

None.

ACKNOWLEDGEMENT

This article is a revision of the Mi Kyung Seo's doctoral dissertation from Pukyong National University.

DATA AVAILABILITY STATEMENT

The data can be obtained from the corresponding authors.

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ORIGINAL ARTICLE

Korean J Adult Nurs Vol. 37 No. 3, 321-331, August 2025
eISSN: 2288-338X
https://doi.org/10.7475/kjan.2025.0421

KJAN
Korean Journal of
Adult Nursing

Influence of Cognitive Function, Health Literacy, and Social Support on the Risk of Self-Care Non-Adherence in Older Adults with Chronic Kidney Disease: A Descriptive Survey Study

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Received: April 21, 2025
Revised: June 6, 2025
Accepted: July 30, 2025

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Purpose: This study examined the effects of cognitive function, health literacy, and social support influence the risk of self-care non-adherence among older adults with chronic kidney disease. **Methods:** A cross-sectional survey was conducted using structured questionnaires. The study included 105 older adults (≥65 years) in the pre-dialysis stage, all of whom were receiving regular follow-up at a nephrology outpatient clinic in Jeonju, Jeollabuk-do, Korea. Data were collected through one-on-one interviews from April to May 2024 and analyzed using SPSS version 26.0. Predictive factors were assessed using hierarchical multiple regression analysis. **Results:** The risk of self-care non-adherence was significantly correlated with cognitive impairment ($r=.61$, $p<.001$), lower social support from healthcare providers ($r=-.36$, $p<.001$), and reduced health literacy ($r=-.42$, $p<.001$). Multiple regression analysis indicated that decreased physical activity ($\beta=.25$, $p=.002$), greater cognitive impairment ($\beta=.29$, $p<.001$), and lower support from healthcare providers ($\beta=-.26$, $p=.008$) were significant predictors of increased risk of self-care non-adherence. The model explained 46% of the variance in the risk of self-care non-adherence. In contrast, family support and health literacy were not significant predictors. **Conclusion:** To reduce the risk of self-care non-adherence in older adults with chronic kidney disease, routine cognitive screening and tailored education for those with cognitive impairment should be implemented in outpatient care. Promoting physical activity and strengthening support from healthcare providers are also key strategies to improve adherence in this population.

Key Words: Chronic kidney disease; Cognitive function; Social support; Health literacy; Self-care

INTRODUCTION

In Korea, the prevalence of chronic kidney disease (CKD) among adults reached 7.6% in 2022, but increased sharply to 21.6% among those aged 70 years and older, reflecting a rapidly aging population [1]. Over the past decade, both the number of CKD patients receiving medical care and the associated healthcare expenditures have grown substantially, establishing CKD as one of the most financially burdensome chronic conditions [2].

CKD is defined by the presence of structural or functional abnormalities of the kidney regardless of glomerular filtration rate (GFR), or a GFR <60 mL/min/1.73 m^2 persisting for more than three months [3]. However, CKD often lacks specific symptoms until advanced stages and is frequently perceived only as a complication of diabetes or hypertension, resulting in low awareness and inadequate preventive care [4]. In Korea, the number of patients progressing to end-stage kidney disease requiring dialysis doubled from 9,335 in 2010 to 18,598 in 2022, with 59% of these patients aged 65 years or older. The proportion of older adults undergoing dialysis has exceeded 50% since 2018, reaching 59.8% in 2022 [1]. Compared to younger populations, older adults face a disproportionate burden of kidney disease and related conditions, including multiple comorbidities, physical frailty, and geriatric syndromes [5].

Patients with CKD require active management to preserve kidney function, slow disease progression, and lower the risk of cardiovascular complications [6]. When kidney function declines to the point of requiring hemodialysis, patients experience increased rates of depression, anxiety, and reduced quality of life. Hemodialysis is also associated with a variety of physical symptoms, such as fatigue, anorexia, anemia, hypotension, and fluid overload [7]. Therefore, it is critical to prioritize appropriate management and preventive strategies for CKD patients who have not yet begun dialysis.

Effective chronic disease management requires active patient engagement in maintaining, monitoring, and managing their condition [8]. Self-care adherence is a key factor in reducing hospital readmissions and mortality rates [9]. However, a study of CKD patients receiving hemodialysis found only moderate levels of self-care adherence (ranging from 3.30 to 3.61 on a 5-point scale) across various behaviors, including dietary control, vascular care, exercise and rest, medication intake, blood pressure and weight monitoring, and physical care [10,11]. Self-care behaviors are shaped by individual experiences, skills, motivation, cultural beliefs and values, confidence, and healthcare accessibility—all of which can promote or impede adherence [12].

Previous studies have shown that cognitive impairment in CKD patients can affect their decision-making ability regarding self-care adherence [13,14]. As kidney function deteriorates, increasing toxin levels in the blood may impair brain function. Furthermore, CKD patients are at elevated risk for cerebrovascular diseases, which may contribute to cognitive decline [15]. CKD is considered a disease of accelerated aging and is associated with decreased physical and cognitive function, increased risk of falls and fractures, reduced quality of life, appetite loss, and chronic inflammation [16]. Accordingly, it is important to assess cognitive function in addition to kidney function and to develop tailored management strategies.

Health literacy also plays a crucial role in the management of CKD. According to previous studies, lower health literacy has been associated with poorer clinical outcomes, increased hospital admissions, and higher emergency department utilization [15]. Among older adults, poor health literacy is linked with worse clinical outcomes due to difficulties accessing and understanding medical information, which ultimately hinders disease and self-management [10]. Social support—particularly from family and healthcare providers—has been identified as a key factor influencing self-care adherence [17]. Positive relationships with family and healthcare providers enhance patients' role performance and self-care behaviors. Hemodialysis patients with strong family support demonstrate higher self-efficacy, quality of life, self-esteem, and role performance [10,17].

The term "adherence" refers to compliance with a prescribed treatment plan, whereas "non-adherence" denotes failure to follow it [18]. Delaying CKD progression requires both pharmacological treatment and risk factor management [6]. Thus, it is necessary to evaluate the risk of self-care non-adherence comprehensively, considering not only the extent of self-care behaviors but also factors such as cognitive function, health literacy, physical functioning, access to care, social support, motivation, and confidence [18]. Ongoing attention and interventions are needed to prevent non-adherence and to improve self-care adherence.

As the population continues to age and chronic diseases become more prevalent, the number of patients with CKD is expected to rise. While many studies have investigated self-care in dialysis patients, few have examined factors influencing self-care non-adherence specifically among older adults with pre-dialysis CKD. In light of this gap, the present study aimed to examine how cognitive function, health literacy, and social support from family and healthcare providers affect the risk of self-care non-adherence in older adults with pre-dialysis CKD, by assessing the levels of these factors and analyzing their impact. These findings may serve as foundational data for developing educational programs and practical interventions in outpatient and inpatient settings to help delay disease progression in this population.

METHODS

1. Study Design

This descriptive survey study investigated the effects of cognitive function, health literacy, and social support on the risk of self-care non-adherence in older adults with CKD. The study is reported in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines (http://www.strobe-statement.org).

2. Setting and Samples

The study included older adults (aged 65 years and older) diagnosed with CKD who had not yet progressed to the end stage requiring dialysis. Participants were recruited either during outpatient follow-up visits or while receiving inpatient treatment at the nephrology department of a tertiary university hospital in J Province, Korea. Inclusion criteria were a diagnosis of CKD, prescription of medication for symptom management, age 65 years or older, voluntary provision of informed consent, and the ability to communicate verbally and understand questionnaires. Exclusion criteria included a diagnosis of depression or dementia and receiving renal replacement therapy such as hemodialysis or peritoneal dialysis.

The minimum sample size was calculated using G*Power version 3.0, with an alpha level of .05, power of 0.95, and an effect size (f^2) of 0.35 based on a previous study by Kwon [17]. Thirteen explanatory variables were included, consisting of demographic and clinical characteristics shown to be significant in prior research—such as age, sex, education level, marital status, presence of a primary caregiver, duration of CKD, hypertension, diabetes, and exercise—along with study-specific variables including cognitive function, health literacy, and social support from family and healthcare providers. Based on this calculation, a minimum of 88 participants was required. To account for a potential 20% dropout rate, a total of 110 participants were recruited. Questionnaires were administered directly by the researcher and were either self-completed or read aloud when necessary. After excluding five incomplete questionnaires due to unanswered items or discontinuation because of health conditions, 105 fully completed questionnaires were included in the final analysis.

3. Instruments

1) General and disease-related characteristics

General characteristics, such as sex, age, marital status, religion, education level, employment status, economic status, cohabitation with family members, presence of a caregiver, smoking and drinking habits, and exercise routine, as well as disease-related factors, including comorbidities, number of medications, hospitalization history, disease duration, and perceived health status, were collected from electronic medical records and a structured questionnaire.

2) Cognitive function

Cognitive function was assessed using the Korean Dementia Screening Questionnaire-C (KDSQ-C), developed by Yang et al. [19] for the early detection of dementia in older adults and designed to be unaffected by age, sex, or education. Permission was obtained from the original authors. The KDSQ-C assesses community-dwelling older adults with 15 items: five on memory, five on language ability, and five on the performance of complex tasks. Each item is rated on a 3-point scale: “not at all” (0 points), “sometimes” (1 point), and “often” (2 points), yielding a total score between 0 and 30. A score less than six was considered normal, while a score of six or higher indicated possible cognitive impairment. The original instrument’s reliability was shown by a Cronbach’s $\alpha = .81$; in this study, it was .85.

3) Health literacy

Health literacy was evaluated using the Short Form of the Korean Functional Health Literacy Test (S-KFHLT), developed by Kim [20] for older adults. The S-KFHLT includes eight items: four assessing reading comprehension and four assessing numeracy. Each correct answer receives 1 point, and each incorrect answer receives 0, resulting in a total score from 0 to 8, with higher scores indicating greater health literacy. The original KR-20 measure for internal consistency was .84; in this study, it was .74.

4) Social support

Social support was measured in two domains: family support and healthcare provider support. The original tool was developed by Kim [21] and revised and expanded by Sim [22] to assess social support from both family and healthcare providers. Family support was measured with 12 items on a 5-point Likert scale from “strongly disagree” (1) to “strongly agree” (5), with higher scores reflecting greater family support. Cronbach’s α was .94 in the original and .93 in this study. Healthcare provider support was assessed using nine items on the same Likert scale, with higher scores indicating greater support from healthcare professionals.

Cronbach's α was .91 in the original and .86 in this study.

5) Risk of self-care non-adherence

Risk of self-care non-adherence was measured using a tool developed by Jo and Oh [18] for individuals with two or more chronic conditions, used here with the original authors' permission. The tool includes 18 items based on six factors: knowledge and skills, physical functioning, access to care, social support, motivation, and confidence. Each item was rated on a 5-point Likert scale: "not at all" (1), "mostly no" (2), "neutral" (3), "mostly yes" (4), and "very much so" (5). The total score ranges from 18 to 90, with higher scores indicating a greater risk of self-care non-adherence. Twelve of the items are reverse-scored and were recoded accordingly. Cronbach's α for the original subdomains ranged from .65 to .81; in this study, overall reliability was shown by a Cronbach's α value of .89.

4. Data Collection Procedures

Data were collected from April 5 to May 30, 2024. After formal approval from both the nursing and nephrology departments of the participating tertiary hospital, the researcher (a geriatric nurse specialist) met with participants individually in outpatient consultation rooms or nephrology ward counseling areas to explain the study's purpose and procedures. Participants were recruited by convenience sampling, with the researcher screening outpatient clinic patients according to predefined criteria and inviting eligible individuals to participate. Those diagnosed with dementia were excluded, but individuals with mild or undiagnosed cognitive decline were included if judged capable of understanding and consenting. If participants had difficulty responding, the researcher read the questionnaire aloud and completed it on their behalf, repeating questions as needed. All participants completed the questionnaire either independently or with assistance. The researcher collected the completed questionnaires, with an average response time of approximately 25 minutes.

5. Ethical Considerations

This study was approved by the Institutional Review Board (IRB) for Biomedical Research, Jeonbuk National University Hospital (IRB No. 2024-02-020-005). Participants were given sufficient time to decide about participation, and written informed consent was obtained from those who agreed. The researcher explained the study's purpose and procedures, potential risks or discomforts, anticipated benefits, voluntary participation, the right to withdraw at any time, and data confidentiality. Personally identifiable information was kept confidential, and unique identification codes were assigned to each participant. All data were securely stored in a locked location and will be retained for three years before being destroyed. Given that participants were older adults who might have diminished cognitive or decision-making capacity, the researcher assessed each participant's ability to provide informed consent; if necessary, written consent from a legal representative was obtained in addition to the participant's own assent.

6. Data Analysis

Data analysis was performed using IBM SPSS version 26.0 (IBM Corp., Armonk, NY, USA), with statistical significance set at $p < .05$. Descriptive statistics (mean, standard deviation, frequencies, and percentages) were used to summarize general characteristics and main study variables. Differences in cognitive function, health literacy, and social support according to general characteristics were analyzed using the independent t-test and analysis of variance, with post hoc comparisons conducted using the Games–Howell method. Pearson's correlation coefficients were calculated to assess relationships among general characteristics, cognitive function, health literacy, and social support. Hierarchical multiple regression analysis was used to identify factors influencing the risk of self-care non-adherence.

RESULTS

1. General Characteristics of Participants

The mean age of participants was 75.7±7.1 years, and 63 participants (60.0%) were male. A majority of participants (n=83, 79.0%) was married. Of the participants, 65 (61.9%) had a middle school education or less, and 92 (87.6%) were unemployed. Most participants (n=80, 76.2%) rated their economic status as "moderate," and 76 participants (72.4%) lived with a spouse. Fourteen participants (13.3%) were current smokers, with an average smoking duration of 38.6±14.1 years. Nineteen participants (18.1%) reported alcohol consumption, with an average drinking duration of 31.6±14.6 years. Nearly half of the participants (n=52,

https://doi.org/10.7475/kjan.2025.0421

49.5%) reported engaging in regular exercise (Table 1).

2. Disease-Related Characteristics and Research Variables

The mean duration since CKD diagnosis was 59.4±68.64 months. Most participants (98.1%) had comorbidities, with hypertension (80.0%) and diabetes (65.7%) being the most prevalent. Regarding CKD stage, 40 participants (38.1%) were in stage 2 and 45 (42.9%) were in stage 3, together comprising 80.9% of the sample. A total of 44.8% reported a history of hospitalization, with 42.9% citing kidney failure as the reason for admission (Table 2). Suspected cognitive impairment, defined as a score ≥6 on the KDSQ-C, was observed in 43.8% of participants. The average family support score was 51.03±11.27 out of a maximum possible score of 60, and the average healthcare provider support score was 39.96±6.16 out of 45. Health literacy, measured by the S-KFHLT, had a mean score of 4.15±2.09 out of 8. The mean score for risk of self-care non-adherence was 39.76±15.45 out of a possible 90 (Table 2).

Table 1. General Characteristics of Study Participants (N=105)

Variables	Categories	n (%) or M±SD
Age (year)		75.7±7.1
	65–75	52 (49.5)
	75–94	53 (50.5)
Sex	Male	63 (60.0)
	Female	42 (40.0)
Marital status	Married	83 (79.0)
	Single/divorced/bereaved	22 (21.0)
Education level	≤Middle school	65 (61.9)
	High school	26 (24.8)
	≥College	14 (13.3)
Employed	Yes	13 (12.4)
	No	92 (87.6)
Economic status	Middle	80 (76.2)
	Low	25 (23.8)
Living with	Spouse	76 (72.4)
	Alone	18 (17.1)
	Children	10 (9.5)
	Caregiver	1 (1.0)
Current smoking	Yes	14 (13.3)
	No	91 (86.7)
Alcohol drinking	Yes	19 (18.1)
	No	86 (81.9)
Regular exercise	Yes	52 (49.5)
	No	53 (50.5)

M=mean; SD=standard deviation.

3. Differences in the Risk of Non-Adherence to Self-Care by Participants' Characteristics and Cognitive Function

Significant differences in self-care non-adherence risk scores were found according to sex, marital status, education level, employment status, perceived economic status, living with family members, alcohol consumption, regular exercise, and cognitive function (Table 3). Female participants had significantly higher risk scores than males (t=–2.29, p=.024). Those who were single, divorced, or widowed had higher risk scores than married participants (t=–2.33, p=.022). Education level showed significant differences (F=15.17, p<.001), with post hoc Games–Howell tests indicating that participants with only middle or high school education had significantly higher risk scores than those with college education or higher. Unemployed participants had significantly higher risk scores than those who were employed (t=–2.80, p=.011). Participants with lower perceived economic status had significantly higher risk scores compared to those reporting moderate status (t=–2.53, p=.013). Those living with a spouse had significantly lower risk scores than those living with children, caregivers, or living alone (F=4.46, p=.025), with post hoc analysis confirming these differences. Participants who did not consume alcohol had significantly higher risk scores than those who did (t=–3.13, p=.003). Those who did not exercise regularly had significantly higher risk scores than those who did (t=–3.87, p<.001). Participants with suspected cognitive impairment (≥6 points on the KDSQ-C) had significantly higher risk scores than those with normal cognitive function (<6 points) (t=–6.65, p<.001) (Table 3).

4. Correlations among Research Variables

The risk of self-care non-adherence was positively correlated with cognitive impairment (r=.61, p<.001), and negatively correlated with family support (r=–.32, p=.001), healthcare provider support (r=–.36, p<.001), and health literacy (r=–.42, p<.001) (Table 4).

5. Factors Influencing Risk of Self-care Non-adherence

To identify factors influencing the risk of self-care non-adherence, hierarchical multiple regression analysis was performed. Variables were entered in two steps, based on theoretical and empirical rationale. In Step 1, general characteristics significantly associated with the dependent vari-

Table 2. Clinical Characteristics of Study Participants and Research Variables (*N*=105)

Variables	Categories	n (%) or M ± SD	Actual range	Possible range
Comorbidities	Yes[†]	103 (98.1)		
	Hypertension	84 (80.0)		
	Diabetes	69 (65.7)		
	Hyperlipidemia	39 (37.1)		
	Angina pectoris	11 (10.5)		
	Myocardial infarction	11 (10.5)		
	Heart failure	12 (11.4)		
	Cardiovascular	28 (26.7)		
	Cerebrovascular	17 (16.2)		
	Others	14 (13.3)		
	No	2 (1.9)		
Period after CKD diagnosis (month)		59.4 ± 68.64		
CKD stage	II	40 (38.1)		
	III	45 (42.9)		
	IV	10 (9.5)		
	V	10 (9.5)		
Hospitalization in the past year	Yes	47 (44.8)		
	Kidney problem	20 (42.6)		
	Others	27 (57.4)		
Perceived health status	Poor	43 (41.0)		
	Fair	51 (48.6)		
	Good	11 (10.5)		
Cognitive function	Normal <6	59 (56.2)	0–23	0–30
	Impaired ≥6	46 (43.8)		
Social support	Family support	51.03 ± 11.27	12–60	12–60
	Healthcare provider support	39.96 ± 6.16	21–45	9–45
Health literacy		4.15 ± 2.09	0–8	0–8
Risk of non-adherence to self-care		39.76 ± 15.42	18–82	18–90

CKD = chronic kidney disease; M = mean; SD = standard deviation; [†]Multiple responses.

able in bivariate analysis (sex, marital status, education level, employment status, perceived economic status, living with family members, alcohol consumption, and exercise) were included as control variables, in line with previous studies on self-care behaviors. In Step 2, key psychosocial variables—cognitive function, social support, and health literacy—were added, as these were central to the study's conceptual framework and showed significant correlations.

Assumption testing confirmed model adequacy (Durbin-Watson = 1.759; all variance inflation factors < 5; residuals were normally distributed and homoscedastic). Model 1 was significant (F = 6.85, $p < .001$), with an adjusted R^2 of .31. A higher risk of self-care non-adherence was observed among those with lower education, unemployment, low economic status, no alcohol consumption, and lack of regular exercise. In Model 2, the addition of the main study variables increased explanatory power to 46% (F = 7.83, $p < .001$). Significant predictors in the final model included lack of regular exercise ($\beta = .25$, $p = .002$), impaired cognitive function ($\beta = .29$, $p < .001$), and lower support from healthcare providers ($\beta = -.26$, $p = .008$) (Table 5).

DISCUSSION

This study aimed to examine levels of cognitive function, health literacy, and social support among older adults with CKD who had not yet initiated dialysis, and to analyze how these factors influenced the risk of self-care non-adherence. The discussion is organized around the major findings of the study. In terms of disease-related characteristics, 80.9% of participants were in CKD stages 2 or 3, and 98.1% had at least one comorbidity. Notably, hypertension (80.0%) and diabetes (65.7%) were highly prevalent, supporting the idea that diabetic nephropathy and hyperten-

Table 3. Differences in the Risk of Non-Adherence to Self-Care by Study Participants' Characteristics and Cognitive Function ($N=105$)

Variables	Categories	M ± SD	t or F	*p*
Age (year)	65–75	36.96 ± 13.95	−1.86	.065
	75–94	42.51 ± 46.45		
Sex	Male	37.00 ± 14.85	−2.29	.024
	Female	43.90 ± 15.56		
Marital status	Married	37.99 ± 14.59	−2.33	.022
	Single/divorced/bereaved	46.45 ± 17.05		
Education level	≤ Middle school^a	41.80 ± 15.29	15.17	< .001†
	High school^b	41.58 ± 15.98		a, b > c
	≥ College^c	26.93 ± 7.93		
Occupation	Yes	32.00 ± 9.77	−2.80	.011
	No	40.86 ± 15.82		
Economic status	Middle	37.69 ± 14.33	−2.53	.013
	Low	46.40 ± 17.24		
Living with	Spouse	37.03 ± 13.60	4.46	.025†
	Children	49.10 ± 13.74		
	Caregiver or single	45.79 ± 19.87		
Smoking	Yes	42.07 ± 14.43	0.60	.550
	No	39.41 ± 15.19		
Alcohol drinking	Yes	32.21 ± 10.44	−3.13	.003
	No	41.43 ± 15.91		
Regular exercise	Yes	34.23 ± 13.74	−3.87	< .001
	No	45.19 ± 15.21		
Cognitive function	Normal < 6	34.32 ± 10.43	−6.65	< .001
	Impaired ≥ 6	49.30 ± 15.67		

M = mean; SD = standard deviation; †Welch's robust analysis of variance was used and post hoc analysis of the variables were analyzed by Games–Howell.

Table 4. Correlations among Research Variables ($N=105$)

Variables	Cognitive function	Family support	Healthcare provider support	Health literacy	Risk of self-care non-adherence
			r (*p*)		
Cognitive function	1				
Family support	−.16 (.096)	1			
Healthcare provider support	−.09 (.338)	.59 (< .001)	1		
Health literacy	−.45 (< .001)	.04 (.724)	.11 (.263)	1	
Risk of self-care non-adherence	.61 (< .001)	−.32 (.001)	−.36 (< .001)	−.42 (< .001)	1

sion-related renal damage are major causes of CKD in older adults [23]. Previous international studies have also demonstrated that advanced stages of CKD are associated with higher readmission rates, primarily due to cardiovascular complications and acute kidney injury [24]. As such, the high prevalence of comorbidities, including cardiovascular risk factors, underscores the need for systematic management to prevent CKD progression.

Hierarchical regression analysis was conducted to identify factors affecting the risk of self-care non-adherence. In the first step of the model, lower educational attainment, unemployment, lower economic status, absence of alcohol consumption, and lack of regular exercise were associated with higher risk of self-care non-adherence. Specifically, individuals with only a high school education or less exhibited a greater risk of non-adherence, consistent with prior research indicating that higher education is associated with better self-care capacity in chronic conditions [25]. Higher education is typically linked to better disease awareness and health knowledge, which can positively influence self-

Table 5. Factors Influencing Risk of Self-Care Non-Adherence ($N=105$)

Variables	Model 1						Model 2					
	B	SE	95% CI	β	t	*p*	B	SE	95% CI	β	t	*p*
(Constant)	10.32	5.43	−0.42 to 21.11		1.92	< .001	53.07	10.88	8.57 to 34.56		4.70	< .001
Female (ref: male)	1.87	3.01	−3.56 to −8.20	.06	0.62	.536	0.33	2.69	−3.20 to 7.33	.01	0.12	.903
Marital status (ref: married)	2.42	5.88	−0.08 to 13.45	.06	0.41	.682	1.48	5.26	−2.74 to 9.63	.04	0.28	.779
≤ High school (ref: ≥ college)	8.47	3.95	0.67 to 16.37	.19	2.14	.035	2.33	3.75	−4.49 to 10.48	.05	0.62	.536
Not employed (ref: yes)	7.89	3.88	0.21 to 15.60	.17	2.03	.045	5.15	3.60	−3.60 to 10.63	.11	1.43	.156
Low economic status (ref: middle)	7.32	3.18	2.06 to 14.15	.20	2.30	.023	3.99	3.05	−2.07 to 10.05	.11	1.31	.195
Living with (ref: spouse)	4.80	5.38	3.02 to 8.20	.14	0.89	.375	2.10	4.91	−7.64 to 11.85	.06	0.43	.669
No drinking (ref: yes)	7.39	3.44	0.46 to 14.01	.19	2.15	.034	4.49	3.08	−1.52 to 10.82	.11	1.46	.149
No exercise (ref: yes)	9.54	2.59	4.51 to 14.77	.31	3.68	< .001	7.76	2.42	2.95 to 12.56	.25	3.20	.002
Cognitive function ≥ 6 (ref: normal < 6)							9.01	2.75	0.60 to 1.67	.29	3.28	< .001
Family support							−0.03	0.13	−0.29 to 0.23	−.02	−0.24	.810
Healthcare provider support							−0.64	0.24	−1.11 to −0.16	−.26	−2.69	.008
Health literacy							−1.00	0.64	−2.25 to 0.29	−.14	−1.56	.123
Adjusted R^2	.31						.46					
ΔR^2							.15					
F value (*p*)	6.85 (< .001)						7.83 (< .001)					

CI = confidence interval; SE = standard error.

care behaviors. Therefore, when implementing nursing interventions to reduce self-care non-adherence, it is essential to provide tailored educational programs that account for patients' educational backgrounds. Additionally, 87.6% of participants were unemployed, most likely reflecting their age and retirement status. The loss of social roles following retirement can lead to reduced social engagement and increased isolation, which in turn may lower motivation for self-care [26]. This highlights the importance of assessing social networks in older CKD patients and implementing strategies to strengthen emotional support. Interestingly, individuals who did not consume alcohol showed a higher risk of self-care non-adherence, which may reflect a subgroup who were advised to abstain for health reasons. Furthermore, self-reported questionnaires introduce the possibility that participants underreported actual alcohol consumption. Future research using larger samples, objective measures, or longitudinal designs should address these limitations.

In the second step of the hierarchical regression, when the main study variables—cognitive function, health literacy, and social support—were included, the explanatory power of demographic variables diminished. This suggests that core variables such as cognitive function play a more substantial role in predicting self-care non-adherence. Thus, intervention strategies should focus primarily on modifiable factors, such as promoting exercise, compensating for cognitive impairment, and enhancing social support from healthcare professionals, rather than on relatively immutable demographic characteristics.

Cognitive function emerged as the most influential factor increasing the risk of self-care non-adherence in the final regression model. Assessment results showed that 43.8% of participants were possibly cognitively impaired. This finding is consistent with previous research demonstrating a significant relationship between cognitive function and self-care among older adults with hypertension [27], and it reflects the higher prevalence of cognitive impairment in older adults with kidney disease. CKD can contribute to cognitive decline through the accumulation of toxins in the blood resulting from reduced kidney function, thereby hindering self-care [27]. Therefore, it is important to assess cognitive function and provide personalized education and interventions based on patients' cognitive status to reduce the risk of self-care non-adherence in older adults with CKD. This study suggests that nursing interventions such as tailored education using visual aids and repeated sessions, provision of medication management checklists, and shared decision-making involving healthcare professionals and family members may be effective strategies to enhance self-care adherence in this population. Although individuals formally diagnosed with dementia were excluded and interviews were conducted one-on-one, a substantial proportion of older participants (mean age, 76 years) exhibited cognitive decline, which may have influenced the findings. Thus, further research is needed to validate these results.

Regular exercise was also identified as a key factor in reducing the risk of self-care non-adherence. Lack of exercise was associated with increased risk, which aligns with prior research showing that physical activity promotes self-care behaviors in older adults with hypertension and diabetes [28,29]. Moreover, exercise interventions in pre-dialysis CKD patients have demonstrated significant benefits in improving GFR and preventing deterioration of renal function [30]. Thus, assessing exercise habits should be a central part of self-care risk evaluation, and strategies to promote physical activity are necessary.

Social support, especially from healthcare professionals, was found to be a significant factor in reducing the risk of self-care non-adherence. Lack of professional support increased the risk of non-adherence, consistent with previous findings that information and guidance from healthcare providers positively influence patients' role performance and engagement in care [31]. The active involvement and regular counseling provided by healthcare professionals play a critical role in promoting adherence to self-care behaviors among older adults with CKD.

However, in this study, health literacy did not significantly affect the risk of self-care non-adherence. This finding differs from previous systematic reviews and survey studies on patients with CKD, which have identified low health literacy as a negative factor influencing self-care adherence [15]. One possible explanation is that participants in this study were older adults, and health literacy showed a moderate negative correlation with cognitive function ($r=.45$). Although no multicollinearity was detected, as both variables were included in the regression model, their overlapping influence may have affected the results. Future studies should include replication with older populations with CKD and comparative studies focusing on patients with normal cognitive function to better understand the impact of health literacy on self-care non-adherence.

In this study, only social support from healthcare providers was significantly associated with the risk of self-care non-adherence, whereas family support was not. This finding contrasts with previous research indicating that patients who receive higher levels of family support demonstrate better adherence to self-care [31]. One possible explanation for this discrepancy may be related to the characteristics of the study population, who were generally in relatively stable health, able to live independently, and capable of attending outpatient visits. These factors may have reduced their reliance on family support. Additionally, emotional or physical distance from family members other than a spouse could have contributed to the diminished influence of family support. This interpretation is supported by a qualitative study suggesting that, among patients with relatively stable health, the relationship with healthcare providers plays a more critical role in self-care adherence [32]. Nevertheless, the present study also emphasizes the importance of involving family members in the decision-making process for older adults with CKD.

Based on these findings, there is a clear need for policy-level strategies to support early detection and effective management of older adults with CKD. Specifically, integrating community-based resources, expanding health insurance coverage for education and counseling services, and strengthening collaboration with primary care providers should be considered as part of a comprehensive policy approach.

This study has several limitations. First, as the research was conducted at a single institution, the generalizability of the findings is limited. Second, the use of a cross-sectional design and self-reported questionnaires introduces potential recall bias and limits the ability to establish causal relationships among the variables. Third, although participants with a formal diagnosis of dementia were excluded, formal cognitive screening tools were not used during participant selection. Notably, 43.6% of participants scored low enough to raise concerns about potential cognitive impairment, suggesting that the accuracy of some self-reported data may have been compromised. Despite these limitations, this study is meaningful in that it identifies key factors associated with self-care non-adherence and highlights the importance of early screening to support self-care behaviors in older adults with CKD.

CONCLUSION

This study identified greater cognitive impairment, lack of regular exercise, and insufficient support from healthcare providers as key predictors of an increased risk of self-care non-adherence among older pre-dialysis adults with CKD. Therefore, before the disease progresses to the stage requiring dialysis, it is crucial to identify individuals at high risk of self-care non-adherence by assessing cognitive function early, providing personalized education, developing programs to encourage physical activity, and strengthening emotional

https://doi.org/10.7475/kjan.2025.0421

and informational support from healthcare providers. Future studies should employ longitudinal designs to objectively assess the risk of self-care non-adherence and to evaluate the effectiveness of tailored interventions aimed at mitigating this risk and improving patient outcomes.

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

Study conception and design - JYS and SYH; supervision - SYH; data collection and processing - JYS; analysis and interpretation - JYS and SYH; drafting and critical revision of the manuscript - JYS and SYH.

FUNDING

None.

ACKNOWLEDGEMENT

This article is partial excerpt from the Ji-Yeon Seo's master thesis from Hanyang university graduate school.

DATA AVAILABILITY STATEMENT

The data can be obtained from the corresponding authors.

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ORIGINAL ARTICLE

Korean J Adult Nurs Vol. 37 No. 3, 332-343, August 2025
eISSN: 2288-338X
https://doi.org/10.7475/kjan.2025.0422

KJAN
Korean Journal of
Adult Nursing

The Role of Inner Strength in Korean Colorectal Cancer Survivors on the Journey from Treatment to New Normal: A Qualitative Study

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Received: April 22, 2025
Revised: June 18, 2025
Accepted: July 30, 2025

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Purpose: Colorectal cancer (CRC) survivors face significant challenges after completing treatment, including returning to work, concerns about the future, and financial difficulties. Understanding how inner strength developed after treatment affects survivors' lives is crucial for informing patient-centered care. This study explored the unique inner strength exhibited by CRC survivors during their transition to a "new normal." **Methods:** We recruited 16 patients from Korea who had completed treatment, to explore their experiences of managing their health. We conducted a qualitative study from July 4, 2022 to July 25, 2022 using individual interviews and directed content analysis. Transcribed interview data were analyzed to interpret meaning from the data, consistent with the naturalistic paradigm. **Results:** Participants described their transition to a new normal by reframing the cancer experience, struggling to return to normal life, experiencing growth promoted by supportive relationships, and encountering both positive and negative life changes. Throughout these experiences as survivors, inner strength played a critical role in adapting to a new normal. **Conclusion:** Our findings suggest that inner strength serves as a dynamic psychological resource, enabling CRC survivors to reframe their illness, regain disrupted roles, and reconstruct a meaningful life despite ongoing physical and emotional challenges. In doing so, inner strength facilitates their adaptation to a new normal.

Key Words: Colorectal neoplasms; Qualitative research; Quality of life; Cancer survivors

INTRODUCTION

Unlike other illnesses, cancer leads to profound changes in one's life, making a full return to pre-cancer existence ultimately unattainable. Consequently, survivors must forge new lives or adapt to changed circumstances, a process often defined as achieving a "new normal" [1-3]. The term "new normal" refers to the standards that arise in response to changing times and contexts. Within this framework, life events and adaptive processes can be understood through the theory of inner strength, which posits that inner strength enables individuals to achieve a new normal and, in turn, influences their quality of life (QOL) [3].

Inner strength is defined as an individual's ability to overcome adversity and promote well-being during life-altering events [4]. Most studies have focused on women's inner strength when establishing this concept [5]. For example, Roux et al. [6] developed a middle-range theory of inner strength using conceptual analysis and meta-synthesis based on qualitative research on women. Further, Roux et al. [7] expanded the theory, identifying key components such as "anguish and searching," "connectedness," "engagement," and "movement." Inner strength has been shown to be an important factor in improving the QOL of female patients with breast and lung cancer [5,8,9].

Smith [10] noted that while inner strength theory was originally developed from women's experiences, it is also highly relevant to men. Inner strength has been found to play a crucial role in male colorectal cancer (CRC) survivors as well [11]. However, research specifically investigating men's inner strength remains limited, aside from some qualitative studies on aging. Among male and female CRC survivors, differences exist not only in QOL but also in the specific symptoms emphasized. Women more often report lower sexual and physical QOL compared to men, while men are more likely to focus on psychological issues [12-14]. This underscores the need to listen to the voices of both male and female CRC survivors regarding the role of inner strength in their lives.

Long-term dietary management and bowel issues often occur after CRC treatment, which can restrict daily activities and diminish QOL, making adaptation to a new normal particularly challenging [15]. In addition to coping with physical symptoms, it is essential to investigate the factors that influence survivors' lives and inner strength. A cross-sectional study examining inner strength among CRC survivors of both genders found that its characteristics varied by gender and the presence of an ostomy [11].

While quantitative research is valuable for identifying patterns and group differences—such as those based on gender or ostomy status—it is limited in capturing the nuanced, lived experiences of individuals, especially regarding inner strength and life adaptation. Therefore, a qualitative approach grounded in inner strength theory is necessary to gain an in-depth understanding of how CRC survivors construct meaning and navigate life following diagnosis and treatment.

This study aimed to explore the lived experiences and inner strength of CRC survivors, seeking to verify and expand the application of inner strength theory in this population. By focusing on the adaptation processes of CRC survivors, this research sought to illuminate the internal mechanisms that foster resilience and adjustment, thereby addressing a critical gap in survivorship research. The central research question was: "What is the role of inner strength in the adaptation experiences of CRC survivors after cancer diagnosis?"

METHODS

1. Study Design

A qualitative method utilizing a directed content analysis approach was selected. Following Hsieh and Shannon [16], who recommend directed content analysis for validating or conceptually extending an existing theory or framework, this study applied and extended the theory of inner strength to CRC survivors of both sexes. Existing theory and research helped focus the research question and guided the identification of key concepts or variables as initial coding categories [16].

2. Participants

The sample included 16 CRC survivors aged 18 years or older who had been diagnosed with cancer and had completed either internal or surgical treatment. In this study, the term "cancer survivor" refers to individuals who have been diagnosed with cancer, regardless of stage or disease progression, consistent with the American Cancer Society's definition. Participants were recruited through an online self-help group community for CRC survivors in Korea. Table 1 presents detailed participant information, including assigned codes for sex, age, marital status, religion, occupation, pathological diagnosis, stage, time since diagnosis, and ostomy status.

A total of 17 participants were initially recruited, but one withdrew consent and was excluded. Ultimately, 16 participants completed interviews. To clarify ambiguities and confirm data saturation, follow-up interviews were conducted with participants who consented. Data collection concluded once saturation was reached.

3. Data Collection

An information sheet and consent form were posted on an online self-help group platform for CRC survivors. The form outlined the study's purpose and procedures, emphasizing the importance of anonymity and confidentiality. Those who agreed to participate completed a self-reported survey after submitting the consent form. Before the interview, participants filled out a questionnaire to confirm their CRC diagnosis, including questions about the timing of their diagnosis and medical history.

The first author conducted all interviews from July 4 to

Table 1. Demographic and Disease-related Characteristics of the Study Participants ($N=16$)

No.	Sex	Age (year)	Marital status	Religion	Job	Pathological diagnosis	Stage	Time since diagnosis (month)	Ostomy status[†]
1	Female	54	Divorced	None	No	Rectal	4	64	Yes
2	Male	60	Divorced	None	No	Rectal	4	43	Yes
3	Male	65	Married	None	Yes	Rectal	3	41	No
4	Female	46	Married	None	No	Rectal	2	33	Yes
5	Female	58	Married	None	Yes	Colon	2	94	No
6	Male	53	Married	Protestantism	Yes	Rectal	3	57	Previous
7	Male	69	Divorced	Buddhism	No	Rectal	4	57	Yes
8	Female	49	Married	None	Yes	Colon	3	51	No
9	Female	40	Married	Protestantism	No	Rectal	3	41	No
10	Female	58	Married	Protestantism	No	Rectal	3	56	Previous
11	Male	56	Married	Buddhism	Yes	Rectal	3	103	Previous
12	Male	68	Divorced	None	No	Rectal	4	37	No
13	Female	54	Married	Protestantism	No	Colon	3	85	No
14	Male	58	Married	None	Yes	Rectal	3	81	Yes
15	Female	58	Married	None	No	Colon	3	89	No
16	Male	46	Married	Buddhism	Yes	Colon	1	48	No

[†] Ostomy status: Yes = currently has an ostomy, No = has never had an ostomy.

July 25, 2022. Prior to the main study, a pilot test was performed to refine the interview process and ensure methodological rigor, involving five CRC survivors and focusing on their experiences of inner strength. No prior relationships existed between the interviewer and participants. Due to coronavirus disease 2019 (COVID-19) restrictions, all interviews were conducted by telephone. To enhance data richness and trustworthiness, strategies such as member checking, peer debriefing, and maintaining detailed field notes immediately after each interview were employed.

After scheduling interviews with consenting participants, telephone interviews were held at predetermined times. Verbal consent was reconfirmed before recording, and participants were informed about data management and security. In second-round interviews, participants were asked to verify the researchers' interpretation of their first interview and to elaborate on key points as needed. Each interview lasted approximately 60 minutes and followed a semi-structured format to balance consistency and flexibility. Interview questions were based on participants' experiences with CRC and grounded in the theory of inner strength; specific questions are provided in Appendix 1. Participants received an honorarium in recognition of their time.

4. Ethical Considerations

This study was approved by the Institutional Review Board of Chung-Ang University (approval no. 1041078-202203-HR-066). The consent form posted online detailed the study's purpose and procedures, emphasizing anonymity, confidentiality, and voluntary participation. Participants were informed that interview notes would be used solely for research purposes and that they could withdraw from the study at any time. This information was reiterated before the initial interview. Prior to the interview, the recording process was explained, and verbal consent was obtained. All research materials, including case records, were encrypted and securely stored in the researcher's private office, with access limited to the research team.

5. Data Analysis

Semi-structured, in-depth interviews were conducted. Participants responded to questions related to the theory of inner strength, focusing primarily on adaptation experiences and sources of inner strength. Interview questions were not provided to participants in advance. All interviews were recorded, transcribed verbatim, reviewed, coded, and analyzed independently by two investigators. Following established strategies for directed qualitative content analysis [16], each transcript was read multiple times for thorough understanding. Significant statements were highlighted to identify initial codes or meaning units within the text. Texts that did not fit the initial coding scheme were assigned new codes. Data collection continued until saturation, when no new information emerged from additional interviews. Participants were reassured regarding confidentiality and anonymity. The authors certify compliance with the principles of ethical publishing. The Consolidated Criteria for Reporting Qualitative Research (COREQ) [17] were used for reporting study findings.

6. Rigor

In developing and conducting our study on the inner strength of CRC survivors, we embraced a rigorous and reflexive approach to ensure the integrity and depth of our research. Our team engaged in thorough discussions regarding the study's focus and carefully considered our wording throughout the development process to promote clarity and relevance. To maintain objectivity and enhance rigor, interviewers participated in frequent team meetings, kept reflective journals, and took detailed notes during and after each interview. These regular discussions provided a foundation for collective reflexivity, as we critically examined our roles in data collection and analysis and openly questioned and validated our interpretations of participants' statements. This ongoing dialogue ensured that our findings were not simply individual perspectives, but were rigorously reviewed and shaped by the team's collective insight. Ultimately, this process enabled us to approach the research with sensitivity, integrity, and a commitment to producing findings that are both trustworthy and genuinely reflective of the complexities of survivors' inner strength.

RESULTS

The general characteristics of the participants are presented in Table 1. Of the 16 participants, five were colon cancer survivors and eleven were rectal cancer survivors. Five had an ostomy, and three had previous experience with an ostomy and had undergone surgery. Analysis of the transcribed interviews yielded 605 codes, 45 categories, 15 sub-themes, and 4 overarching themes (Table 2). Each theme was associated with the subcategories of "connectedness," "engagement," "anguish and searching," and "movement" from the theory of inner strength [3]. To ensure validity, the coding process was cross-checked by two researchers.

1. Theme 1: Reframing the Cancer Trajectory

1) An unacceptable thing

Some participants experienced shock upon discovering they had cancer, questioning, "Why did this happen to me?" and attributing their diagnosis to past actions they viewed negatively. Male participants often confronted their cancer experience assertively, either by reframing it in a positive light or facing it head-on. In contrast, female participants tended to focus more on fears of recurrence or metastasis, concerns for their families after their death, and

Table 2. Themes and Sub-themes Related to Colorectal Cancer Survivors' Inner Strength

Themes	Sub-themes
Reframing cancer trajectory	An unacceptable thing Fear of death The burden beyond treatment Knowing myself and cancer Grateful for my ostomy—indispensable!
Struggle to return to a normal life	Disrupted daily life If you cannot avoid it, have a positive attitude Belief that I can overcome cancer Battle with myself Ambivalence
Growth promoted by supportive relationships	Support entwined with guilt as a source of strength Prayer to the trustworthy
Well-being	Interpersonal interaction Balance of body and mind Living a new normal

https://doi.org/10.7475/kjan.2025.0422

the difficulties of living with an ostomy.

> I feel like I'm being punished by receiving a cancer diagnosis. It's my fault. Receiving the diagnosis made me reflect on the past, the wrong things I did, you know, those times when you may have wronged someone. I felt like I was being punished for my wrongdoings. (#7)

2) Fear of death

After diagnosis and as acceptance began to set in, participants described an intense fear of death and contemplation of their own mortality. For some, the prospect of death was not daunting, but for most, it was a challenging concept, and they worried about the loved ones they might leave behind. Over time, however, a sense of hope and belief in the possibility of survival began to take root.

> What if I die? I worry about my spouse and children I'll leave behind, thinking about the family I'll leave after I'm gone. However, with advancements in technology, could we potentially cure cancer? If so, I sometimes think, "Oh, maybe I could live longer." (#3)

3) The burden beyond treatment

Even as participants began to believe in the possibility of overcoming cancer, persistent symptoms continued to trouble them. Chemotherapy and radiation therapy were especially taxing. Unexpected events and constant anxiety about recurrence or metastasis added to their distress. While the early stages of treatment were manageable, ongoing symptoms, such as unpleasant odors and discomfort associated with CRC, became increasingly challenging.

> During colorectal cancer treatment, I unexpectedly experienced a drop in platelets, preventing me from receiving cancer treatment. It was devastating. Having to undergo treatment but not progressing made it difficult. I also experienced side effects like diarrhea. It seemed I may have eaten something wrong. Unexpected incidents kept happening. (#9)

4) Knowing myself and cancer

Over time, participants sought to better understand cancer and confront the challenges it brought, rather than merely resigning themselves to their fate. Support from medical professionals was important in this process, but CRC survivors often felt they lacked sufficient information. Gradually, they came to see cancer as a disease rather than an insurmountable hardship or death sentence.

> Accepting cancer as a disease, I think I've begun my second life with cancer, and I just live happily. (#2)

5) Grateful for my ostomy—indispensable!

Although living with an ostomy was initially daunting, participants gradually learned to manage their bodies and came to appreciate the benefits an ostomy could offer. At first, the ostomy was seen as an unwanted presence that damaged their body image. Over time, however, many adapted, gaining a sense of control and even gratitude. For those with permanent ostomies, a sense of shame sometimes persisted, but the ostomy had also become essential to their daily comfort and functioning.

> Initially, survival was more critical to me. I was busy with treatments and surgeries, so I didn't think deeply about the ostomy. But once I had it, meeting people became difficult. Socializing became challenging. Unexpected incidents like the ostomy bag suddenly leaking or bursting happened without warning. So, even though I wanted to meet people, I couldn't go outside. If I wanted to meet people, I had to avoid gas-inducing foods the day before or not eat at all. Talking to people became exhausting. After eating something, gas would build up in the ostomy bag, preventing me from wearing my old clothes. But now, I manage my ostomy well without any difficulties. It's not burdensome. (#1)
>
> I thought that having a temporary ostomy would make everything okay again, like in the past. But after the reversal surgery, I had to go to the bathroom dozens of times. So, I asked to have an ostomy again. Now that I have the ostomy again, I can eat, and it's so comfortable. I'm grateful to the ostomy. Living with an ostomy is better. I am grateful for my ostomy. (#7)

2. Theme 2: Struggle to Return to a Normal Life

1) Disrupted daily life

CRC survivors encountered persistent challenges in maintaining social relationships. Even long after diagnosis, the constant need to manage their diet and frequent trips to the toilet disrupted daily routines and made it difficult to leave home, especially due to concerns about the availability of nearby restrooms. This instilled a fear of venturing outside.

> Once, I fainted while outside, and since then, I've been afraid of offline gatherings. (#15)
>
> Since I stopped going to work, I've been using the bathroom 30–50 times a day. Although my daily life at home remained similar to pre-cancer days, I couldn't go out at all. During the early days of frequent bathroom visits, I was emotionally overwhelmed. Owing to the toilet issue, I'm scared to go out. (#3)

Some survivors managed to retain their jobs, but for most, cancer significantly disrupted their work and sense of normalcy. For men, the inability to return to work often brought feelings of guilt about not being able to provide for their families.

> After my cancer diagnosis, I couldn't even do small jobs while going to the hospital. I need to earn money. If my body allows, I want to do even small tasks. (#12)

2) If you cannot avoid it, have a positive attitude

Upon accepting their cancer diagnosis, participants described a shift in their attitudes, moving toward a more positive mindset. This outlook was not limited to confronting cancer alone; at times, participants found comfort by comparing their situations to others' misfortunes and expressed gratitude simply for being alive.

> When I hear stories of others with colorectal cancer, those who have experienced metastasis or relapse, I feel comforted about my situation. I am okay now. (#5)
>
> Living with thoughts of happiness, appreciating that there are people in more difficult situations, I am grateful for my current circumstances. Living positively, I enjoy my life with joy. (#7)

3) Belief that I can overcome cancer

Participants conveyed confidence in their ability to overcome cancer, drawing strength from family and friends, trust in medical professionals, or a sense of responsibility toward their families.

> For me, the support of my family was helpful. Thanks to my family, I have confidence to overcome cancer. I am relatively quick to recover compared to others, so I want to work hard and live a healthy life. (#11)

4) Battle with myself

Participants emphasized their desire to fight cancer independently, relying on psychological determination to overcome it on their own terms. Sometimes, this meant choosing not to disclose their difficulties to others.

> You have to manage yourself on your own. That's how you can overcome it. Having the mental determination to fight and overcome cancer is crucial. (#16)

5) Ambivalence

Participants experienced ambivalence, simultaneously wanting to be treated as both cancer patients and as ordinary individuals. They found it difficult when others, especially their children, did not show the care or consideration they hoped for.

> I disliked it when people treated me as a cancer patient or tried to comfort me. It was tough being treated as a cancer patient. (#6)
>
> I think, outside, I don't want to be treated as a cancer patient, but at home, I want consideration from my family. (#13)

3. Theme 3: Growth Promoted by Supportive Relationships

1) Support entwined with guilt as a source of strength

Enduring the challenges of CRC was possible due to support from various relationships. However, rather than feeling only gratitude, participants frequently experienced a sense of guilt for the help they received.

> I've been sick for a long time. My husband suffered while taking care of me. I'm truly grateful to my husband. There's a part of me that feels sorry because my husband couldn't really work properly due to him taking care of me, causing financial difficulties. (#10)

2) Prayer to the trustworthy

Spiritual beliefs and prayer served as important sources of strength. Participants, including those without formal religious affiliations, reported praying for their health or their families, and found comfort in the prayers of others. Notably, even among female participants without a religious background, prayer became a means of emotional support during difficult times.

> I'm not religious. However, when I was first diagnosed with cancer, I prayed. I prayed to God, Buddha—everything. I prayed for my health. Praying during really difficult times became a great source of strength for me. (#5)

4. Theme 4: Well-being

1) Interpersonal interaction

The COVID-19 pandemic further complicated socialization for CRC survivors, who turned to online meetings as alternatives to in-person gatherings. While interactions—both offline and online—could be challenging and sometimes had negative outcomes, participation generally had a positive impact. Female participants expressed dissatisfaction with the lack of both online and offline interaction, emphasizing the value of face-to-face connections. In contrast, male participants tended to be more active in online groups but preferred not to reveal their difficulties, coping with challenges more independently.

> Being alone makes me feel down. Having meetings, doing exercises, and going out a bit release endorphin. After going out and returning, household chores feel more manageable. (#4)
>
> During online meetings, I often hear bad news from colorectal cancer patients. I can handle bad news from fellow cancer patients without it really bothering me. I don't care. Moreover, sharing various information about disease in meetings is helpful, I think. (#15)

2) Balance of body and mind

Achieving a balance between body and mind was crucial for participants. Many exercised, rested, and practiced healthy eating habits after diagnosis.

> After being diagnosed with colorectal cancer, I quit my job, but recently I started working again. In reality, I want to rest a bit more, due to financial issues, I resumed work. But when taking a break, I listen to music and entrust my body, which improves my mood. (#8)
>
> My days feel short. Working, exercising, resting – I think I'm using my time well these days. (#9)

3) Living a new normal

While many aspired to return to their pre-cancer lives, various challenges made this impossible. Ultimately, participants began to create new paths for themselves, gradually establishing a "new normal."

> After cancer treatment, my role in the household changed. I used to earn money alone, but now my wife works, and I do housework at home. I've become quite skilled in cooking. It was a bit uncomfortable at first, but now I've adapted. (#14)
>
> Having an ostomy made me different from other people. Though externally, I look like everyone else, sometimes when I experience pain, I suddenly remember that I was a cancer patient. Now, I've changed my priorities, and I'm determined to live a family life and enjoy ordinary times after retiring. (#1)

Returning to pre-cancer life proved impossible, but many survivors found their "new normal." Some even claimed they were now living better lives than before cancer.

> I consider myself to have overcome cancer. After defeating cancer, my physical health even improved. (#4)
>
> I believe I have overcome every cancer-related challenge. (#12)

DISCUSSION

Inner strength, initially observed in female patients with chronic illness, has received increasing attention in research involving cancer patients [10,11,18]. Much like resilience, inner strength enables individuals to experience personal growth following negative life events [4,19]. For cancer survivors, inner strength is understood in a broader sense—not simply as a means to return to pre-cancer life, but as the foundation for embracing a "new normal" shaped by changes arising from diverse social interactions. Furthermore, attributes of inner strength consistent with those described in existing theories were identified among CRC survivors of both genders. From the moment of diagnosis, these survivors embarked on a journey of accepting or overcoming cancer and designing new lives.

In the established theory of inner strength, individuals recognize their illness, seek assistance—often from a religious perspective—actively participate in overcoming the illness, and ultimately adapt in their own ways. CRC survivors also followed this general trajectory in forging a new life after cancer. However, in contrast to those with chronic diseases, CRC survivors face distinctive challenges, such as long-term dietary management, persistent bowel issues, fear of recurrence and metastasis, and ambivalent emotions about cancer. These disease-specific factors significantly influenced how survivors established their own “new normal.” Their perceptions and coping strategies varied according to gender and ostomy status.

Whereas supportive relationships in inner strength theory have often been viewed through a religious lens [4-6], CRC survivors formed supportive relationships based on faith, family, and friends. With the advent of the COVID-19 pandemic, many survivors’ lives shifted toward virtual interactions. Concerns about vaccination added another barrier to in-person outings for cancer survivors [20]. As a result, participants expressed a preference for virtual meetings. Web-based counseling and support, including online chats and participation in self-help support groups, alleviated depression and anxiety in CRC survivors [21,22]. Similarly, virtual support groups served as vital avenues for communication and support. However, hearing news of death or relapse during online meetings sometimes led to self-reflection or heightened anxiety, resulting in negative effects.

Because cancer symptoms, recurrence, or metastasis directly impact survivors’ QOL and life expectancy [23], support from others remains a crucial factor [24]. Interestingly, while CRC survivors expressed gratitude for the support they received, they also described feelings of guilt, particularly regarding the burden their illness placed on caregivers. Although such mixed emotions are not unique to CRC survivors, this emotional complexity appeared especially salient in our findings. The need for ongoing care due to long-term symptoms or the presence of an ostomy often increased dependence on others and limited social functioning. Thus, gratitude was not always experienced as a purely positive emotion [25,26], but was frequently intertwined with self-blame or emotional discomfort. For some CRC survivors, gratitude and guilt were deeply entangled, reflecting a heightened sense of responsibility and relational sensitivity.

Building on the work of Yu and Ryu [11], this study explored how CRC survivors construct and express inner strength amid their unique challenges. Rather than focusing solely on general characteristics of inner strength, our findings emphasize the lived difficulties that require and shape its development. In particular, restroom-related issues were prominent, as CRC survivors commonly face persistent, long-term bowel problems similar to those described by Rockwood et al. [27], with critical life-altering consequences. Post-surgical and restroom-related supportive care was crucial. Frequent restroom visits often remained unresolved, acting as a barrier to social participation and resulting in negative outcomes. Limited ability to go out not only restricted social interaction but also hampered physical activity [28]. Additionally, fears and stigma related to diarrhea were prevalent, highlighting the ongoing challenges of living with such symptoms [29]. These findings underscore the contextual pressures under which inner strength is tested and cultivated among CRC survivors.

Contrary to earlier negative perceptions, our study shows that CRC survivors do not necessarily regard an ostomy solely as a negative outcome. For many, an ostomy alleviated restroom-related problems, enabling them to leave the house and enjoy certain foods again. Some even regretted undergoing ostomy reversal surgery. Thus, living with an ostomy is not inherently negative. This adaptation over time, following the initial shock, may be due to improvements in symptoms such as frequent bowel movements [30].

This study also broadens the understanding of inner strength in CRC survivors by including both female and male participants. While Yu and Ryu [11] examined inner strength and QOL in male and female CRC survivors, it was challenging to discern their specific characteristics. Our findings, however, identified attributes of inner strength unique to both groups. Male participants tended to develop inner strength in a more independent and self-reliant manner. Female participants, by contrast, often expressed ambivalent emotions related to their illness and to others’ reactions, but their inner strength was largely enhanced through interpersonal interactions.

Male CRC survivors, in their efforts to overcome cancer, tended to reject help from others and conceal their emotions, with their social interactions often limited to online gatherings. This phenomenon can be interpreted in light of Confucian and patriarchal values prevalent in East Asian societies. According to traditional gender role socialization, men are expected to be strong, economically active, and leaders within their families [31]. Such cultural characteristics continue to shape the formation and expression of inner strength among male CRC survivors.

While male CRC survivors primarily focused on how cancer affected their work or social activities, often from a patriarchal perspective, female survivors mainly discussed their symptom experiences and their lives within the home. The experience of having cancer led some women to internalize stigma, manifesting as self-blame for their perceived inability to live a “normal” life. This internalized stigma can foster negative self-criticism, including guilt and shame [32,33], and act as a barrier to social interaction. Notably, female survivors expressed a paradoxical desire: they did not want to be labeled as cancer patients, yet at the same time, they wanted to be treated or considered as such. This phenomenon mirrors findings by Tsai and Lu [34], who reported that ambivalence in emotional experience is closely linked to depression and self-blame. Further studies on ambivalence in CRC survivors are warranted.

In summary, this study expands the theoretical understanding of inner strength by highlighting its role as a dynamic and context-dependent mechanism through which CRC survivors reconstruct identity, regain agency, and achieve psychosocial adaptation. Rather than representing a fixed trait, inner strength emerges as an evolving capacity shaped by illness experience, gendered responses, and relational contexts. This conceptualization underscores the need for tailored interventions that foster survivors’ inner strength to support their transition to a new normal.

This study extends the theory of inner strength by including both male and female CRC survivors. However, the generalizability of the findings is limited due to the focus on Korean participants and the small number of ostomy holders, whose experiences of stigma may not reflect those of all CRC survivors. Gender-related patterns emerged during analysis rather than through stratified sampling, indicating a need for further validation. Future studies should recruit more diverse populations to strengthen the applicability of these findings.

CONCLUSION

This study explored the role of inner strength in the lived experiences of CRC survivors, particularly in their adaptation to a “new normal” following diagnosis and treatment. The findings revealed that CRC survivors did not seek to return to their pre-cancer lives but instead aimed to reconstruct their lives by accepting and adjusting to persistent symptoms, lifestyle changes, and shifting social roles. Inner strength played a central role in this adaptation process, enabling participants to find meaning, regain agency, and navigate daily challenges. Inner strength helped individuals accept and reinterpret cancer as part of life, redefine their roles amid changed circumstances, and enhance psychological resilience through external support, faith, and family responsibility. It also served as a foundation for meaning-making in relationships characterized by both guilt and gratitude, and for sustaining self-care behaviors. Notably, differences in the expression of inner strength were observed based on gender and the presence of an ostomy. Male survivors often internalized their struggles and developed strength in a more self-reliant manner, while female survivors emphasized relational support and more frequently expressed emotional ambivalence, including feelings of guilt and gratitude. These findings highlight the contextual nature of inner strength and underscore its importance in fostering psychological adaptation and resilience among CRC survivors. Future efforts should focus on developing supportive interventions that nurture inner strength in alignment with survivors’ lived realities, ultimately enhancing their QOL as they construct and live their “new normal.”

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

Study conception and design acquisition - HY and ER; data curation and analysis - HY; interpretation of the data - HY and ER; and drafting or critical revision of the manuscript for important intellectual content-HY and ER.

FUNDING

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korean government (MSIT) (No. 2021R1F1A1055687).

ACKNOWLEDGEMENT

None.

DATA AVAILABILITY STATEMENT

The data can be obtained from the corresponding authors.

https://doi.org/10.7475/kjan.2025.0422

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APPENDICES

Appendix 1. Interview questions

1. Please provide a self-introduction.
    1-1. What is your diagnosis?
    1-2. What treatments have you received?
    1-3. What is your current treatment status? (Ongoing/Recovered)
2. What experiences have you had regarding your illness, diagnosis, treatment (and bowel incontinence)?
    2-1. What were your feelings when you were first diagnosed with cancer?
    2-2. What emotions did you experience during the diagnosis and treatment process for colon cancer?
    2-3. Were there any unexpected events related to the illness?
    2-4. If so, what emotions did you experience?
    2-5. Do you experience any discomfort in your daily life?
    2-6. Are there any difficulties in your daily life?
    2-7. Have you disclosed the cancer diagnosis to others?
3. Are you currently part of any group?
4. What role do you currently play within your family?
    4-1. What experiences did you have when you returned home after treatment?
    4-2. Are there any difficulties you feel as a family member related to the disease?
    4-3. Are there any positive aspects gained from family members related to the disease?
5. What experiences are you having in your current affiliations (with friends, work, hobbies)?
    5-1. Are there any difficulties you feel in your affiliations?
    5-2. Are there any positive aspects gained from members of your affiliations?
    5-3. Do you have someone you can rely on, such as family, friends, or coworkers?
    5-4. Do you maintain a balance between rest and work? Can you have time for yourself?
6. Do you have a religion?
    6-1. (If yes) Please talk about your experiences through religious activities.
    6-2. (If yes) What prayers do you offer through religious activities? (For others/for yourself?)
    6-3. (If yes) What are the positive/negative aspects of religious activities related to the disease?
7. After treating colon cancer, what other difficulties do you face?
8. Do you think you have adapted to or overcome the difficulties caused by the disease?
    8-1. What events/people helped you overcome all these experiences and difficulties?
    8-2. Do you believe you can overcome the difficulties related to the disease?
9. What are your life plans?

ORIGINAL ARTICLE

Korean J Adult Nurs Vol. 37 No. 3, 344-353, August 2025
eISSN: 2288-338X
https://doi.org/10.7475/kjan.2025.0509

KJAN
Korean Journal of
Adult Nursing

Factors Influencing Nurses' Person-Centered Care: A Cross-sectional Descriptive Study

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Received: May 9, 2025
Revised: July 18, 2025
Accepted: August 14, 2025

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Purpose: Person-centered care is essential to improving patient outcomes, yet the factors that influence it require further investigation. This study examines the relationships among nurses' compassion competence, cultural competence, intercultural communication skills, and person-centered care, and it identifies key predictors of person-centered care. **Methods:** A descriptive survey was conducted among 191 nurses from two general hospitals using convenience sampling between April 1 and April 22, 2024. Data collection included measures of compassion competence, cultural competence, intercultural communication skills, and person-centered care. Statistical analyses involved descriptive statistics, the independent t-test, analysis of variance, Pearson's correlation coefficient, and stepwise multiple regression. **Results:** Of the 191 participants, 172 (90.1%) were females and 19 (9.9%) were males, with an average clinical experience of 8.89 years. Person-centered care showed significant positive correlations with compassion competence ($r = .58$, $p < .001$), cultural competence ($r = .62$, $p < .001$), and intercultural communication skills ($r = .63$, $p < .001$). Key predictors of person-centered care included intercultural communication skills ($\beta = .29$, $p = .001$), compassion competence ($\beta = .27$, $p < .001$), cultural competence ($\beta = .20$, $p = .024$), and non-shift work status ($\beta = .12$, $p = .031$). The model explained 47.9% of the variance in person-centered care ($F = 44.76$, $p < .001$). **Conclusion:** In this study, person-centered care among nurses was influenced by compassion competence, cultural competence, intercultural communication skills, and work type. Further research is warranted on the delivery of person-centered care among nurses who provide care to patients from diverse cultural backgrounds.

Key Words: Communication; Cultural competency; Empathy; Nursing care; Patient-centered care

INTRODUCTION

In Korea, 20,431 multicultural marriages were recorded in 2023, representing a 17.2% increase (3,003 cases) from the previous year and indicating a steady rise in multicultural families [1]. Moreover, the proportion of foreign residents relative to the total population has consistently remained below 5% since 2019 [2]. These demographic changes, together with increasing cultural diversity among patients, require nurses to deliver the highest quality care to individuals from diverse cultural backgrounds [3]. As frontline caregivers, nurses are obligated to provide equitable and culturally sensitive person-centered care to all patients [4].

Person-centered care emphasizes the whole person and contributes to improving patient satisfaction and health outcomes by delivering nursing care that respects and harmoniously reflects each patient's unique needs [5]. Compassion, cultural competence, and effective communication with patients should be the cornerstones of all care provided [6]. Compassionate care involves empathetic engagement, recognizing patients' perspectives, and addressing their concerns within their respective cultural and social contexts [7,8]. Meanwhile, cultural competence equips nurses with the ability to navigate cultural differences and collaborate effectively with patients, ensuring care that is both holistic and sensitive [9]. Intercultural communication skills further promote trust and understanding by bridging diverse cultural values and beliefs [10]. Together, these competencies serve as foundational pillars for establishing therapeutic relationships and enhancing both patient satisfaction and health outcomes [11].

Theoretical frameworks offer critical insights into how these competencies are integrated into nursing practice. McCormack and McCance's person-centered nursing framework, for example, highlights the interaction among nurses' attributes, care processes, and the care environment in achieving person-centered outcomes [12]. This framework closely aligns with the competencies addressed in this study—compassion, cultural competence, and intercultural communication skills—providing a robust conceptual basis for investigating their impact on person-centered care. Previous research has demonstrated positive correlations between person-centered care and factors such as empathy capacity [13,14], compassion satisfaction [15], cultural empathy and transcultural self-efficacy [16], as well as human understanding and communication skills [14]. Specifically, studies have reported that higher levels of empathy capacity [13,14], compassion satisfaction [15], cultural empathy and transcultural self-efficacy [16], and human understanding and communication skills [14] are associated with higher levels of person-centered care. Although the literature underscores the importance of these competencies, a comprehensive understanding of their interactions within the Korean healthcare context remains limited.

Therefore, this study aims to examine the influence of nurses' compassion, cultural competence, and intercultural communication skills on person-centered care, clarify the relationships among these variables, and develop strategies applicable to nursing education and clinical practice. These insights will serve as foundational data to help nurses provide more inclusive and effective care to patients from diverse cultural backgrounds.

METHODS

1. Study Design

This descriptive research study was conducted to identify the influence of nurses' compassion, cultural competence, and intercultural communication skills on person-centered nursing.

2. Setting and Samples

Participants included nurses with a minimum of three months of clinical experience, employed at two general hospitals in Jeju City, South Korea [17]. Head nurses not directly involved in patient care were excluded from the study [18].

3. Study Tools

1) General characteristics

General characteristics were assessed using 10 items: sex, education level, position, clinical career, work type, presence of foreign friends, recent experience providing nursing care to multicultural patients, experience in multicultural nursing education, availability of multilingual caregiver education materials at the workplace, and familiarity with the term "person-centered care."

2) Compassion competence

Compassion competence was measured using the tool developed by Lee and Seomun [19]. This instrument includes 17 items across three subdomains: communication, sensitivity, and insight. Each item is rated on a 5-point Likert scale, yielding a total score range of 17 to 85, with higher scores indicating greater compassion competence. The reliability of the tool was shown by Cronbach's α values of .91 in Lee and Seomun's original study [19] and .86 in the present study.

3) Cultural competence

Cultural competence was assessed using the instrument developed by Kim et al. [17]. This tool consists of 35 items within seven subdomains: communication, biocultural ecology and family, dietary life, death rituals, spirituality, equality, and empowerment/intermediation. Each item is rated on a 5-point Likert scale, for a total score range of 35 to 175. Higher scores reflect greater cultural competence.

Cronbach's α was .94 in the original study [17] and .93 in this study.

4) Intercultural communication skills

Intercultural communication skills were measured using the instrument developed by Lee [20] and revised by Lee and Kim [21]. This tool contains 40 items divided into four subdomains: intercultural communication skills, intercultural communication knowledge, intercultural communication attitudes, and intercultural communication awareness. Each item is rated on a 5-point Likert scale, with a total score range of 40 to 200. Higher scores indicate greater intercultural communication skills. The reliability of the tool was shown by Cronbach's α values of .96 in the study by Lee and Kim [21] and .96 in this study.

5) Person-centered care

Person-centered care was evaluated using the instrument developed by Lee [18]. This tool comprises 25 items across five subdomains: relationship, holism, respect, individualization, and empowerment. Each item is rated on a 5-point Likert scale, giving a total score range of 25 to 125. Higher scores indicate a higher degree of person-centered care. The tool's reliability was demonstrated by Cronbach's α values of .94 in the original study [18] and .95 in this study.

4. Data Collection

Data collection was conducted from April 1 to April 22, 2024. After a detailed explanation of the study's purpose, procedures, the possibility of withdrawal, and assurances of anonymity and confidentiality via an information sheet, participants who voluntarily agreed signed a written consent form before completing the questionnaire. It was explained that all collected data would be used solely for research purposes and would be destroyed three years after the study's conclusion. Using G*Power 3.1.9.2, the required sample size for regression analysis was calculated to be 162, based on an effect size of 0.15, $\alpha=0.05$, $1-\beta=0.90$ [13], and 13 predictors (10 general characteristics, 3 independent variables). To account for potential dropouts, 201 paper-based questionnaires were distributed, with 191 responses analyzed after excluding 10 incomplete questionnaires.

5. Ethical Considerations

This study was conducted following review and approval by the Institutional Review Board (IRB) of the affiliated institution (JJNU-IRB-2024-028). Before completing the survey, participants were informed about the voluntary nature of participation, the anonymity of data, their right to withdraw at any time, and the assurance that non-participation would not result in any disadvantage. Written informed consent was obtained from all participants. As a token of appreciation, a small gift was provided to those who participated in the study.

6. Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 22.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics summarized the general characteristics, compassion competence, cultural competence, intercultural communication skills, and person-centered care of the participants. Differences in compassion competence, cultural competence, intercultural communication skills, and person-centered care according to general characteristics were examined using the independent t-test and analysis of variance, with post hoc analysis performed using the Scheffé test. Correlations between variables were analyzed using Pearson's correlation coefficient. Factors influencing nurses' person-centered care were identified through stepwise multiple regression analysis.

RESULTS

1. General Characteristics of Participants

Among the 191 participants, 172 (90.1%) were female and 19 (9.9%) were male. The majority held a bachelor's degree (139, 72.8%) and worked as general nurses (162, 84.8%). Most participants were engaged in rotating shift work (156, 81.7%), with an average clinical experience of 8.89±5.86 years. Additionally, 21 nurses (11.0%) reported having foreign friends, and 140 nurses (73.3%) had provided nursing care to multicultural patients within the past year. Only 14 nurses (7.3%) had received education related to multicultural care, while 42 nurses (22.0%) reported that their workplace provided educational materials for patients and families in foreign languages. Furthermore, 144 nurses (75.4%) indicated that they were familiar with the term

https://doi.org/10.7475/kjan.2025.0509

"person-centered care" (Table 1).

2. Compassion Competence, Cultural Competence, Intercultural Communication Skills, and Person-Centered Care

Participants scored an average of 3.68 out of 5 on compassion competence, with the "sensitivity" subdomain recording the highest score of 3.88. The average score for cultural competence was 3.41, with "equality" being the highest scoring subdomain at 3.94. The average score for intercultural communication skills was 3.42, with the "intercultural communication attitudes" subdomain scoring highest at 3.59. For person-centered care, the average score was 4.02, with the highest score being 4.22 for "respect" and the lowest 3.76 for "holism" (Table 2).

3. Differences in Compassion Competence, Cultural Competence, Intercultural Communication Skills, and Person-Centered Care by General Characteristics

Compassion competence showed significant differences according to total clinical experience (F=5.79, p=.001), foreign friends (t=2.24, p=.035), multicultural care education experience (t=2.14, p=.033), availability of educational materials in foreign languages (t=2.24, p=.026), and experience with person-centered care terminology (t=2.33, p=.021). Cultural competence demonstrated significant differences according to position (F=5.21, p=.006), total clinical experience (F=4.74, p=.003), work type (t=–2.28, p=.024), and foreign friends (t=2.68, p=.014). Intercultural communication skills exhibited significant differences according to position (F=4.27, p=.015), total clinical experience (F=4.01, p=.008), work type (t=–2.18, p=.030), foreign friends (t=3.41, p=.002), and recent experience in providing nursing care to multicultural patients (t=2.09, p=.039). Person-centered care showed significant differences according to total clinical experience (F=4.13, p=.007) and work type (t=–3.23, p=.001) (Table 3).

4. Correlations between Variables

Person-centered care demonstrated significant positive correlations with compassion competence (r=.58, p<.001), cultural competence (r=.62, p<.001), and intercultural

Table 1. General Characteristics of the Participants (N=191)

Variables	Categories	n (%)
Sex	Female	172 (90.1)
	Male	19 (9.9)
Education level	Diploma	27 (14.1)
	Bachelor's degree	139 (72.8)
	Master's degree	25 (13.1)
Position	Registered nurse	162 (84.8)
	Charge nurse	19 (9.9)
	Physician assistant nurse	10 (5.3)
Clinical career (year)	<3	20 (10.5)
	3 to <6	37 (19.4)
	6 to <10	65 (34.0)
	≥10	69 (36.1)
Work type	Shift	156 (81.7)
	Non-shift	35 (18.3)
Foreign friends	Yes	21 (11.0)
	No	170 (89.0)
Recent experience providing nursing care to multicultural patients	Yes	140 (73.3)
	No	51 (26.7)
Experience in multicultural nursing education	Yes	14 (7.3)
	No	177 (92.7)
Multilingual caregiver education materials	Yes	42 (22.0)
	No	149 (78.0)
Familiarity with the term "person-centered care"	Yes	144 (75.4)
	No	47 (24.6)

Table 2. Means of Compassion Competence, Culture Competence, Intercultural Communications Skills, and Person-Centered Care (*N* = 191)

Variables	Mean ± SD	Minimum	Maximum	Range
Compassion competence	3.68 ± 0.40	2.41	4.71	1–5
Communication	3.66 ± 0.46	2.25	4.88	
Sensitivity	3.88 ± 0.49	2.20	5.00	
Insight	3.47 ± 0.54	2.00	5.00	
Culture competence	3.41 ± 0.43	2.60	4.91	1–5
Communication	3.78 ± 0.42	2.67	5.00	
Biocultural ecology and family	3.14 ± 0.62	2.11	5.00	
Dietary life	3.62 ± 0.64	2.00	5.00	
Death rituals	3.31 ± 0.75	1.00	5.00	
Spirituality	3.23 ± 0.82	1.33	5.00	
Equality	3.94 ± 0.49	2.80	5.00	
Empowerment and intermediation	3.07 ± 0.63	1.50	4.83	
Intercultural communications skills	3.42 ± 0.50	1.90	4.95	1–5
Intercultural communication skills	3.57 ± 0.51	1.70	4.90	
Intercultural communication knowledge	3.04 ± 0.66	1.60	5.00	
Intercultural communication attitudes	3.59 ± 0.52	1.90	5.00	
Intercultural communication awareness	3.46 ± 0.56	1.90	5.00	
Person-centered care	4.02 ± 0.42	2.88	5.00	1–5
Relationship	3.99 ± 0.44	2.57	5.00	
Holism	3.76 ± 0.61	2.00	5.00	
Respect	4.22 ± 0.50	3.00	5.00	
Individualization	4.07 ± 0.48	2.80	5.00	
Empowerment	4.05 ± 0.58	2.50	5.00	

SD = standard deviation.

communication skills (r = .63, *p* < .001) (Table 4).

5. Factors Influencing Person-Centered Care

Significant variables, including compassion competence, cultural competence, intercultural communication skills, total clinical experience, and work type (each demonstrating significant differences based on general characteristics), were entered as independent variables in the stepwise multiple regression analysis. Total clinical experience and work type were treated as dummy variables for the analysis.

The Durbin-Watson statistic was 1.92, indicating no issues of autocorrelation among variables. Tolerance values ranged from .344 to .971 (all above the threshold of .1), and variance inflation factors ranged from 1.03 to 2.91 (all below 10), confirming the absence of multicollinearity.

The regression analysis identified intercultural communication skills (β = .29, *p* = .001), compassion competence (β = .27, *p* < .001), cultural competence (β = .20, *p* = .024), and non-shift work (β = .12, *p* = .031) as significant factors influencing person-centered care, while clinical career was not found to be significant. This regression model was statistically significant (F = 44.76, *p* < .001), explaining 47.9% of the variance (Table 5).

DISCUSSION

This study examined the relationships among nurses' intercultural communication skills, compassion competence, cultural competence, and person-centered care, and investigated how these factors influence person-centered nursing.

Participants scored an average of 3.68 on compassion competence, which is similar to the 3.61 reported in a study of nurses at tertiary hospitals [19], and higher than the 3.53 found among nurses at general hospitals [22]. The average score for cultural competence was 3.41, slightly lower than the 3.51 reported during the development of the measurement tool [17]. Notably, an experimental study of graduate nursing students who received multicultural education demonstrated an increase in cultural competence scores

https://doi.org/10.7475/kjan.2025.0509

Table 3. Differences in Compassion Competence, Culture Competence, Intercultural Communication Skills, and Person-Centered Care by General Characteristics ($N = 191$)

Variables	Categories	Compassion competence		Cultural competence		Intercultural communication skills		Person-centered care	
		Mean ± SD	t or F (p)	Mean ± SD	t or F (p)	Mean ± SD	t or F (p)	Mean ± SD	t or F (p)
Sex	Female	62.33 ± 6.53	−1.11	119.06 ± 14.66	−0.99	135.89 ± 18.94	−1.21	100.30 ± 10.48	−1.20
	Male	64.68 ± 9.01	(.280)	123.58 ± 19.38	(.336)	143.47 ± 26.66	(.242)	103.37 ± 11.57	(.232)
Education level	Diploma	63.81 ± 7.85	0.53	122.52 ± 16.09	1.13	137.78 ± 22.21	0.48	101.48 ± 11.66	0.48
	Bachelor’s degree	62.35 ± 5.93	(.589)	118.50 ± 14.23	(.325)	135.85 ± 18.30	(.622)	100.16 ± 10.46	(.618)
	Master’s degree	62.40 ± 9.88		121.84 ± 18.99		139.84 ± 25.54		102.16 ± 10.40	
Position	Registered nurse^{a,†}	62.31 ± 6.57	2.87	118.64 ± 14.59	5.21	135.20 ± 19.47	4.27	100.37 ± 10.69	0.40
	Charge nurse^{b,†}	65.84 ± 8.51	(.059)	129.58 ± 19.29	(.006)	149.05 ± 22.77	(.015)	102.68 ± 11.51	(.669)
	Physician assistant nurse^{c,†}	60.40 ± 6.10		114.50 ± 7.93	c < b	136.40 ± 12.83	a < b	100.50 ± 7.08	
Clinical career (year)	$< 3^{a,\dagger}$	66.55 ± 6.72	5.79	126.20 ± 12.98	4.74	145.20 ± 21.05	4.01	106.30 ± 12.32	4.13
	3 to $< 6^{b,\dagger}$	60.84 ± 6.66	(.001)	118.73 ± 13.07	(.003)	137.32 ± 16.87	(.008)	100.14 ± 9.78	(.007)
	6 to $< 10^{c,\dagger}$	60.85 ± 5.95	b,c < a	114.65 ± 12.56	c < a	130.49 ± 16.77	c < a	97.71 ± 9.87	c < a
	$\geq 10^{d,\dagger}$	63.94 ± 7.04		122.57 ± 17.69		139.59 ± 22.32		101.94 ± 10.47	
Work type	Shift	62.15 ± 6.50	−1.78	118.33 ± 14.05	−2.28	135.17 ± 18.85	−2.18	99.46 ± 10.19	−3.23
	Non-shift	64.40 ± 7.94	(.077)	124.74 ± 18.83	(.024)	143.20 ± 23.13	(.030)	105.71 ± 11.00	(.001)
Foreign friends	Yes	66.52 ± 8.82	2.24	130.90 ± 21.36	2.68	153.76 ± 25.02	3.41	102.81 ± 11.97	1.01
	No	62.07 ± 6.40	(.035)	118.10 ± 13.69	(.014)	134.53 ± 18.15	(.002)	100.34 ± 10.42	(.314)
Recent experience providing nursing care to multicultural patients	Yes	63.06 ± 6.69	1.70	120.47 ± 16.17	1.68	138.22 ± 21.01	2.09	101.43 ± 10.81	1.79
	No	61.18 ± 7.05	(.091)	116.86 ± 11.85	(.096)	132.31 ± 15.75	(.039)	98.35 ± 9.74	(.076)
Experience in multicultural nursing education	Yes	66.29 ± 7.72	2.14	124.07 ± 15.94	1.17	140.93 ± 20.26	0.84	102.57 ± 12.46	0.72
	No	62.27 ± 6.68	(.033)	119.15 ± 15.12	(.244)	136.31 ± 19.87	(.404)	100.45 ± 10.46	(.473)
Multilingual caregiver education materials	Yes	64.62 ± 5.70	2.24	120.62 ± 14.90	0.54	139.36 ± 20.44	1.00	102.60 ± 11.12	1.38
	No	61.98 ± 7.01	(.026)	119.19 ± 15.31	(.593)	135.88 ± 19.72	(.318)	100.05 ± 10.42	(.169)
Familiarity with the term “person-centered care”	Yes	63.21 ± 6.71	2.33	119.80 ± 15.29	0.46	137.40 ± 20.05	0.92	100.28 ± 10.29	−0.75
	No	60.57 ± 6.85	(.021)	118.62 ± 15.01	(.645)	134.34 ± 19.38	(.362)	101.62 ± 11.55	(.453)

SD = standard deviation; †Scheffé test.

Table 4. Correlation between Compassion Competence, Culture Competence, Intercultural Communication Skills, and Person-Centered Care (*N* = 191)

Variables	Compassion competence	Cultural competence	Intercultural communication skills
		r (*p*)	
Person-centered care	.58 (< .001)	.62 (< .001)	.63 (< .001)

Table 5. Factors Influencing Person-Centered Care (*N* = 191)

Variables	B	SE	β	t	*p*	F (*p*)	Adj. R^2
(Constant)	35.88	5.37		6.68	< .001	44.76	.479
Intercultural communications skills	0.16	0.05	.29	3.39	.001	(< .001)	
Compassion competence	0.41	0.11	.27	3.89	< .001		
Cultural competence	0.14	0.06	.20	2.28	.024		
Non-shift work (reference = Shift work)†	3.16	1.45	.12	2.18	.031		

SE = standard error; †Dummy variable

from 3.17 before the program to 4.06 after completion [23]. The average intercultural communication skills score among participants was 3.42, which exceeds the 3.18 [21] and 3.33 [24] reported in studies of nursing students, as well as the 3.38 found among general hospital nurses [25]. For person-centered care, the average score was 4.02, consistent with other studies reporting scores ranging from 3.75 [18] to 3.99 [26]. Such variations are likely attributable to regional and individual differences.

Among participants' general characteristics, statistically significant differences in cultural competence and intercultural communication skills were observed according to position. Although not statistically significant, charge nurses exhibited the highest levels of compassion competence and person-centered care. This finding supports previous reports that managerial and charge nurses generally demonstrate higher levels of person-centered care compared to staff nurses [13,26]. Clinical career was associated with significant differences across all four variables, with nurses having less than three years of experience scoring the highest. However, aside from this group, scores tended to increase with greater clinical experience. This pattern differs from earlier studies indicating that compassion competence [22] and person-centered care [13] improve with longer clinical careers. The higher scores among early-career nurses may reflect a recent emphasis in curricula on empathy and cultural sensitivity. Previous studies have also identified position as an influencing factor for person-centered care [13,26]. Therefore, further research is needed to explore more closely the interplay between clinical experience and job position, and how these characteristics influence person-centered care.

Intercultural communication skills emerged as the most significant factor influencing nurses' person-centered care. These skills are crucial for understanding patient needs, establishing trust, and enhancing satisfaction and outcomes in diverse healthcare settings [10,11]. Furthermore, intercultural communication skills constitute a core element of multicultural care [24], and higher multicultural awareness is linked to improved intercultural communication abilities [21]. Therefore, promoting interest and awareness in multiculturalism is likely to further enhance intercultural communication skills. There is a need to explore in greater depth the effects of intercultural communication skills on nurses' psychological attributes and behaviors, and to integrate these insights into nursing education curricula.

The second most influential factor was compassion competence, which is an essential personal attribute for delivering person-centered care [12]. Compassion competence is closely linked to building therapeutic relationships founded on trust, facilitating effective communication, resolving conflicts, and performing care activities [7,22]. Higher levels of compassion competence [13,14] and compassion satisfaction [15,27] have both been positively associated with person-centered practices. Nurses who are able to empathize with their patients are better positioned to achieve positive patient outcomes [28]. To strengthen nurses' capacity for empathy in person-centered care, strategies should emphasize the development of strong therapeutic relationships, active listening, and reflective practice [29]. Future research should focus on designing and validating strategies to enhance both compassion competence and compassion satisfaction.

Cultural competence was the third factor identified as influencing person-centered care. Education and training in cultural competence are essential for contemporary nursing practice [3]. Multicultural nursing courses have been shown to significantly improve cultural competence among nursing graduates [23]. Additionally, although not measuring precisely the same variable, a study on nursing students [15] found that higher levels of cultural empathy and transcultural self-efficacy correlated with increased person-centered care, supporting the present findings. The lack of culturally appropriate policies and training impedes the delivery of culturally competent care [30]. Therefore, research and interventions should focus on building cultural databases, developing educational resources reflecting multicultural needs, and conducting further related studies.

Non-shift work was the final factor found to influence person-centered care. Few studies have directly compared shift work and non-shift work with respect to person-centered care, highlighting an area in need of further research. Chun et al. [31] reported that day shift nurses showed higher compassion levels than shift workers and had greater patient interaction due to fixed schedules, which may enhance interpersonal skills. Shift work is associated with increased job stress and fatigue, both of which can adversely affect nurses' health, well-being, and patient outcomes [32,33]. These findings suggest that work schedules may play an important role in nurses' ability to provide person-centered care. Further research should examine the impact of shift work environments on person-centered care, extending beyond fatigue and stress to include broader aspects of job satisfaction and interpersonal relationships.

This study underscores the importance of nurses' adaptation to multicultural environments and the necessity of providing person-centered care. It also proposes the need for concrete educational programs to support this goal. Programs that incorporate simulations, role-playing, case-based learning, an understanding of specific cultures, and communication skills can significantly enhance practical readiness [3,29]. Importantly, there is a notable disparity between the high rate of experience in caring for multicultural patients (73.3%) and the low rate of multicultural nursing education experience (7.3%). Similar trends have been observed in previous studies [23], which reported rates of 83.3% and 5.6%, respectively. This suggests that nurses are often exposed to multicultural care environments without sufficient preparation, potentially increasing their burden and leading to cultural misunderstandings. If cultural characteristics are overlooked in communication, patients may not receive appropriate care and may even face misdiagnosis [34]. Expanding educational opportunities at the systemic level, beyond individual initiatives, is therefore critical.

This study has several limitations. It employed a convenience sampling method and included nurses from a specific region, which may restrict the generalizability of the findings and limit the ability to explain causal relationships between variables. Additionally, the lack of research on factors related to shift work, and the use of self-reported questionnaires, introduces the risk of social desirability bias. Due to the descriptive nature of the study, causal inferences cannot be made. Future research should include samples from diverse regions and groups, and utilize in-depth, multidimensional data collection to improve the validity of findings. Moreover, experimental or longitudinal designs could be adopted to investigate causal relationships and provide deeper insights into the dynamic interactions between variables.

CONCLUSION

This descriptive survey study investigated the effects of nurses' compassion competence, cultural competence, and intercultural communication skills on person-centered care. The findings confirmed that compassion competence, cultural competence, intercultural communication skills, and work patterns significantly influence person-centered care among nurses. Future research should focus on developing and validating systematic, sustainable educational programs and assessment tools to support nurses working in multicultural settings, enabling them to understand cultural differences and communicate effectively. Additionally, in-depth analyses of the impact of work types and environments on person-centered care are needed, along with practical strategies to enhance both nurse job satisfaction and patient satisfaction in subsequent studies.

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CONFLICTS OF INTEREST

The authors declared no conflict of interest.

AUTHORSHIP

Study conception and/or design acquisition - HJ and YAK; statistical analysis and drafted the manuscript - HJ; critically reviewed the manuscript and supervised the whole study process - YAK; all authors read and approved the final manuscript.

FUNDING

None.

ACKNOWLEDGEMENT

This article is a condensed form of Heesun Jang's master's thesis from the Jeju National University.

DATA AVAILABILITY STATEMENT

The data can be obtained from the corresponding authors.

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Instructions for Authors

Korean Journal of Adult Nursing
Enacted in June 1994, most recently revised in May 2025 and, applied from Vol. 37, No. 2 (May 2025).

KJAN
Korean Journal of Adult Nursing

Table of Contents

I. AIMS AND SCOPE

The *Korean Journal of Adult Nursing* (KJAN) is the official peer-reviewed research journal of the Korean Society of Adult Nursing (KSAN). KJAN is devoted to the dissemination of groundbreaking research on theory, practice, and education in the field of adult nursing. Research on other subject areas or issues that contribute to adult nursing is published at the discretion of the Editorial Board. The goal of KJAN is to contribute to health maintenance, health promotion, and disease prevention and management in adults by publishing research. KJAN is published four times per year at the end of February, May, August, and November.

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If a manuscript is based on a master's thesis or doctoral dissertation, the author must disclose that the manuscript is the product of his/her thesis or a dissertation for an academic degree. The first author must be the recipient of the academic degree from the work presented in the manuscript.

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At submission, authors are required to disclose whether they used AI-assisted technologies (such as Large Language Models [LLMs], chatbots, or image creators) in their work. Authors should describe how they used AI-assisted technologies in both the cover letter and the appropriate section of the manuscript. For example, if AI was used for writing assistance, this should be described in the Acknowledgments section. If AI was used for data collection, analysis, or figure generation, the authors should describe this use in the Methods section. Chatbots (such as ChatGPT) should not be listed as authors because they cannot be held responsible for the accuracy, integrity, and originality of the work, and these responsibilities are required for authorship. Therefore, authors are responsible for any submitted material that included the use of AI-assisted technologies. Authors should carefully review and edit AI-generated results because AI can generate authoritative-sounding output that can be incorrect, incomplete, or biased. Authors must ensure there is appropriate attribution of all quoted material, including full citations, and should not list AI and AI-assisted technologies as an author or co-author, nor cite AI as an author.

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3) *Invited Articles* provide concise reviews of a subject of importance to nursing researchers written by an invited expert in nursing science.
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7) **References and citation style:** References and citations follow the National Library of Medicine (NLM) Style. The submitting authors are responsible for ensuring adherence to NLM guidelines.

3. Research Reporting Guidelines

Authors are encouraged to adhere to relevant reporting guidelines when describing their study. Reporting guidelines endorsed by the journal are listed below, from the EQUATOR network (https://www.equator-network.org/).

Observational cohort, case-control, and cross-sectional studies
Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)
Meta-analysis of Observational Studies in Epidemiology (MOOSE)
Qualitative studies
Consolidated Criteria for Reporting Qualitative Research (COREQ)
Standards for Reporting Qualitative Research (SRQR)
Quasi-experimental/ non-randomized trials
Transparent Reporting of Evaluations with Non-randomized Designs (TREND)
Randomized (and quasi randomized) controlled trials
Consolidated Standards of Reporting Trials (CONSORT)
Study of Diagnostic accuracy/assessment scale
Standards for the Reporting of Diagnostic Accuracy Studies (STARD)
Systematic Review and meta-analysis
Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA)
Meta-analysis of Observational Studies in Epidemiology (MOOSE)
Quality improvement studies
Standards for Quality Improvement Reporting Excellence (SQUIRE)

4. Manuscript Components

The composition of manuscripts shall be in the following order: title page, abstract and keywords, main text, references, tables and figures, and appendices. Each section begins on a new page. The main body of the manuscript (including the references, figures, tables, acknowledgements, and any funding information) should not include any identifying information, such as the authors' names or affiliations, to ensure a blind review.

1) Title page

The following should be included on the title page: (1) the title of the article; (2) the running title; (3) author information (ORCID number is required for all authors); (4) permission for measurements/instruments used in the study; (5) IRB approval institution and number; (6) disclosure; and (7) reporting guidelines checklist relevant to the research design used.

2) Abstract and Keywords

An abstract of up to 250 words for articles (including reviews) should be typed double-spaced on a separate page. It should cover the main factual points, including statements of the Purpose, Methods, Results, and Conclusion. The abstract should be accompanied by a list of three to five keywords for indexing purposes. Medical Subject Headings (MeSH) keywords (http://www.nlm.nih.gov/ mesh/meshhome.html) should be used, with careful selection of keywords that precisely reflect the focus of the study.

3) Main text

The text should be composed in the following order: Introduction, Methods, Results, Discussion, Conclusion, and References.

Introduction: Clearly state the need for this study and the main question or hypothesis of the study. Summarize the literature review or background in the area of the study.

Methods: Describe the study design, setting and samples, measurements/instruments, data collection/procedure, ethical considerations, and data analysis. If a study presents qualitative research, the instrument can be omitted. When discussing research methods, it is important to provide specific and detailed information to enable reproducibility. In the section on ethical considerations, the author should state that the study protocol was approved by the institutional review board (IRB No. ##-##-###). Please provide the initials of institutional names at the time of submission for peer review.

Results: Describe the main results in a concise paragraph. This section should be the most descriptive.

Discussion: The discussion should be based only on the reported results. It is strongly recommended that authors discuss how the study findings relate to advances in nursing practice, nursing knowledge development, and nursing implications.

Conclusion: State the conclusions and recommendations for further study. Do not summarize the study results.

4) References

In-text Citation: Citations of references in the text should follow Citing Medicine: The NLM Style Guide for Authors Editors, and Publishers 2nd edition (http://www.nlm.nih.gov/citingmedicine). References should be numbered serially in the order of appearance in the text, with numbers in brackets [ ] (e.g., social support [1], fatigue [2,3], depression [4-6]). If a reference is cited more than once, use the original reference number (e.g., social support [1,2], fatigue [2-5], depression [1,4-6]).

Reference list: References should be listed on a separate page at the end of the paper in the order of citation. The number of references should be 35 or less for an original article except for a manuscript on model construction, which is allowed to include up to 50 references. Citations of master's and doctoral dissertations should be minimized, with a maximum of three citations.

5) Tables and Figures

There should be no more than five tables and figures in total. Tables and figures should be self-contained and complement, but not duplicate, information contained in the text. Each table and figure should be placed on a separate page. All lines are to be single. Vertical lines are not acceptable. The title of a table should be placed on top. Within the title, the first letters of important words should be capitalized (e.g., Table 1. Clinical Characteristics of the Sample). The title of the figure should be placed below the figure with the first letter capitalized (e.g., Figure 1. Path diagram of the model.). Tables and Figures should be numbered consecutively in Arabic numerals. All abbreviations used in tables should be explained in footnotes. List abbreviations in alphabetical order; do not include the word “and” before the last abbreviation (e.g., BP = blood pressure; ED = emergency department). Footnote symbols including asterisks and other symbols should be placed after abbreviations in the table. Table footnotes should be indicated with superscript symbols in sequence: †, ‡, §, ∥, ¶, #, *, ††

If the point value of a number can exceed 1, write “0” before the decimal point (e.g., $t = 0.26$, $F = 0.98$, $R^2 = .61$), otherwise do not write “0” before the decimal point (e.g., $p < .001$). The p value (as an indicator of statistical significance) should be written without a footnote and should be rounded to three decimal places (e.g., $p = .003$). If “*p*” is .000, then indicate that p is less than 0.001 (e.g., $p < .001$). Percentages (%) should be rounded off to one decimal place (e.g., 24.7%); test statistics, such as t, F, x^2, and r, should be rounded off to two decimal places (e.g., $t = 0.26$, $F = 0.98$, $R^2 = .61$).

6) Appendices

Authors should submit an appendix containing the final developed instrument in instrument development studies and a list of reviewed articles in a systematic review or meta-analysis.

5. Reference Format

1) Journals

(1) For six or fewer authors, list all authors:

1. Han S, Min J, Kim DK, Kong ID, Kim N. The understanding and application of telomere length as an emerging biomarker in adult nursing research: a review. Korean J Adult Nurs. 2023;35(1):1-12. https://doi.org/10.7475/kjan.2023.35.1.1

(2) For more than six authors, list the first six followed by et al.

1. Lee S, Kim MK, Hong EY, Lee JJ, Kim HJ, Kim HS, et al. Structural equation modeling on spiritual nursing care of clinical nurses based on the theory of planned behavior. Korean J Adult Nurs. 2022;34(1):27-38. https://doi.org/10.7475/kjan.2022.34.1.27

(3) Forthcoming journal articles

1. van Corven CT, Bielderman A, Wijnen M, Leontjevas R, Lucassen PL, Graff MJ, et al. Defining empowerment for older people living with dementia from multiple perspectives: a qualitative study. Int J Nurs Stud. Forthcoming 2020 Nov 10. https://doi.org/10.1016/j.ijnurstu.2020.103823

2) Periodicals or magazines

1. Rutan C. Creating healthy habits in children. Parish Nurse Newsletter. 2012 May 15:5-6.

3) Newspaper articles

1. Cho CU. Stem cell windpipe gives Korean toddler new life. The Korea Herald. 2013 May 1; Sect. 01.

4) Books

(1) Reference to an entire book

1. Hughes JH. Military veteran psychological health and social care: contemporary issues. 1st ed. London: Taylor & Francis; 2017.
2. Kim SJ. Nursing theory. Seoul: Soomoonsa; 1985.

(2) Chapter in an edited book

1. Miller CW. Applied cardiovascular physiology. In: Wingfield WE, Raffe MR, editors. The veterinary ICU book. Jackson, WY: Teton NewMedia; 2002. p. 1-14.

(3) An edited book

1. Munslow A, Rosenstone RA, editors. Experiments in rethinking history. New York, NY: Routledge; 2004.

(4) Unknown authors or editors

1. Merriam-Webster’s collegiate dictionary. 10th ed. Springfield, MA: Merriam-Webster; 1995.

(5) Book with translator(s)

1. McEwen M, Wills EM. Theoretical basis for nursing. 4th ed. Koh CK, translator. Philadelphia, PA: Wolters Kluwer; 2019. p. 20-5.

(6) An encyclopedia or dictionary

1. Sadie S, editor. The New Grove dictionary of music and musicians. 6th ed. London: Macmillan; 1980.
2. Fitzpatrick JJ, Wallace M, editors. Encyclopedia of nursing research. 3rd ed. New York, NY: Springer Publishing Company; 2012.

5) Scientific and technical reports

1. Hong S, Sung M, Choi J, Kim J, Kim S. Family policies implications in the context of an increase in one-person households. Korean Women’s Devel-

opment Institute Report. Seoul: Korean Women's Development Institute; 2017 July. Report No.: 1105012716.

6) Unpublished dissertations and theses: Not recommended. Maximally three dissertations and theses in total are al- lowed if necessary.
  (1) Dissertations
    1. Zhao JJ. Design of a 3D virtual learning environment for acquisition of cultural competence in nursing education: experience of nursing and other health care students, instructors, and instructional designers [dissertation]. Vancouver: University of British Columbia; 2019. p. 100-5.
  (2) Theses
    1. Huh MS. Effect of Danjeon breathing on stress urinary incontinence and quality of life in middle aged wom- en [master's thesis]. Busan: Dongeui University; 2005.

7) Conference proceedings
  (1) Unpublished proceedings
    1. Lankntree C, Briere J. Early data on the trauma symp- tom checklist for children (TSCC). Paper presented at: The meeting of the American Professional Society on the Abuse of Children; 1991 January 25; San Diego, CA.
  (2) Posters
    1. Cho YJ, Han YR. The relationship between the professional self concept, work stresses and their triage competency in emergency nurses. Poster session pre- sented at: Korean Society of Nursing Science; 2020 October 23; Seoul.

8) Web
    1. Ministry of the Interior and Safety. Safety experience center [Internet]. Sejong: Ministry of the Interior and Safety; 2022 [cited 2023 January 12]. Available from: https://www.mois.go.kr/frt/sub/a06/b10/safe- tyExperience/screen.do

IV. SUBMISSION AND PEER REVIEW

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After making changes to the manuscript, the author should upload the updated files along with a response to each reviewer's comment. Revisions from the author must be finished within 14 days of the request. The Editorial Board will inform the author if it is not received by the deadline. The author should discuss an extension with the Editorial Board if they want to prolong the revision window past 14 days. The Editorial Board may consider further review upon the author's request. The Editorial Board will ultimately decide whether to approve the submitted manuscript for publication and may, if necessary, ask for additional alterations, edits, and deletions to the article text. Statistical editing is also done if a statistician needs to review the data professionally.

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☐ The number of references should be 35 or fewer (50 or fewer for model construction).
☐ References follow NLM style.
☐ All references are written with DOIs.
☐ All citations in the paper should have a complete and accurate corresponding reference in the reference list.
☐ Present recent (within 5 years) articles to the extent possible.

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