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Original Article

# Development of a Korean version of the Frailty Model with a Holistic Perspective: A Delphi Study

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**Purpose:** This study aimed to develop a Korean version of the frailty model that reflects a holistic perspective. There were three phases of the study: a literature review, a two-round Delphi study, and a public hearing. **Methods:** The model was developed based on the middle-range theory generation approach proposed by Roy. A literature search was conducted, and a review of 36 studies on frailty involving Koreans led to the development of an initial frailty model. A two-round Delphi study was then conducted with nine experts to evaluate the appropriateness of the model. The revised model was presented at a public hearing to achieve consensus. Based on feedback indicating the need for improved visualization, a finalized diagrammatic model was developed. **Results:** The final frailty model comprised four domains, seven subdomains, and 30 items. It included specific items reflecting the distinctive characteristics of Korean culture, such as relationships with adult children (filial piety), nutritional status (consumption of red meat), and type of residential building. **Conclusion:** The final frailty model provides a comprehensive perspective on the factors contributing to frailty, their interactions, and the potential interventions that healthcare providers can implement to prevent frailty.

**Key Words:** Asian; Frailty; Health promotion; Nurses

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## INTRODUCTION

Frailty is an age-related syndrome characterized by decreased physical function, impaired stress tolerance, and an increased risk of negative health outcomes [1]. Before reaching a frail state, individuals remain in a clinically silent phase with an increased risk of progressing to frailty; researchers have defined this condition as prefrailty [2]. A recent review of 240 studies found that the overall prevalence of frailty in adults aged 50 and older ranged from 12% to 24%, while the prevalence of prefrailty ranged from 46% to 49%[3]. In South Korea, the national prevalence of frailty among those aged 65 and older was 23.1% in 2020, aligning with the global average [4]. As global life expectancy rises, the concept of frailty has become increasingly significant for healthy aging. The literature indicates that frailty is associated with several negative health outcomes, including falls, fractures, dependency, hospitalization, cognitive decline, and increased mortality [5]. To mitigate these risks, frailty should be managed at an early stage by assessing risk factors for frailty.

To enable early identification and intervention for frailty, appropriate measurement tools are essential. In response to this need, researchers have developed various instruments to assess frailty and understand its underlying causes [6, 7]. Among these, the frailty measure proposed by Fried and colleagues is widely used in both clinical and community settings [6]. Within this framework, known as the frailty phenotype, frailty is characterized by five criteria: (a) unintentional weight loss of at least 4.5kg in the past year, (b) self-reported exhaustion, (c) weakness, (d) slow gait speed, and (e) low physical activity. Individuals meeting at least three of these criteria are classified as frail [6]. However, other measurements of frailty are also commonly employed. One such measure is the frailty index, which quantifies frailty by dividing the number of health deficits an individual has by the total number of deficits assessed [7]. The scores range from 0 to 1, with higher scores indicating greater frailty.

Existing frailty measures are simple and easy to apply, enabling the rapid identification of clinical features indicative of frailty [8]. They also provide clear cutoff scores for assessing the degree of frailty, thereby assisting clinical decision-making [6-8]. Despite these strengths, concerns have been raised that current frailty measures may not fully capture the complexity of the condition, particularly from a holistic nursing standpoint [9,10]. For example, the Fried phenotype, proposed by Fried and colleagues, assesses the degree of frailty based solely on clinical features indicative of physical weakness, without taking into account psychological, social, or environmental factors [6]. Nursing emphasizes a holistic approach that considers the physical, psychological, and social domains of individuals, as well as their surrounding environments [11,12]. These domains have not been fully considered in existing frailty measures [9]. Therefore, a holistic frailty model is needed to increase the accuracy of frailty assessments and care delivery.

Studies conducted in South Korea have predominantly used the frailty phenotype and frailty index to assess the extent of frailty [4,13,14]. However, the suitability of these frailty measures for the Korean population remains questionable. Extant frailty measures were primarily developed based on research conducted with non-Asian populations, particularly North American populations [6, 7]. Given that Asians have different physical conditions, lifestyles, health behaviors, and diseases, the current frailty measures may not be suitable for assessing frailty in Asian populations [15]. While Asian countries share certain similarities, notable differences exist among them in dietary habits, health cultures, and the prevalence of chronic diseases [16]. Therefore, it is necessary to develop a frailty model tailored to the characteristics of the Korean population. For example, protein intake related to muscle synthesis is crucial for preventing frailty. However, Korean older adults tend to reduce meat consumption as they age and are more likely to believe that a vegetarian diet is beneficial for their health [17]. Cultural differences can significantly influence the development of frailty, yet current frailty measures fail to adequately address these factors.

To fill this gap, we developed a Korean version of the frailty model. The aim of this study was to create a model that embodies a comprehensive nursing perspective on frailty and incorporates the cultural characteristics of Koreans. The new frailty model is expected to meet the needs of healthcare providers seeking an assessment tool that is more appropriate for Koreans. Once validated, this model could be a foundational framework for developing culturally adapted frailty assessments in other Asian populations with similar characteristics.

## METHODS

### 1. Design

A three-phase study was conducted to develop the Korean version of the frailty model (Figure 1). The initial phase involved a comprehensive literature search to identify frailty risk factors in Koreans. This phase led to the discovery of key risk factors and the development of a draft

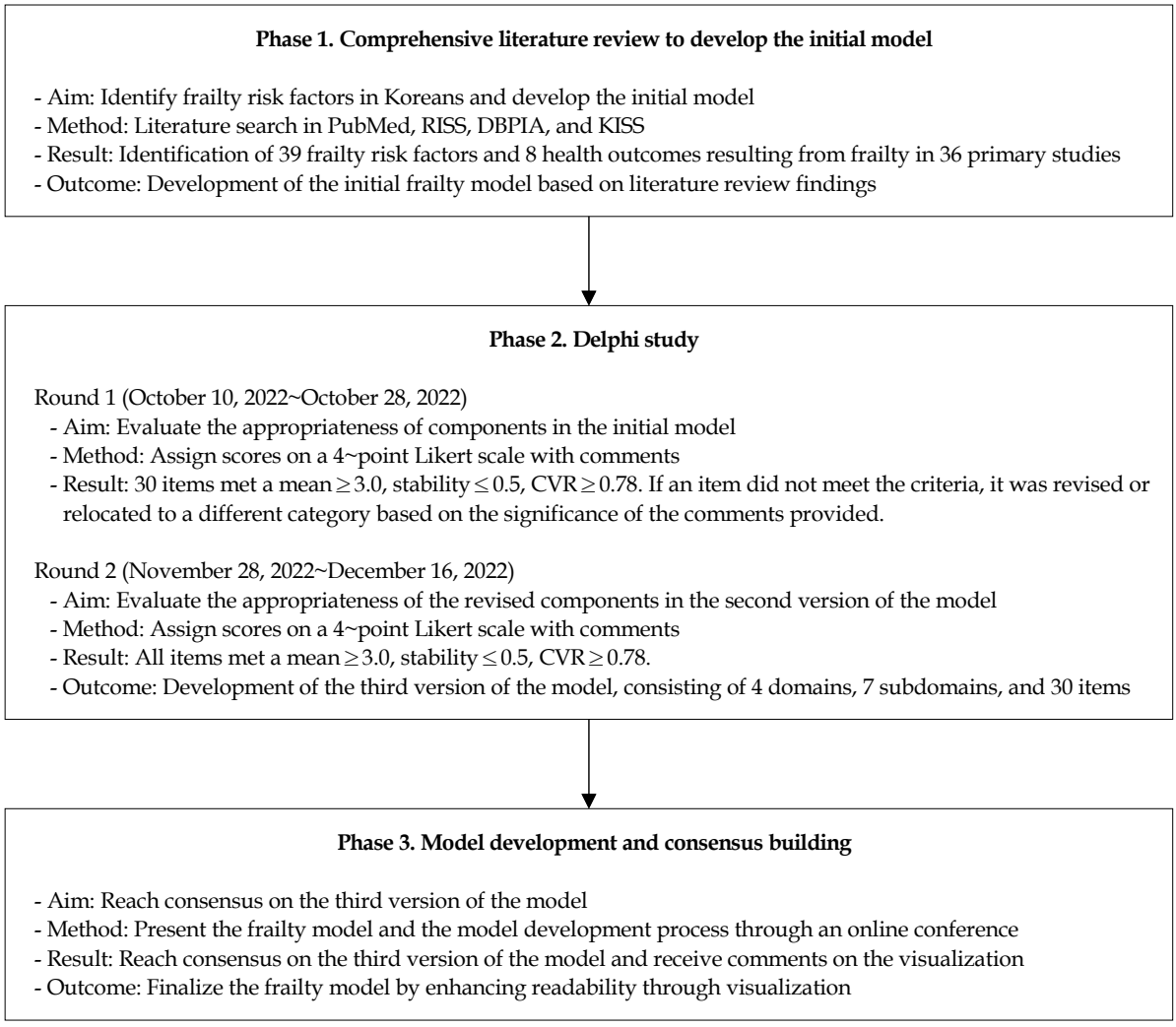


**Figure 1.** Process of the development of a Korean version of the frailty model.

frailty model. The second phase consisted of a two-round Delphi study aimed at collecting expert opinions on the draft model. Following the Delphi study, the second and third versions of the frailty model were formulated. In the final phase, additional feedback was solicited from nursing experts during public hearings to achieve consensus on the completed frailty model.

## 2. The Theoretical Framework

The model development process was based on the method for generating middle range theory proposed by Roy [18]. Roy outlined six steps to derive a middle range theory from related studies: (1) identifying relevant studies and grouping them by similarities, (2) pinpointing the major findings of these studies, (3) assessing the specificity of the concepts to determine their generalizability, (4) creating a schema of the major and interrelated concepts, (5) elucidating the relationships between the major and interrelated concepts, and (6) substantiating the newly developed theory with data-driven evidence. In our three-phase study, we developed a model following the steps outlined by Roy [18]. We completed up to the fifth step in this study.

## 3. Phase One: Comprehensive Literature Review

### 1) Literature search process

Three researchers conducted a thorough literature review to identify studies on frailty risk factors among Koreans. They adhered to the guidelines suggested by Templier and Paré[19]. A specific research question was developed using the population-intervention or exposure-comparison-outcome (PICO) framework, asking: What are the factors that influence frailty in Koreans? The literature

search spanned several databases, including PubMed, RISS, DBPIA, and KISS, with additional searches in various Korean databases. The search terms used were: (frailty OR frail) AND (influence OR risk OR related OR affect) AND (Korean OR Korea). Studies qualified for inclusion in the review if they (a) provided information on factors related to frailty in Koreans, (b) were written in either English or Korean, and (c) were available as full-text articles. The search did not place a restriction upon publication dates.

The initial search yielded 642 studies, from which 266 duplicates were removed. After reviewing the titles and abstracts, 292 studies were excluded. Of the remaining studies, 48 were further excluded for the following reasons: lack of information (n=34), irrelevance to Koreans (n=3), and absence of full text (n=11). Ultimately, 36 studies were included in the review (Figure 2).

**2) Data analysis**

Three researchers thoroughly reviewed the full texts of 36 studies. They extracted data on the study design, demographic characteristics, factors related to frailty, and the consequences of frailty. The data were compiled into a matrix table and organized by similarity. When the same factor was categorized into multiple groups, the researchers engaged in discussions until they reached a consensus on the most appropriate grouping. From these findings, we developed an initial frailty model that includes four domains, each with three levels: domain, subdomain, and items.

## 4. Phase Two: Delphi Study

**1) Expert panel**

The criteria for the expert panel included healthcare professionals who: (a) had conducted research on frailty

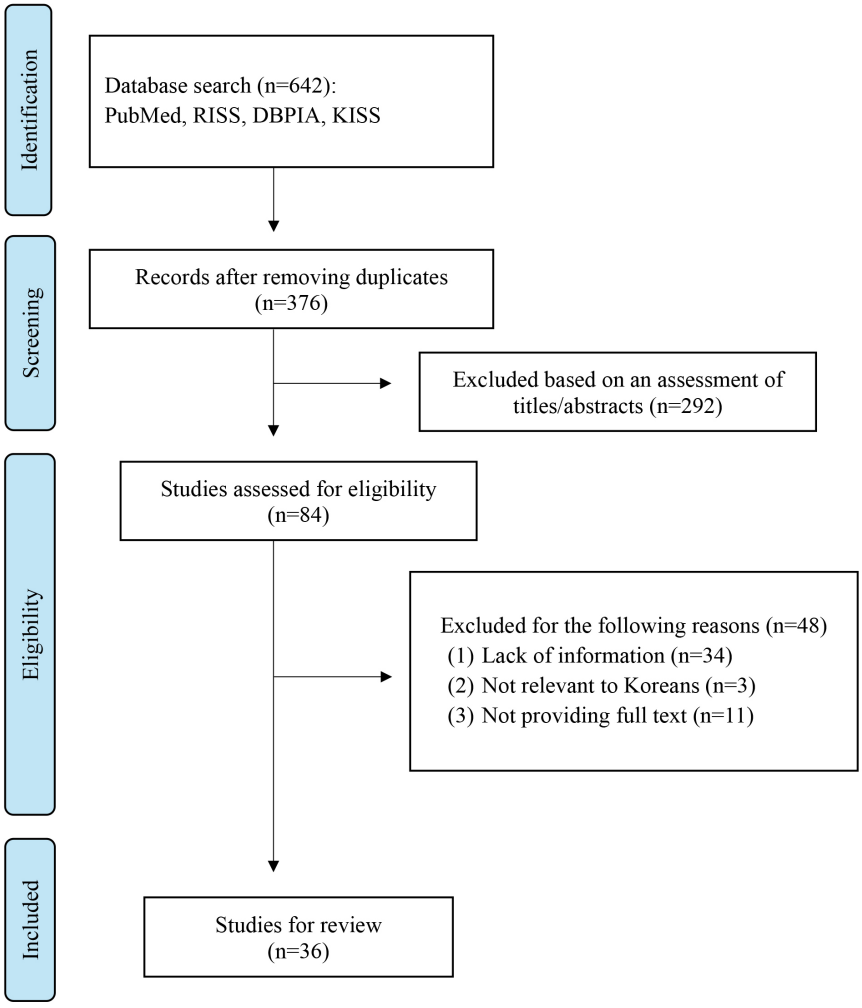


**Figure 2.** The PRISMA flow diagram for the literature review.


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within the past 5 years, (b) had at least 5 years of work experience with frail populations, (c) held a doctoral degree in a medical-related field, and (d) were actively working in their filed. Keeney and colleagues stated that the appropriate size of an expert panel may vary according to the purpose, design, and time constraints of the study; however, they recommended the inclusion of at least 10 experts [20]. Furthermore, they emphasized the importance of incorporating a heterogeneous group to ensure a comprehensive range of perspectives [20]. In this study, 10 healthcare professionals who met these criteria were identified through Google Scholar and healthcare websites. We contacted these professionals via email, providing information about the study and inviting them to participate in the Delphi study. Among 10 healthcare professionals, nine agreed to participate in two rounds of the Delphi study, and 66.7% were nursing experts (Table 1). They received an informed consent form, detailed information about the Delphi study, and an evaluation form for the model via email.

**Table 1.** General Characteristics of the Experts (*N*=9)

| Variables | n (%) or M±SD |
|---|---|
| Gender, Women | 7 (77.8) |
| Age | 51±5.7 |
| Specialization in doctoral degree | |
| Medicine | 3 (33.3) |
| Nursing | 6 (66.7) |
| Professional status | |
| Working in clinical practice | 5 (55.6) |
| Working in educational program | 4 (44.4) |
| Research experience on frailty | 8±1.4 |
| Clinical experience working with frail populations | 13±3.6 |

M=mean; SD=standard deviation.

**2) Methods**

Two researchers developed an evaluation form based on a literature review. The evaluation form was composed of items that constituted the initial model. The evaluation form used in the first round included 39 items across four domains and seven subdomains, while the form in the second round comprised 30 items categorized into the same domains and subdomains. The expert panel was asked to evaluate the appropriateness of each item using a 4-point Likert scale, where 1 represented "strongly disagree" and 4 represented "strongly agree." Higher scores denoted greater perceived appropriateness [20]. Additionally, an opportunity was provided for the expert panel to offer subjective feedback on each item to gather their insights.

**3) Data collection and analysis**

The first round of the Delphi study was conducted from October 10, 2022 to October 28, 2022, and the second round was conducted from November 28, 2022 to December 16, 2022. The expert panel was given two weeks to evaluate the items and was asked to return the completed evaluation form by email. In each round, the returned evaluation forms were anonymized, and the data were entered into an Excel sheet for analysis. To refine items, the mean, standard deviation, stability, content validity ratio (CVR), degree of convergence (CVG), and degree of consensus (CSS) for each item were calculated. With a panel of nine experts, a CVR value of 0.78 or higher is required to confirm content validity [21]. A CVG value closer to 0 indicates greater convergence of the experts' opinions, while a CSS value closer to 1 suggests less variation in their opinions. Stability refers to the consistency of responses across repeated surveys, with a value of 0.50 or lower considered acceptable [22].

The criteria for determining item appropriateness were set as follows: mean $\geq$3.5, stability $\leq$0.5, and CVR $\geq$0.78. Although CVR and CSS were not used as primary criteria for determining item appropriateness, they were considered as supplementary references. Even if an item did not meet the evaluation criteria, any significant subjective feedback provided by experts led to revisions of the item or its relocation to a different category. The items and categories were revised over two rounds of the Delphi study.

## 5. Phase 3: Model Development and Consensus Building

To achieve consensus on the final frailty model, we conducted a public hearing and presented the model through an online conference platform. An advertisement poster for the public hearing was distributed via email to nursing graduate students, nursing faculty members, nurses affiliated with the university hospital, and clinical professionals to invite their participation. After presenting the final frailty model and the development process, questions and opinions were received through an online chat and verbally. All proceedings were recorded on video, and the collected feedback was subsequently documented.

### 6. Ethical Considerations

Ethical approval was obtained from the Institute Review Board of the S Hospital Human Research Protection Center (No. 4-2022-0955). Prior to initiating the second phase of a three-phase Delphi study, we thoroughly explained the study's objectives, procedures, expected benefits, potential risks, and the participants' right to withdraw to the expert panel. Only those experts who agreed to participate completed the informed consent process.

## RESULTS

### 1. Literature Review

Based on the literature review, an initial frailty model was developed, comprising four domains, seven subdomains, and 39 items. The initial set of items, derived from the literature review matrix, consisted of 46 items; however, similar items were consolidated for conciseness, resulting in a final total of 39 items.

The first domain, demographic characteristics, comprised six items (i.e., age, gender, race, marital status, socioeconomic status, and relationships with adult children) without any subdomains. The second domain, intrinsic factors, included 17 items organized into three subdomains: functional factors, health-related factors, and psychological factors. The third domain, extrinsic factors, contained eight items in two subdomains: living environment and social/community environment. The fourth domain was health-related outcomes that represent the consequences of frailty. In the fourth domain, eight items were included in two subdomains: short-term and long-term. The short-term subdomain refers to health-related outcomes within 5 years resulting from frailty, while the long-term subdomain pertains to health-related outcomes occurring more than 5 years after becoming frail [23].

### 2. Delphi Study: First Round

The expert panel evaluated 39 items, and each item was analyzed using mean, standard deviation, stability, CVR, CVG, and CSS (Table 2). In the first domain (demographic characteristics), race was deleted due to a low mean score and CVR. The expert panel agreed to delete this item, as race has not been a significant consideration in South Korea to date. In the second domain (intrinsic factors), four items did not meet the criteria (intellectual activity, smoking, alcohol intake, abnormal biomarkers) were moved to other subcategories rather than deleted, based on expert feedback. Over 70% of experts indicated that these items were unsuitable as independent factors, but they could be appropriate as sub-items within broader constructs. Accordingly, intellectual activity was moved to the subcategory of cognitive function, and smoking and alcohol intake were placed under a new subcategory, health habits. Abnormal biomarkers were moved to the subcategory of objective health. The expert penal recommended deleting two items (quality of life, trust in healthcare providers) in the second domain. Experts explained that it is more appropriate to consider quality of life as a result rather than a cause of frailty, and that trust in healthcare providers should be integrated into the items of the third domain (extrinsic factors).

All items in the third domain (extrinsic factors) satisfied the criteria. In the fourth domain (health-related outcomes), the items related to admission period and non-home discharge did not meet the criteria. Additionally, these items were deemed inappropriate based on expert feedback and were subsequently deleted. Through data analysis, 39 items were revised and refined into 30 items, and the second version of the model was developed.

### 3. Delphi Study: Second Round

The expert panel evaluated 30 items, and each item was analyzed using the same statistical methods as in the first round (Table 3). Expert feedback and the same statistical criteria were considered collectively to determine the appropriateness of items. In the second round of the Delphi study, all items met the criteria, demonstrating a mean $\geq 3.5$, stability $\leq 0.5$, and CVR $\geq 0.78$. The changes in the items based on the first and second rounds of the Delphi study are presented in Supplementary Appendix 1.

The third version of the model was developed based on the results of the second round of the Delphi study, and it comprised four domains, seven subdomains, and 30 items. To visualize the structure of the model, we focused on illustrating the interrelationships among influencing factors and highlighting the characteristics of each item. The third version of the model depicted the relationships between influencing factors, frailty, and outcomes resulting from frailty using arrows. Modifiable items were identified with an asterisk, while items measurable as continuous values were marked with a cross symbol. The direction of the relationship between item value and frailty was indicated by a black triangle symbol. For instance, we used a black triangle symbol to denote an increase in both age and frailty to illustrate that the risk of frailty increases with age. Additionally, we depicted the nursing area as

**Table 2.** Results of the Delphi Study (Round 1)

| Domain | Subdomain | Item | M±SD | Stability | CVR | CVG | CSS |
|---|---|---|---|---|---|---|---|
| Demographic characteristics | | Age | 3.78±0.44 | 0.12 | 1.00 | 0.00 | 1.00 |
| | | Gender | 3.75±0.46 | 0.12 | 0.78 | 0.13 | 0.94 |
| | | Race | 2.44±0.53 | 0.22 | -0.11 | 0.50 | 0.50 |
| | | Marital status | 3.22±0.44 | 0.14 | 1.00 | 0.00 | 1.00 |
| | | Socioeconomic status | 3.67±0.50 | 0.14 | 1.00 | 0.50 | 0.75 |
| | | Relationships with adult children | 3.78±0.44 | 0.12 | 1.00 | 0.00 | 1.00 |
| Intrinsic factors | Functional factors | Physical function | 4.00±0.00 | 0.00 | 1.00 | 0.00 | 1.00 |
| | | Cognitive function | 4.00±0.00 | 0.00 | 1.00 | 0.00 | 1.00 |
| | | Sensory function | 3.33±0.71 | 0.21 | 0.78 | 0.50 | 0.67 |
| | | Intellectual activity | 2.67±0.71 | 0.27 | 0.11 | 0.50 | 0.67 |
| | Health-related factors | Objective health | 3.89±0.33 | 0.09 | 1.00 | 0.00 | 1.00 |
| | | Subjective health | 3.78±0.44 | 0.12 | 1.00 | 0.00 | 1.00 |
| | | Smoking | 3.11±0.93 | 0.30 | 0.33 | 1.00 | 0.33 |
| | | Alcohol intake | 2.78±0.97 | 0.35 | -0.11 | 1.00 | 0.00 |
| | | Nutrition status | 3.78±0.44 | 0.12 | 1.00 | 0.00 | 1.00 |
| | | Physical activity | 4.00±0.00 | 0.00 | 1.00 | 0.00 | 1.00 |
| | | History of falls over the past year | 3.78±0.44 | 0.12 | 1.00 | 0.00 | 1.00 |
| | | Abnormal biomarkers | 2.89±0.78 | 0.27 | 0.33 | 0.50 | 0.67 |
| | | Comorbidities | 4.00±0.00 | 0.00 | 1.00 | 0.00 | 1.00 |
| | Psychological factors | Self-efficacy | 3.44±0.53 | 0.15 | 1.00 | 0.50 | 0.67 |
| | | Depression | 3.78±0.44 | 0.12 | 1.00 | 0.00 | 1.00 |
| | | Quality of life | 2.78±0.67 | 0.24 | 0.33 | 0.50 | 0.67 |
| | | Trust in healthcare providers | 2.56±1.13 | 0.44 | -0.33 | 1.00 | 0.00 |
| Extrinsic factors | Living environment | Residential building type | 3.44±0.53 | 0.15 | 1.00 | 0.50 | 0.67 |
| | | Hazards in residential area | 3.22±0.97 | 0.30 | 0.78 | 0.50 | 0.67 |
| | | Hospital/long-term care setting | 3.33±0.71 | 0.21 | 0.78 | 0.50 | 0.67 |
| | | Acute admission over the past year | 3.44±0.53 | 0.15 | 1.00 | 0.50 | 0.67 |
| | | Admission period | 3.78±0.44 | 0.12 | 1.00 | 0.00 | 1.00 |
| | Social, community environment | Health resources | 3.67±0.50 | 0.14 | 0.78 | 0.50 | 0.75 |
| | | Family/social support | 3.89±0.33 | 0.09 | 1.00 | 0.00 | 1.00 |
| | | Satisfaction with care | 3.44±0.53 | 0.15 | 1.00 | 0.50 | 0.67 |
| Health-related outcomes | Short-term (<5 years) | Falls | 4.00±0.00 | 0.00 | 1.00 | 0.00 | 1.00 |
| | | Healthcare costs | 3.89±0.33 | 0.09 | 1.00 | 0.00 | 1.00 |
| | | Complications | 3.78±0.44 | 0.12 | 1.00 | 0.00 | 1.00 |
| | | Admission period | 2.56±1.13 | 0.44 | -0.33 | 1.00 | 0.00 |
| | | Readmission | 3.67±0.50 | 0.14 | 1.00 | 0.50 | 0.75 |
| | | Non-home discharge | 3.11±0.93 | 0.30 | 0.33 | 1.00 | 0.33 |
| | Long-term (≥5 years) | Mortality | 3.78±0.44 | 0.12 | 1.00 | 0.00 | 1.00 |
| | | Quality of life | 3.67±0.50 | 0.14 | 1.00 | 0.50 | 0.75 |

Note. Items highlighted in gray indicate those that did not meet the criteria of mean ≥3.5, stability ≤0.5, CVR ≥0.78.
CSS=degrees of consensus; CVG=degrees of convergence; CVR=content validity ratio; M=mean; SD=standard deviation.

encircling frailty to highlight how nursing interventions can influence the level of frailty.

## 4. Public Hearing

After developing the third version of the model, we organized a one-day public hearing through an online conference platform. A total of 53 participants currently working or studying in healthcare fields attended the public hearing. During the presentation of the third version of the model, feedback indicated that the model's visual layout was unclear and difficult to interpret for conveying the model's structure. Based on the feedback, we reorganized the structure of the model to better represent the interre-

**Table 3.** Results of the Delphi Study (Round 2)

| Domain | Subdomain | Item | M±SD | Stability | CVR | CVG | CSS |
|---|---|---|---|---|---|---|---|
| Demographic characteristics | | Age | 3.89±0.33 | 0.09 | 1.00 | 0.00 | 1.00 |
| | | Gender | 3.67±0.71 | 0.19 | 0.78 | 0.00 | 1.00 |
| | | Marital status/Living together | 3.33±0.50 | 0.15 | 1.00 | 0.50 | 0.67 |
| | | Relationships with adult children | 3.67±0.71 | 0.19 | 0.78 | 0.00 | 1.00 |
| | | Socioeconomic status | 3.78±0.44 | 0.12 | 1.00 | 0.00 | 1.00 |
| Intrinsic factors | Functional factors | Physical function | 4.00±0.00 | 0.00 | 1.00 | 0.00 | 1.00 |
| | | Cognitive function | | | | | |
| | | - Health literacy | 3.78±0.44 | 0.12 | 1.00 | 0.00 | 1.00 |
| | | - Intellectual activity | | | | | |
| | | Sensory function | 3.44±0.53 | 0.15 | 1.00 | 0.50 | 0.67 |
| | | - Visual function | | | | | |
| | | - Hearing function | | | | | |
| | Health-related factors | Subjective health | 3.78±0.44 | 0.12 | 1.00 | 0.00 | 1.00 |
| | | Objective health | 3.78±0.44 | 0.12 | 1.00 | 0.00 | 1.00 |
| | | - Abnormal biomarkers | | | | | |
| | | Health habit | 3.44±0.73 | 0.21 | 0.78 | 0.50 | 0.75 |
| | | - Smoking | | | | | |
| | | - Alcohol intake | | | | | |
| | | - Physical activity | | | | | |
| | | Nutrition status | 4.00±0.00 | 0.00 | 1.00 | 0.00 | 1.00 |
| | | History of falls over the past year | 3.89±0.33 | 0.09 | 1.00 | 0.00 | 1.00 |
| | | Comorbidities | 3.89±0.33 | 0.09 | 1.00 | 0.00 | 1.00 |
| | Psychological factors | Self-efficacy | 3.56±0.53 | 0.15 | 1.00 | 0.50 | 0.75 |
| | | Depression | 3.89±0.33 | 0.09 | 1.00 | 0.00 | 1.00 |
| Extrinsic factors | Living environment | Residential building type | 3.78±0.44 | 0.12 | 1.00 | 0.00 | 1.00 |
| | | Hazards in residential area | 3.44±0.53 | 0.15 | 1.00 | 0.50 | 0.67 |
| | | Hospital/Long-term care setting | 3.56±0.53 | 0.15 | 1.00 | 0.50 | 0.75 |
| | | Acute admission over the past year | 3.22±0.44 | 0.14 | 1.00 | 0.00 | 1.00 |
| | | Admission period | 3.33±0.50 | 0.15 | 1.00 | 0.50 | 0.67 |
| | Social, community environment | Accessibility of health resources | 3.44±1.01 | 0.29 | 0.78 | 0.50 | 0.75 |
| | | Emotional-support network | 4.00±0.00 | 0.00 | 1.00 | 0.00 | 1.00 |
| | | Therapeutic network with healthcare professionals | 3.56±0.73 | 0.20 | 0.78 | 0.50 | 0.75 |
| Health-related outcomes | Short-term (<5 years) | Falls | 4.00±0.00 | 0.00 | 1.00 | 0.00 | 1.00 |
| | | Healthcare costs | 3.89±0.33 | 0.09 | 1.00 | 0.00 | 1.00 |
| | | Complications | 3.67±0.50 | 0.14 | 1.00 | 0.50 | 0.75 |
| | | Hospitalization | 3.67±0.50 | 0.14 | 1.00 | 0.50 | 0.75 |
| | Long-term (≥5 years) | Mortality | 3.89±0.33 | 0.09 | 1.00 | 0.00 | 1.00 |
| | | Quality of life | 4.00±0.00 | 0.00 | 1.00 | 0.00 | 1.00 |

CSS=degrees of consensus; CVG=degrees of convergence; CVR=content validity ratio; M=mean; SD=standard deviation.

lated nature of its components and visualized the items to reflect their hierarchical levels. In addition, color was applied to the previous black-and-white model to improve clarity and facilitate better interpretation. No additional comments were provided regarding the items comprising the model.

## 5. The Final Version of the Frailty Mode

The final version of the frailty model is presented in Figure 3. The model consisted of four domains, seven subdomains, and 30 items. Among the four domains, demographic characteristics, intrinsic factors, and extrinsic factors are identified as influencing factors of frailty. The model suggests that these three domains can interact with each other and either positively or negatively contribute to frailty. As individuals become frail, health-related outcomes emerge as a consequence of frailty. However, the model also indicates that frailty can be managed through nursing care, and health-related outcomes can be modi-

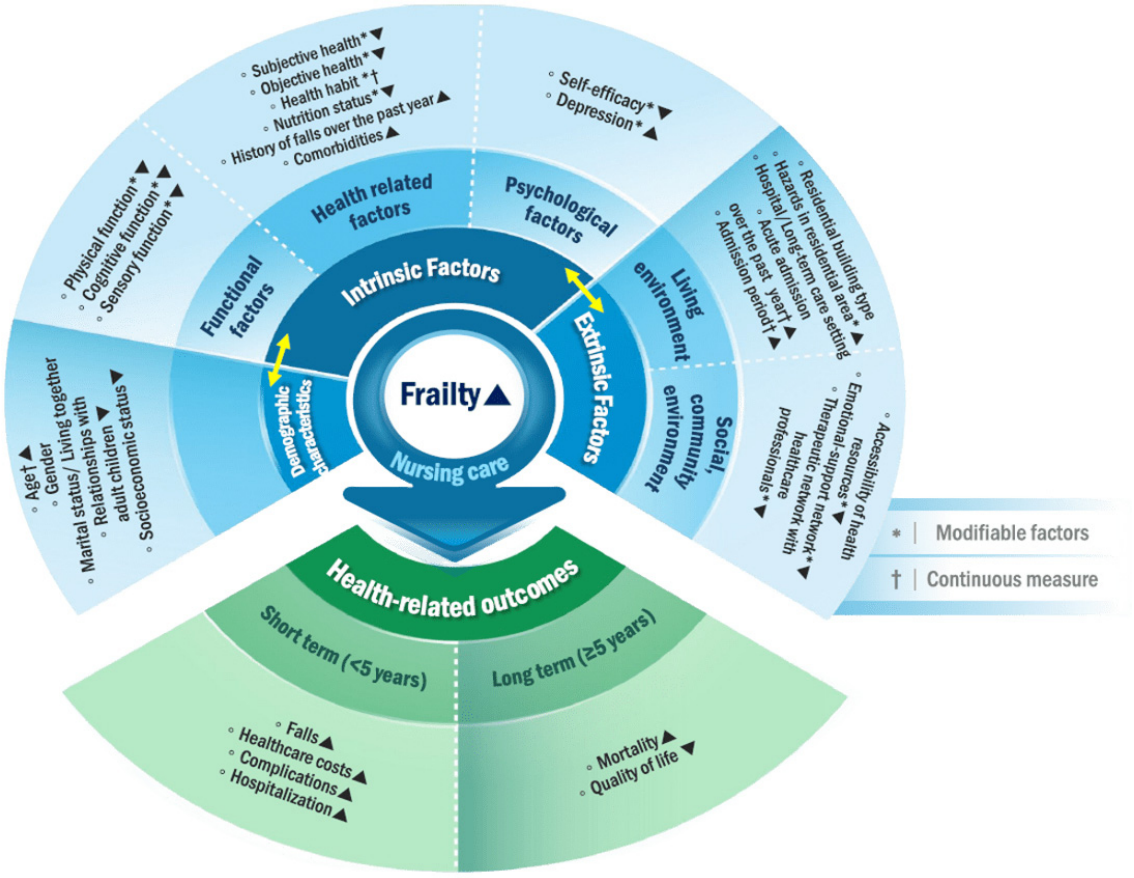


**Figure 3.** The final version of the Korean frailty model.

fied through such management.

Under each domain, subdomains and items are included according to their conceptual levels. The items are represented with various symbols to indicate whether they are modifiable, can be measured as continuous variables, and the direction of their relationship with frailty. For example, the domain of demographic characteristics includes age as an item. The model illustrates that age can be measured as a continuous variable and has a positive relationship with frailty. In some cases, items that could be included as sub-items exist independently. For example, under the subdomain of health-related factors, "history of falls over the past year" and "comorbidities" could have been included as sub-items under objective health. However, based on the expert panel feedback that these two items have a significant impact on frailty, they were placed as independent items to emphasize their importance.

## DISCUSSION

In this study, we developed a Korean version of the frailty model using a three-step process. The three-step process included a comprehensive literature review, two rounds of Delphi study, and a consensus-building process. The final version of the frailty model reflects the following cultural characteristics of Koreans. The domain of demographic characteristics included relationships with adult children, emphasizing filial piety. In Korea's distinct filial culture, children are expected to care for and obey their parents consistently. Older Koreans with strong ties to their adult children tend to experience less loneliness and report better health outcomes [24]. Additionally, when adult children provide financial support to their parents in line with filial norms, it enables the parents to afford better housing and adopt healthier behaviors [24,25].

In the domain of intrinsic factors, nutritional status was considered. Older Koreans often consume less red meat, attributing this choice to issues like poor digestion and constipation. Although protein is crucial for maintaining muscle mass, many older adults believe that a vegetarian diet is healthier [17]. Another dietary concern related to Koreans is the increase in carbohydrate intake as they age [17,26]. Healthcare experts have emphasized that the dietary habits of older adults in Korea, particularly their pref-

erence for foods such as noodles, rice cakes, and white bread, are factors contributing to obesity, type 2 diabetes, and muscle loss; experts recommend increasing protein intake to address this issue [27,28]. The phenomenon of low protein intake in older age has also been observed in Japan. Motokawa and colleagues reported that the average protein consumption of frail Japanese older adults was 83.3 g per day, which was relatively lower than the 86.2 g per day consumed by robust Japanese older adults [29]. Considering that frail older adults in Korea consumed an average of 45.3~50.1 g of protein per day, the decrease in protein intake in older age appears to be more pronounced in Korea [26].

In the domain of extrinsic factors, the type of residential building was included. According to the national statistics in 2021, apartments with elevators were the most prevalent form of housing in Korea, accounting for 64%[30]. Older adults residing in these apartments benefit from the use of elevators instead of stairs, reducing the risk of injuries such as falls [31]. Previous studies have indicated that safety incidents among older adults are more common in houses than in apartments, which has been attributed to the older architectural structures and stairs found in houses [32]. Given the widespread perception that living in apartments is more convenient, safer, and valuable than living in houses, it is presumed that older adults in Korea tend to prefer apartment living [33].

The final version of the frailty model integrates cultural and social factors specific to Korea, which can significantly influence the frailty process, distinguishing it from existing models. Gobbens and colleagues [34] proposed the integral conceptual model of frailty to explain the causes and consequences of frailty. According to the integral conceptual model of frailty, life-course determinants and disease lead to frailty, and adverse health outcomes may result from frailty. The related factors presented in the integral conceptual model of frailty are not classified according to conceptual levels, and do not reflect cultural characteristics [34]. Although this has the advantage of making the model universally applicable, it also presents a limitation in that it makes more sophisticated frailty screening and interventions difficult.

## 1. Implications for Practice and Research

The Korean version of the frailty model can help in understanding and closely examining frailty risk factors among Koreans. This model takes a holistic approach by considering functional and psychological factors, as well as living, social, and community environments. Since the model reflects characteristics common to Asian countries, it can be applied in other Asian countries that share similar cultural contexts or characteristics with Korea. Additionally, the model's versatility across various settings is noteworthy. It was developed after a comprehensive review of literature from both clinical and community settings, incorporating a wide array of identified frailty risk factors.

The model offers an intuitive representation of modifiable frailty risk factors that healthcare providers can manage. By utilizing this model, healthcare providers and researchers can identify manageable risk factors early and implement timely interventions. Further refinement through model evaluation could aid in the development of frailty screening tools tailored for Asian populations.

## 2. Limitations and Strengths

There are several limitations in this study. The first limitation is the absence of a model evaluation using real-world data. Fawcett [35] emphasizes the importance of applying conceptual models in practice to determine their conceptual-theoretical-empirical relevance. Consequently, further research is necessary to assess the validity of the newly developed model. The second limitation is that the model was formulated based on studies involving Koreans. To extend its applicability to other Asian countries, researchers must consider the distinct characteristics unique to those nations. The third limitation is that the number of expert panels in the Delphi study may not have been sufficient to ensure analytical stability. Although 10 experts were initially recruited, only 9 ultimately participated, which falls short of the generally recommended minimum of 10 participants [20]. Lastly, during the public hearing, there was a lack of meaningful feedback beyond suggestions regarding the model's structural modifications and visualization. While some questions were raised about the model's overall composition, no additional comments were provided concerning the individual items or their practical applicability. This issue limited the generalizability of the model.

The strength of this study lies in the development of a multi-domain frailty model that is applicable to Koreans and potentially other Asian populations. While many researchers have primarily concentrated on the physical aspects of frailty, our approach includes multiple domains to provide a more accurate assessment. Additionally, we took into account the unique cultural aspects of Koreans, which may also resonate with other Asian countries. These strengths make the model versatile for use in diverse Asian countries.

## CONCLUSION

This study contributed to the development of a Korean version of the frailty model by incorporating the perspectives of nurses. Although this model is in the conceptual stage, it is expected that it can be further developed for practical application in clinical settings. If applied in clinical practice, the model would allow healthcare providers to assess frailty in a more comprehensive manner at an early stage. Additionally, the model enables healthcare providers to actively manage modifiable risk factors associated with frailty. This would facilitate the early detection of frailty and prompt interventions in Korean populations, ultimately contributing to the improvement of health outcomes for older adults.

### CONFLICTS OF INTEREST

The authors declare that they have no known competing interests.

### AUTHORSHIP

Conceptualization - Lee JH; Literature review - Kim E, Kim L and Yoo J-H; Data curation, Formal analysis - all authors; Methodology - Kim E, Kim L and Yoo J-H; Manuscript preparation - Lee JH and Yoo J-H; Manuscript review and revision - Kim GS, Kim S, Kim E and Kim L.

### DATA AVAILABILITY

Please contact the corresponding author for data availability.

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**Supplementary Appendix 1**. Item Revision Flow Table

| Domain | Subdomain | Item | Study process (number of items) | | | |
|---|---|---|---|---|---|---|
| | | | Literature review (46) | For Delphi Round 1 (39) | After Delphi Round 1 (30)† | After Delphi Round 2 (30)† |
| Demographic characteristics | | Age | √ | √ | √ | √ |
| | | Gender | √ | √ | √ | √ |
| | | Race | √ | √ | (deleted) | - |
| | | Marital status | √ | √ | √ (revise terminology: Marital status/Living together) | √ |
| | | Socioeconomic status | - | √ (merge ①②) | √ | √ |
| | | Low education ① | √ | - | - | - |
| | | Low income ② | √ | - | - | - |
| | | Relationships with adult children | √ | √ | √ | √ |
| Intrinsic factors | Functional factors | Physical function | - | √ (merge ③④⑤⑥) | √ | √ |
| | | Physical disability ③ | √ | - | - | - |
| | | Decreased mobility ④ | √ | - | - | - |
| | | Low ADL/IADL ⑤ | √ | - | - | - |
| | | Low physical resilience ⑥ | √ | - | - | - |
| | | Cognitive function | √ | √ | √ | √ |
| | | - Health literacy | - | - | √ (added the major issue of cognitive impairment) | √ |
| | | - Intellectual activity | - | - | √ | √ |
| | | Sensory function | √ | √ | √ | √ |
| | | - Visual function | - | - | √ (added the major issue of sensory function) | √ |
| | | - Hearing function | - | - | √ (added the major issue of sensory function) | √ |
| | | Intellectual activity | √ | √ | (moved to under the cognitive function) | - |
| | Health-related factors | Objective health | - | √ (merge ⑦⑧⑨) | √ | √ |
| | | - Abnormal biomarkers | | | √ | √ |
| | | Obesity/BMI ⑦ | √ | - | - | - |
| | | Weight loss ⑧ | √ | - | - | - |
| | | Multiple medications ⑨ | √ | - | - | - |
| | | Subjective health | √ | √ | √ | √ |
| | | Health habit | - | - | √ | √ |
| | | - Smoking | √ | √ | (moved to under the health habit) | - |
| | | - Alcohol intake | √ | √ | (moved to under the health habit) | - |
| | | - Physical activity | √ | √ | (moved to under the health habit) | - |
| | | Nutrition status | √ | √ | √ | √ |
| | | History of falls over the past year | √ | √ | √ | √ |
| | | Abnormal biomarkers | √ | √ | (moved to under the objective health) | - |
| | | Comorbidities | √ | √ did not merge into objective health to emphasize its importance | √ | √ |
| | Psychological factors | Self-efficacy | √ | √ | √ | √ |
| | | Depression | √ | √ | √ | √ |
| | | Quality of life | √ | √ | (deleted) | - |
| | | Trust in healthcare providers | √ | √ | (deleted) | - |
| Extrinsic factors | Living environment | Residential building type | √ | √ | √ | √ |
| | | Hazards in residential area | √ | √ | √ | √ |
| | | Hospital/long-term care setting | √ | √ | √ | √ |
| | | Acute admission over the past year | √ | √ | √ | √ |
| | | Admission period | √ | √ | √ | √ |
| | Social, community environment | Health resources | √ | √ | √ (revised terminology: Accessibility of health resources) | √ |
| | | Family/social support | √ | √ | √ (revised terminology: Emotional-support network) | √ |
| | | Satisfaction with care | √ | √ | √ (revised terminology: Therapeutic network with healthcare professionals) | √ |
| Health-related outcomes | Short-term (< 5 years) | Falls | √ | √ | √ | √ |
| | | Healthcare costs | √ | √ | √ | √ |
| | | Complications | - | √ merge ⑩⑪ | √ | √ |
| | | Depression ⑩ | √ | - | - | - |
| | | Physical/Cognitive disability ⑪ | √ | - | - | - |
| | | Hospitalization | | | √ (merge ⑫⑬⑭) | √ |
| | | Admission period ⑫ | √ | √ | - | - |
| | | Readmission ⑬ | √ | √ | - | - |
| | | Non-home discharge ⑭ | √ | √ | - | - |
| | Long-term (≥ 5 years) | Mortality | √ | √ | √ | √ |
| | | Quality of life | √ | √ | √ | √ |

†The number of items does not include sub-items.