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Associations of Biochemical Nutritional Indicators with Frailty Among Older Adults Using Community Welfare Centers: A Cross-Sectional Study

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Purpose: Nutritional imbalance has been associated with frailty in older adults. This study aimed to examine the relationships between biochemical nutritional indicators and frailty among community-dwelling older adults, with the long-term goal of informing the development of frailty and exacerbation prevention programs.
Methods: Data were collected from 192 community-dwelling older adults aged ≥65 years across three cities from August to September, 2019. Anthropometric measures, blood tests, and structured questionnaires were used to collect data. Study variables included general characteristics, appetite, body mass index, biochemical nutritional indicators (protein, carbohydrates, vitamins, and electrolytes), and frailty. Data were analyzed using descriptive statistics, t-tests, ANOVA, and hierarchical regression.
Results: Frailty differed significantly according to age, number of chronic diseases, appetite, vitamin D, and calcium. These variables together explained 35% of the variance in frailty.
Conclusion: To prevent frailty in older adults, age, number of chronic diseases, appetite, vitamin D, and calcium levels should be continuously monitored, and nursing interventions that manage diet, provide nutritional supplements, and provide oral medication are needed to maintain normal vitamin D and calcium levels in community-dwelling older adults.

Keywords: Aged; Frailty; Vitamin D; Calcium

Introduction

Frailty in older adults is a different concept from normal aging. Frail older adults easily develop various diseases or disabilities even with a low level of stress [1]. Additionally, frailty is associated with higher mortality rates compared to non-frail older adults [2], and many frail older adults experience exacerbations of their existing disabilities [3]. Approximately 17% of adults aged 60 and older across 62 countries are affected by frailty [4] and 26.3% of older adults in South Korea are experiencing frailty [5]. Failure to implement appropriate policies and interventions to prevent frailty in South Korea, which is currently undergoing rapid aging of its population, would not only spike individual medical expenditure but also bring about various social problems [6].

Multiple factors predict frailty in older adults, including chronic illness, depression, reduced physical activity, sarcopenia, cognitive impairment, and nutritional deficiency [7,8]. Vulnerability to frailty is higher among female than male older adults and associated with older age, lower education and income, and among those who live alone [9,10]. Among these predictors, nutritional status is increasingly recognized as a key modifiable factor influencing frailty [8,11]. Loss of appetite is a major trigger of malnutrition and predicts morbidity and mortality in older adults in

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various clinical settings [12]. Body mass index (BMI) is also a predictor of frailty in older adult [2]. A low BMI indicates chronic nutritional deficiency, which directly contributes to sarcopenia and leads to frailty [13].

Nutrients strongly related to frailty in older adults include protein [14], high-density lipoprotein (HDL) [2], vitamin D [15], and calcium (Ca) [16]. With advancing age, catabolism of muscle proteins is elevated, which leads to reduced protein and muscle mass, thereby accelerating frailty [17]. In addition, vitamin D plays an important role in maintaining muscle function by regulating protein synthesis and calcium absorption, while calcium is essential for muscle contraction, nerve transmission, and the maintenance of bone density [15,18,19]. Further, HDL levels also decrease with age, which increases the risk of frailty [2]. Inappropriate vitamin D concentration in older adults is associated with frailty [15]. Consumption of Ca intake along with vitamin D is important to enhance bone mineral density (BMD) [20], and Ca absorption is affected by vitamin D intake, whereby vitamin D stimulates intestinal Ca resorption [21]. Older adults with masticatory difficulties experience insufficiency of vitamins and minerals such as fibers, Ca, magnesium, vitamin A, and vitamin C [22]. Insufficiency of such nutrients, vitamins, and minerals causes malnutrition, which in turn contributes to frailty. Therefore, providing appropriate nutrients related to frailty is a crucial nursing intervention for preventing frailty in older adults [11].

Previous studies investigating nutrition and frailty among community-dwelling older adults largely relied on dietary assessments [11-12, 14-15], which may limit the precision in identifying specific nutrients directly impacting frailty. Biochemical nutritional indicators, by contrast, offer objective and clinically relevant markers of nutritional status, enabling more accurate screening and individualized care planning. Moreover, frailty itself may contribute to further nutritional deterioration through decreased appetite, impaired mobility, and social isolation, suggesting a potential bidirectional relationship that underscores the importance of early nutritional intervention [23,24].

To address these study gaps, the present study employs biochemical nutritional indicators including protein, carbohydrates, vitamins, and other electrolytes derived from laboratory tests to identify nutrient predictors of frailty.

Methods

Study design

This descriptive cross-sectional study was conducted to identify biochemical nutritional indicators that predict frailty among community-dwelling older adults aged 65 years and above.

Participants

Participants were recruited from two senior welfare centers located in D city, Korea, and were eligible if they were aged 65 years or older and agreed to participate in the study. All participants were informed of the study purpose and procedures, and written informed consent was obtained prior to data collection. Individuals with a score of 24 or higher on the Korean version of the Mini-Mental State Examination (MMSE-L), indicating cognitively intact functioning, and those capable of independent ambulation were included. Older others who had been assigned a long-term care grade under Korea's national long-term care insurance program due to impaired cognitive function or limitations in activities of daily living (ADL) were excluded.

The required sample size was calculated using the G*Power 3.1 software [25]. With a power of .90, a significance level of .05, a moderate effect size of .15, and 14 variables, the required sample was 166. Considering a potential 20% withdrawal rate, questionnaire and blood tests were administered to 198 participants. After excluding six individuals who did not compete the questionnaire, a total of 192 participants were included in the final analysis.

Measures

1. General characteristics

Sex, age, marital status, and economic status were surveyed as general characteristics. Marital status was divided into single, married but living alone, and married living with family. Economic status was determined based on monthly allowance after deducting living expenses.

2. Appetite

Appetite was examined using the Short Nutritional Assessment Questionnaire (SNAQ) which assesses appetite according to weight loss and reduced appetite. The SNAQ consists of four items (level of appetite, amount of food that provides satiety, daily meal frequency, and taste), on a five-point rating scale. A total score of below 14 indicates a risk for weight loss and appetite loss [26]. The Cronbach's α of the original tool was .70 [27] and was .65 in this study.

3. Body Mass Index

Participants' Body Mass Index (BMI) was computed by dividing body weight (kg) by height squared (m^2) as defined by the World Health Organization [28]. In accordance with the

Asia-Pacific criteria, BMI was classified as underweight (18.4 kg/m^2), normal (18.5-22.9 kg/m^2), overweight (23-24.9 kg/m^2), obese I (25~29.9 kg/m^2), and obese II (≥ 30 kg/m^2).

4. Frailty

Frailty in older adults was measured using the frail older adults scale used in the Visiting Health Management Project of Korean public health centers [29]. This is a Korean translation of the questionnaire developed by the Ministry of Health, Labor, and Welfare of Japan to select target populations of the Care Prevention Project, and the predictive validity of the Korean version has been verified [30,31]. This tool consists of six subscales: activities of daily living (ADLs), physical motor function, nutritional state, oral health, outdoor activities, and cognitive function [29]. Each item is rated on a two-point scale, where a higher score indicates a higher level of frailty. A total score of 10 or higher is considered frail. The Cronbach's α was .78 in the study by Park and Lee [32] and was .73 in this study.

5. Biochemical nutritional indicators

Biochemical nutritional indicators were selected based on the nutrients commonly used to assess the nutritional state of older adults, nutrients previously identified to be often insufficient in older adults, and nutrients related to the mechanism or risk factor of frailty by reviewing the literature and having them validated by three nursing professor and one nutrition professor with PhD. The following indicators were selected according to five nutrient categories: protein (albumin, total protein), carbohydrates (blood glucose), lipid (triglyceride, high-density lipoprotein, low-density lipoprotein), vitamin (B1, B12, C, D), and other electrolytes (iron, Ca, magnesium). A blood sample (5 mL) was collected from participants' brachial vein in an Ethylenediaminetetraacetic acid (EDTA)-treated test tube, centrifuged, and submitted to a laboratory for analysis.

Procedure and ethical considerations

The study recruitment advertisement was sent to two senior welfare centers in D cities in Korea, and the data were collected from participants from August to September, 2019 using anthropometry, blood test, and a structured questionnaire. Anthropometric measurements and surveys were administered by three nursing students after they were trained and interrater reliability was confirmed. The blood samples were collected by three registered nurses. To ensure the reliability of the measurements, the recruitment notice informed participants that fasting from midnight before the examination was required. Before blood sampling, participants were asked to confirm that they had fasted for at least eight hours. The study was reviewed and approved by the Daejeon University institutional review board in Korea (IRB No.: 1040647-201904-HR-017-03).

Data analysis

Data were analyzed using the SPSS 27.0 (SPSS; IBM, Armonk, NY, USA). Descriptive statistics (frequency, percentage, mean, and standard deviation) were used to summarize the major variables. Differences in mean frailty scores according to key variables were examined using independent t-tests and one-way ANOVA, followed by Scheffé's post hoc test for multiple comparisons. Hierarchical multiple regression analysis was conducted to identify predictors of frailty based on variables found to be statistically significant in univariate analyses. Multicollinearity was assessed using variance inflation factor (VIF) and tolerance values.

Results

Participants' general characteristics

Of the participants, 30.2% were male and 69.8% were female. The most common age group was 75-84 years (56.8%), followed by 65-74 years (30.2%) and ≥ 85 years (12.5%). The number of diagnosed chronic diseases was 0 (13.5%), 1-2 (55.7%), 3-4 (24.0%), and 5 or more (5.8%). Regarding appetite, 46.4% had poor appetite and 53.6% had normal appetite. Most participants had a normal BMI (33.3%), followed by obese I (30.7%), overweight (22.4%), obese II (6.8%), and underweight (2.6%). A total of 82.8% were non-frail and 16.7% were frail. The mean frailty score was 5.23 in non-frail older adults and 11.53 in frail older adults (Table 1).

Differences in frailty according to participants' general characteristics, appetite, and BMI

Frailty was significantly more common in the ≥ 85 years group than in the 65-74 years or 75-84 years groups ($F = 6.76$, $p = .001$). Frailty was significantly more prevalent in the ≥ 5 group compared with the 0, 1-2, and 3-4 groups ($F = 3.26$, $p = .023$). Frailty also significantly differed according to appetite ($t = 3.42$, $p = .001$).

Although frailty scores were higher in female than male older adults, this difference was not statistically significant ($t = -1.27$, $p = .205$). Frailty scores did not differ significantly by marital status/cohabitation ($F = 2.34$, $p = .099$), economic status ($F = 0.48$, $p = .749$), or BMI ($F = 1.36$, $p = .249$) (Table 2).

Table 1. Characteristics of Participants (*N*=192)

Variables	Categories	n (%) or Mean ± SD	Range (Min - Max)
Sex	Male	58 (30.2)	
	Female	134 (69.8)	
Age†	65-74	58 (30.2)	
	75-84	109 (56.8)	
	85 ≤	24 (12.5)	
Marriage†	Unmarried	7 (3.6)	
	Married (live together)	56 (29.2)	
	Married (live alone)	120 (62.5)	
Economy Status†	Low	74 (38.9)	
	Low-Medium	54 (28.4)	
	Medium	58 (30.5)	
	Medium-High	3 (1.6)	
	High	1 (0.5)	
Number of chronic diseases	0	26 (13.5)	
	1~2	107 (55.7)	
	3~4	46 (24.0)	
	> 5	13 (6.8)	
Appetite	Poor (< 14)	89 (46.4)	
	Normal (≥ 14)	103 (53.6)	
BMI†	Underweight (≤ 18.4)	5 (2.6)	
	Normal (18.5-22.9)	64 (33.3)	
	Overweight (23.0-24.9)	43 (22.4)	
	Obese I (25.0-29.9)	59 (30.7)	
	Obese II (≤ 30)	13 (6.8)	
Frailty	Non-frailty	160 (82.8)	
		5.23 ± 2.30	
	frailty	32 (16.7)	
		11.53 ± 1.57	
Protein	Albumin (g/dL)	4.13 ± 0.42	(0.0-7.0)
	Total Protein (g/dL)	7.30 ± 0.44	(6.0-8.4)
Carbohydrate	Glucose (mg/dL)*	121.40 ± 41.81	(72-370)
Lipid	Tryglyceride (mg/dL)	151.86 ± 83.19	(1.2-506.0)
	HDL (mg/dL)	51.37 ± 12.40	(25-118)
	LDL (mg/dL)	114.52 ± 28.57	(43-209)
Vitamin	B1 (μg/L)	60.28 ± 30.87	(4.1-203.0)
	B12 (pg/mL)*	390.74+494.50	(0.8-2451.6)
	C (mg/dL)	9.76 ± 11.54	(0.5-53.7)
	D (ng/mL)	40.17 ± 27.42	(9.8-142.0)
Mineral	Fe (μg/L)	97.00 ± 28.31	(9.0-164.0)
	Ca (mg/L)	9.00 ± 0.46	(7.8-10.1)
	Mg (mg/L)	2.90 ± 6.99	(1.6-99.0)

†Missing values excluded; BMI=body mass index; HDL=High Density Lipoprotein; LDL=Low Density Lipoprotein; dl=deciliter; Fe=Iron; Ca=Calcium; Mg=Magnesium.

Table 2. Differences in Frailty According to Participants' General Characteristics, Appetite, and BMI (*N*=192)

Variables		Frailty Mean ± SD	t/F	*p*	Scheffe's test
Sex	Male	5.81 ± 3.06	-1.27	.205	
	Female	6.46 ± 3.00			
Age†	65-74[a]	5.91 ± 2.87	6.76	.001	a, b < c
	75-84[b]	5.94 ± 3.24			
	85 ≤ [c]	8.46 ± 3.34			
Marriage†	Unmarried[a]	7.57 ± 3.74	2.34	.099	
	Married (live together)[b]	5.57 ± 3.05			
	Married (live alone)[c]	6.51 ± 3.14			
Economy Status†	Lowa	6.23 ± 2.76	0.48	.749	
	Low-Medium[b]	6.15 ± 3.14			
	Medium[c]	6.50 ± 3.81			
	Medium-High[d]	4.33 ± 2.89			
	Highe	4.00 ± 2.19			
Number of chronic diseases	0	5.19 ± 2.71	3.26	.023	a, b, c < d
	1~2[b]	6.05 ± 3.36			
	3~4[c]	6.80 ± 3.16			
	≥ 5[d]	8.23 ± 2.35			
Appetite	Poor (< 14)	7.11 ± 3.57	3.42	.001	
	Normal (≥ 14)	5.52 ± 2.72			
BMI†	Underweight (≤ 18.4)	9.20 ± 3.27	1.36	.249	
	Normal (18.5-22.9)	6.34 ± 3.54			
	Overweight (23.0-24.9)	5.77 ± 3.14			
	Obese I (25.0-29.9)	6.25 ± 3.08			
	Obese II (≤ 30)	5.85 ± 1.99			

†Missing values excluded; BMI=body mass index

Differences in frailty according to biochemical nutritional indicators

There were significant differences in frailty scores across the vitamin D deficiency, insufficiency, sufficiency, and excess groups ($F = 2.78$, $p = .043$). Frailty scores also differed significantly between the calcium insufficiency and sufficiency groups ($t = 26.02$, $p < .001$) (Table 3).

Nutritional indicators that predict frailty in older adults

The VIF values ranged from 1.00 to 1.12, all below the threshold of 10, and tolerance values ranged from 0.90 to 1.00, all above 0.10, indicating that multicollinearity among the independent variables was not present.

In the first model, age and the number of chronic diseases, included as control variables, significantly explained 7% of the variance in frailty ($F = 8.19$, $p < .001$). In the second model, the con-

Table 3. Differences in Frailty According to Biochemical Nutritional Indicators (*N*=192)

Variables			N (%)	Frailty Mean ± SD	t/F	*p*
Protein	Albumin (g/dL)	Deficiency (< 3.8)	4 (2.1)	6.00 ± 1.16	0.09	.919
		Sufficiency (3.8-5.1)	186 (96.9)	6.25 ± 3.26		
		High (5.2 ≤)	1 (0.5)	5.00 ± 0.00		
	Total Protein (g/dL)	Deficiency (< 5.8)	1 (0.5)	3.00 ± 0.00	0.55	.577
		Sufficiency (5.8-8.1)	187 (97.4)	6.27 ± 3.22		
		Toxicity (8.1 <)	4 (2.1)	6.75 ± 4.27		
Carbohydrate	Glucose† (mg/dL)	Hypoglycemia (< 70)	0 (0.0)		0.07	.791
		Normal (70-199)	134 (69.8)	6.60 ± 3.37		
		Hyperglycemia (200 ≤)	5 (2.6)	7.00 ± 1.87		
Lipid	Triglyceride (mg/dL)	Normal (< 150)	115 (59.9)	6.31 ± 3.27	0.91	.404
		Borderline high (150-199)	37 (19.3)	5.68 ± 3.12		
		High (200 ≤)	40 (20.8)	6.65 ± 3.23		
	HDL (mg/dL)	Deficiency (≤ 39)	32 (16.7)	6.28 ± 3.18	2.13	.122
		Normal (40-59)	121 (63.0)	6.55 ± 3.26		
		High (60 ≤)	39 (20.3)	5.33 ± 3.22		
	LDL (mg/dL)	Optimal (< 100)	58 (30.2)	5.53 ± 3.01	1.56	.188
		Near optimal (100-129)	81 (42.2)	6.53 ± 3.42		
		Borderline high (130-159)	43 (22.4)	6.37 ± 2.98		
		High (160-189)	9 (4.7)	8.00 ± 3.64		
		Very High (190 ≤)	1 (0.5)	6.00 ± 0.00		
Vitamin	B1 (μg/L)	Insufficiency (< 28.0)	7 (3.6)	7.57 ± 2.57	0.72	.489
		Sufficiency (28.0-85.0)	153 (79.7)	6.16 ± 3.22		
		Excess (85.1 <)	32 (16.7)	6.47 ± 3.44		
	B12* (pg/mL)	Insufficiency (< 160.0)	59 (30.7)	5.59 ± 2.59	0.16	.857
		Sufficiency (160.0-970.0)	69 (35.9)	5.87 ± 3.03		
		Excess (970.1 ≤)	12 (6.3)	5.83 ± 3.04		
	C (mg/dL)	Insufficiency (< 4.6)	98 (51.0)	6.32 ± 3.13	1.85	.160
		Sufficiency (4.6-14.9)	46 (24.0)	6.59 ± 3.34		
		Excess (15.0 ≤)	41 (21.4)	5.37 ± 2.97		
	D (ng/mL)	Deficiency (< 10.0)	1 (0.5)	10.00 ± 0.00	2.78	.043
		Insufficiency (10.0-30)	99 (51.6)	6.70 ± 3.42		
		Sufficiency (30.1-100.0)	86 (44.8)	5.90 ± 2.99		
		Excess (100.1 ≤)	6 (3.1)	3.67 ± 1.51		
Mineral	Fe (μg/L)	Insufficiency (< 29.0)	1 (0.5)	9.00 ± 0.00	0.48	.492
		Sufficiency (29.0-164.0)	129 (67.2)	6.61 ± 3.45		
		Excess (164.1 ≤)	0 (0.0)			
	Ca (mg/L)	Insufficiency (< 8.3)	12 (6.3)	10.67 ± 3.11	26.02	< .001
		Sufficiency (8.3-10.2)	174 (90.6)	6.01 ± 3.05		
		Excess (10.3 ≤)	0 (0.0)			
	Mg (mg/L)	Insufficiency (< 1.6)	0 (0.0)		0.11	.744
		Sufficiency (1.6-2.6)	179 (93.2)	6.27 ± 3.29		
		Excess (2.7 ≤)	12 (6.3)	6.58 ± 1.93		

†Missing values excluded; HDL=High Density Lipoprotein; LDL=Low Density Lipoprotein; dl=deciliter; Fe=Iron; Ca=Calcium; Mg=Magnesium.

trol variables (age and number of chronic diseases) together with appetite, a noninvasive self-reported measure, significantly explained 18% of the variance in frailty (F = 14.73, $p < .001$). In the third model, the control variables, the noninvasive variable (appetite), and invasive biochemical nutritional indicators obtained through blood sampling (serum vitamin D and secum calcium) jointly explained 35% of the variance in frailty (F = 21.17, $p < .001$).

Specifically, frailty increased with higher age (B = 0.04), and a greater number of chronic diseases (B = 0.52) and with lower appetite (B = -0.51), lower serum vitamin D levels (B = -0.03), and lower serum calcium levels (B = -2.52) (Table 4).

Discussion

This study aimed to identify biochemical nutritional indicators associated with frailty in community-dwelling older adults. The findings showed that age, the number of chronic diseases, appetite, vitamin D and calcium were significant factors associated with frailty among older adults in the community. These results reaffirm that frailty in older adults is influenced not only by nutritional factors such as appetite and specific micronutrients but also by the combined aspects of advancing age and physical comorbidities, underscoring its multidimensional nature [7-12]. However, although several findings were consistent with previous study findings, others diverged from existing literature. These inconsistencies may be attributable to characteristics of the study sample and limitations of the measurement tools.

First, the level of frailty observed in this study was higher than that reported in previous domestic studies that used the same measurement tool. This may be related to the increasing proportion of older adults in Korea and the growing prevalence of chronic diseases, which together contribute to greater overall vulnerability in health. The significant association between age and frailty is also consistent with multiple previous studies [9,33].

However, sociodemographic variables such as sex, economic status, marital status, and living arrangement were not significantly associated with frailty in this study. This finding contrasts with prior literature reporting that female older adults, those with low income, and those living alone have a higher risk of frailty compared with their counterparts [10,34]. These discrepancies may be explained by the characteristics of our sample. Individuals who were recipients of Korea's long-term care insurance and thus had mobility limitations were excluded, and participants were those who voluntarily utilized community welfare centers, indicating that they engaged in at least some level of social activity. Such sample characteristics may have attenuated the associations between certain sociodemographic variables and frailty.

The absence of direct measurement of social activity and social support limits the interpretation of these findings. Future research should incorporate comprehensive indicators of social engagement, such as social support, participation frequency, and social connectedness, to better elucidate factors contributing to frailty in community-dwelling older adults.

Among the general characteristics, the number of chronic diseases emerged as a significant factor associated with frailty. Chronic conditions in older adults are known to accelerate the progression of frailty through mechanisms such as pain, mobility limitations, reduced physical activity, decreased appetite, and heightened inflammatory responses. This finding is consistent with previous research reporting that the accumulation of multiple chronic diseases increases the risk of poor nutritional status and sarcopenia [7,8]. These results suggest that chronic disease management should be a central component of frailty prevention strategies in community-dwelling older adults.

Table 4. Biochemical Nutritional Indicators That Predict Frailty in Older Adults (*N*=192)

Model	Variables	B	SE	β	t	adj R^2	F(*p*)
1	Age	0.11	0.04	0.20	2.67	.07	8.19 (< .001)
	Number of chronic diseases	0.88	0.30	0.21	2.78		
2	Age	0.11	0.04.	0.20	2.79	.18	14.73 (< .001)
	Number of chronic diseases Appetite	0.71	0.28	0.17	2.42		
		-0.47	0.09	-0.34	-4.96		
3	Age	0.04	0.03	0.07	1.05	.35	21.17 (< .001)
	Number of chronic diseases	0.52	0.25	0.12	2.06		
	Appetite	-0.51	0.08	-0.37	-6.15		
	Vitamin D	-0.30	0.01	-0.25	-4.18		
	Calcium	-2.52	0.44	-0.37	-5.77		

Appetite emerged as a major factor associated with frailty in this study, which is consistent with previous findings indicating that reduced appetite leads to malnutrition and sarcopenia, thereby exacerbating frailty [11,35]. In contrast, BMI was not associated with frailty, a finding that differs from some prior studies [2]. This discrepancy may be attributable to the characteristics of our study population, which consisted of relatively active older adults who were physically capable of visiting community welfare centers and were not recipients of long-term care grades. This suggests that muscle mass, physical function, and activity levels may be more closely related to frailty than BMI itself. Future research should therefore incorporate direct assessments of physical function, such as the Timed Up and Go test and grip strength.

Vitamin D and calcium, on the other hand, were significant biochemical nutritional indicators associated with frailty, which aligns with previous research demonstrating that vitamin D contributes to muscle function by regulating protein synthesis and calcium absorption, and that calcium is essential for muscle contraction, nerve transmission, and the maintenance of bone density [15,18,19]. In contrast, protein and other vitamins and minerals were not significantly related to frailty. This may be explained by the fact that more than 98% of participants had protein levels within the normal range, indicating that the lack of association may have resulted from the characteristics of the sample rather than the absence of a true relationship.

Implications for community health nursing practice

These findings suggest several practical strategies for community-based nursing practice.

1. Routine screening for serum vitamin D and calcium levels should be standardized within community visiting-nurse services and public health center home-visit health management programs.

2. Targeted interventions to support adequate vitamin D and calcium status are needed, including structured sunlight-exposure programs (for example, 10-15 minutes of sunlight exposure three times per week), tailored nutrition education focusing on diets rich in vitamin D and calcium, and clear guidelines for appropriate supplementation.

3. A 6-month reassessment system should be introduced for older adults at high risk of frailty to enable early identification of changes in nutritional status and frailty progression.

4. Multicomponent nursing interventions that integrate nutrition management with physical activity programs, strength training, and social participation activities should be developed and implemented in collaboration with community welfare center programs.

Overall, this study provides important empirical evidence that specific biochemical nutritional indicators, particularly vitamin D and calcium, are significantly associated with frailty among community-dwelling older adults. These findings offer valuable guidance for the development of community-based frailty prevention and management programs.

Despite these strengths, several limitations should be acknowledged. The data were collected five years ago and were obtained from older adults residing in only a few regions of Korea, which limits the generalizability of the findings to the current nationwide older population. The sample consisted of relatively healthy and socially active older adults who voluntarily attended community welfare centers, which may further restrict representativeness. The absence of direct measurements of social activity and social support, the reliance on convenience sampling, and the cross-sectional design also constrain the interpretation of the results. Future research should use more recent data from diverse regions of Korea, include older adults with varying health statuses, incorporate social and psychological variables such as depression, and apply repeated measurements across multiple time points to build more comprehensive and generalizable evidence.

Future research should include samples from diverse regions and with varying health statuses, and employ multifactorial analyses that incorporate social and psychological factors to refine frailty prevention strategies. In addition, psychological variables such as depression, which have been reported to influence frailty in previous studies, should be examined to further elucidate the complex relationships among frailty, nutritional status, and psychosocial determinants in older adults. Studies using recent data from multiple regions of Korea are also recommended to enhance the relevance and generalizability of the findings.

Conclusion

This study identified age, the number of chronic diseases, appetite, vitamin D, and calcium as key factors associated with frailty among community-dwelling older adults. These findings indicate that frailty is a multidimensional condition shaped by nutritional status, disease burden, and functional vulnerability, underscoring the need for comprehensive assessment in older adult

care. The results provide essential evidence for early identification of frailty risk in community settings and support the development of intervention strategies that incorporate appetite assessment, vitamin D and calcium monitoring, and nutritional management. These insights offer a foundation for developing frailty prevention programs and highlight the need to integrate nutrition-focused strategies into community health nursing practice.

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Conflict of interest

The authors declared no conflict of interest.

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Authors' contributions

Eunjeong Nam contributed to formal analysis, methodology, data curation, writing - original draft, and investigation. Jin Kyoung Park contributed to conceptualization, funding acquisition, project administration, writing - review & editing, resources, and validation. Hye Seung Choi contributed to data curation, investigation, and writing - review & editing.

Data availability

Please contact the corresponding author for data availability.

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References

1. Fried LP, Ferrucci L, Darer J, Williamson JD, Anderson G. Untangling the concepts of disability, frailty, and comorbidity: implications for improved targeting and care. The Journals of Gerontology. 2004;59(3):M255–M263. https://doi.org/10.1093/gerona/59.3.M255
2. Rockwood K, Howlett SE, MacKnight C, Beattie BL, Bergman H, Hébert R, et al. Prevalence, attributes, and outcomes of fitness and frailty in community-dwelling older adults: report from the Canadian study of health and aging. The Journals of Gerontology. 2004;59(12):1310–1317. https://doi.org/10.1093/gerona/59.12.1310
3. Dismore L, Hurst C, Granic A, Tullo E, Witham MD, Dodds RM, et al. Why are older adults living with the complexity of multiple long-term conditions, frailty and a recent deterioration in health under-served by research? A narrative synthesis review of the literature. Journal of Frailty, Sarcopenia Falls. 2023;8(4):230–239. https://doi.org/10.22540/JFSF-08-230
4. O'Caoimh R, Sezgin D, O'Donovan MR, Molloy DW, Clegg A, Rockwood K, et al. Prevalence of frailty in 62 countries across the world: a systematic review and meta-analysis of population-level studies. Age Ageing. 2021;50(1):96–104. https://doi.org/10.1093/ageing/afaa219
5. Jung HW, Baek JY, Jang IY, Guralnik JM, Rockwood K, Lee E, et al. Short physical performance battery as a crosswalk between frailty phenotype and deficit accumulation frailty index. The Journals of Gerontology. 2021;76(12):2249–2255. https://doi.org/10.1093/gerona/glab087
6. Ko Y, Jang HY, Han SY. Influence of combined cognitive impairment and social frailty on physical frailty in community-dwelling older adults. Geriatric Nursing. 2022;46:125–131. https://doi.org/10.1016/j.gerinurse.2022.05.013
7. Welstead M, Jenkins ND, Russ TC, Luciano M, Muniz-Terrera G. A systematic review of frailty trajectories: their shape and influencing factors. Gerontologist. 2021;61(8):e463–e475. https://doi.org/10.1093/geront/gnaa061
8. Kim E, Sok SR, Won CW. Factors affecting frailty among community-dwelling older adults: a multi-group path analysis according to nutritional status. International Journal of Nursing Studies. 2021;115:103850. https://doi.org/10.1016/j.ijnurstu.2020.103850
9. Wang HY, Lv X, Du J, Kong G, Zhang L. Age- and gender-specific prevalence of frailty and its outcomes in the longevous population: The Chinese longitudinal healthy longevity study. Frontiers in Medicine. 2021;8:719806. https://doi.org/10.3389/fmed.2021.719806
10. Jang W, Kim MJ, Kim YH. Association between living alone with frailty among elderly Korean men. Journal of Nutrition and Health. 2025;58(1):77–86. https://doi.org/10.4163/jnh.2025.58.1.77
11. Shi L, Tian X, Bongsook Y, Chen J. Predicting the unseen: Nu-

tritional interventions as a key to combat frailty. Frontiers in Nutrition. 2025;12:1575922. https://doi.org/10.3389/fnut.2025.1575922
12. Fielding RA, Landi F, Smoyer KE, Tarasenko L, Groarke J. Association of anorexia/appetite loss with malnutrition and mortality in older populations: a systematic literature review. Journal of Cachexia Sarcopenia Muscle. 2023;14(2):706–729. https://doi.org/10.1002/jcsm.13186
13. Xie RZ, Li XS, Zha FD, Li GQ, Zhao WQ, Liang YF, et al. Relationship between BMI and low skeletal muscle mass in adults based on NHANES 2011-2018. Scientific Reports. 2025;15(1):2596. https://doi.org/10.1038/s41598-025-87176-4
14. Wu SY, Yeh NH, Chang HY, Wang CF, Hung SY, Wu SJ, et al. Adequate protein intake among older adults in the context of frailty: cross-sectional results from NHST Taiwan 2014-2017. The American Journal of Clinical Nutrition. 2021;114(2):649–660. https://doi.org/10.1093/ajcn/nqab070
15. Cai Y, Wanigatunga AA, Mitchell CM, Urbanek JK, Miller ER, Juraschek SP, et al. Effects of vitamin D supplementation on frailty in older adults at risk for falls. BMC Geriatrics. 2022;22:312. https://doi.org/10.1186/s12877-022-02888-w
16. Demiriş B, Basat S, Kurt F, Aksakal B, Basat O. Frailty and fracture risk in adults ≥65 years using FRAX. Southern Clinics of Istanbul Eurasia. 2023;34(1):42–48. https://doi.org/10.14744/scie.2022.66564
17. Ali SR, Nkembo AT, Tipparaju SM, Ashraf M, Xuan W. Sarcopenia: advances in detection, progression, and metabolic alterations along with therapeutic targets. Canadian Journal of Physiology and Pharmacology. 2024;102(12):697–708. https://doi.org/10.1139/cjpp-2024-0201
18. Voulgaridou G, Papadopoulou SK, Detopoulou P, Tsoumana D, Giaginis C, Kondyli FS, et al. Vitamin D and calcium in osteoporosis: and the Role of Bone Turnover Markers: A Narrative Review of Recent Data from RCTs. Diseases. 2023;11(1):29. https://doi.org/10.3390/diseases11010029
19. Zheng Z, Xu W, Wang F, Qiu Y, Xue Q. Association between vitamin D3 and frailty: a large cross-sectional study. Frontiers in Nutrition. 2022;9:980908. https://doi.org/10.3389/fnut.2022.980908
20. Dawson-Hughes B. Effect of Vitamin D, falls and fractures: evidence from recent mega-trials. Metabolism Open. 2024;23:100300. https://doi.org/10.1016/j.metop.2024.100300
21. Christakos S. Vitamin D as a regulator of intestinal physiology. JBMR Plus. 2021;5(12):e10554. https://doi.org/10.1002/jbm4.10554
22. Kim SH, Kwon YS, Hong KH. Chewing ability and nutritional status among Korean older adults. Nutrients. 2023;15(9):2042. https://doi.org/10.3390/nu15092042
23. Pan C. Bidirectional relationships among social isolation, loneliness, and frailty. Innov Aging. 2024;8(3):igae019. https://doi.org/10.1093/geroni/igae019
24. de Souto Barreto P, Cesari M, Morley JE, Roberts S, Landi F, Cederholm T, et al. Appetite loss and anorexia of aging: ICFSR Task Force Report. The Journal of Frailty Aging. 2022;11(2):129–134. https://doi.org/10.14283/jfa.2022.14
25. Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analysis using G*Power 3.1. Behavior Research Methods. 2009;41(4):1149–1160. https://doi.org/10.3758/BRM.41.4.1149
26. Kruizenga HM, Seidell JC, de Vet HCW, Wierdsma NJ, van Bokhorst-de van der Schueren MAE. Development and validation of a hospital malnutrition screening tool: SNAQ. Clinical Nutrition. 2005;24(1):75–82. https://doi.org/10.1016/j.clnu.2004.07.015
27. Wilson MM, Thomas DR, Rubenstein LZ, Chibnall JT, Anderson S, Baxi A, et al. Simple appetite questionnaire predicts weight loss in older adults. The American Journal of Clinical Nutrition. 2005;82(5):1074–1081. https://doi.org/10.1093/ajcn/82.5.1074
28. World Health Organization. The Asia-Pacific perspective: redefining obesity and its treatment [Internet]. Sydney: Health Communications Australia; 2000 [cited 2025 Oct 18]. Available from: https://iris.who.int/bitstream/handle/10665/206936/0957708211_eng.pdf
29. Ministry of Health and Welfare. Guideline of Home Visiting Health Care Services in 2023. Policy Report. Sejong: Ministry of Health and Welfare; 2023. Report No.: 11-1352000-00869-10.
30. Lee IS, Park YI, Park EO, Lee SH, Jeong IS. Validation of instruments to classify frailty in the elderly. Journal of Korean Academy of Community Health Nursing. 2011;22(3):302–314. https://doi.org/10.12799/jkachn.2011.22.3.302
31. SunWoo D, Lee SH, Park JS, Bae SS, Cho YH, Kim CB, et al. Effects of muscle strength exercise on physical function and QOL in frail elderly. Korean Journal of Health Education and Promotion. 2008;25(1):39–53.
32. Park JK, Lee JE. Factors related to frailty among Korean elderly: a 3-year longitudinal study. International Journal of Nursing Knowledge. 2019;30(1):55–63. https://doi.org/10.1111/2047-3095.12198
33. Ofori-Asenso R, Chin KL, Mazidi M, Zomer E, Ilomaki J, Zullo AR, et al. Global incidence of frailty and prefrailty: a me-

ta-analysis. JAMA Network Open. 2019;2(8):e198398. https://doi.org/10.1001/jamanetworkopen.2019.8398
34. Siriwardhana DD, Hardoon S, Rait G, Weerasinghe MC, Walters KR. Prevalence of frailty and prefrailty among community-dwelling older adults in low-income and middle-income countries: a systematic review and meta-analysis. BMJ Open. 2018;8(3):e018195. https://doi.org/10.1136/bmjopen-2017-018195
35. Park BJ, Lee YJ. Integrative approach to elderly frailty. Korean Journal of Family Medicine. 2010;31(10):747–754. https://doi.org/10.4082/kjfm.2010.31.10.747