

# Correlates of Frailty in Community-Dwelling Older Adults with Cancer: 2017 Survey of Living Condition of Elderly Study in South Korea

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## ABSTRACT

**Objective:** Frailty is prevalent among community-dwelling older adults with cancer and is associated with increased mortality and complications of treatments. However, evidence on the multiple factors influencing frailty in this population is scarce. This paper aimed to identify the demographic, sociobehavioral, and health status-related correlates of frailty in community-dwelling older adults with cancer. **Methods:** This was a descriptive cross-sectional study using data from the fourth wave of the Living Condition of Elderly Study in South Korea conducted in 2017. Among the 10,299 individuals aged  $\geq 65$  years who participated in the survey, data of 391 individuals with cancer were analyzed. Frailty status (robust, prefrailty, and frailty) was assessed using the Korean version of the 5-item: Fatigue, Resistance, Ambulation, Illnesses, and Loss of weight scale. We performed descriptive statistical analysis to report summary measures, and bivariate

(t-test, Chi-squared test, and analysis of variance) and multivariate regression analyses. **Results:** Frailty and prefrailty were prevalent in 24.8% and 50.6% of the participants, respectively. The strongest correlate of frailty was a greater level of depression, followed by low levels of physical activity, dependency in instrumental activities of daily living, a greater number of comorbidities, an advanced age, a lower household income, and a widowed marital status. **Conclusions:** Community-dwelling older adults who had cancer and depression had the highest risk of frailty. Given the adverse impact of frailty on health outcomes in this population, health-care providers need to provide interventions incorporating the management of depression, physical activity, and comorbidities to prevent or manage frailty.

**Key words:** Cancer, community, frailty, older adults

## Introduction

The rapid aging of the population has also resulted in an increase in the incidence of cancer in individuals aged  $\geq 65$  years. It is expected that approximately 50% of new invasive cancer cases will be in older adults in the United States,<sup>[1]</sup> and most of those with cancer are treated in the community.<sup>[2]</sup> However, advances in cancer treatment

and improvement in health behaviors have also led to decreased death rates of cancer patients;<sup>[1]</sup> thus, the goal of cancer management in later life needs to shift to minimizing adverse treatment outcomes and preventing the worsening of symptoms or recurrence.

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Phenotype frailty is a condition characterized by a decrease in the physiologic reserve and lowered resistance to stressors.<sup>[3]</sup> Frailty results from a cumulative decline in multiple physical systems and increases the risk of adverse outcomes.<sup>[4]</sup> Frailty in older adults usually manifests as loss of muscle mass, lower bone density, poor nutritional status, cognitive deterioration, or fatigue.<sup>[5]</sup> The Cardiovascular Health Study<sup>[4]</sup> showed that frailty was associated with hospitalization, falls, worsening disability in activities of daily living (ADLs), worsening mobility, and death. The prevalence of frailty increases with aging. In the general older population, <10% of people aged  $\geq 65$  years have frailty, whereas this prevalence increases to between 25% and 50% in those aged  $\geq 85$  years.<sup>[6]</sup>

Older adults with cancer are likely to become frailer than those without cancer because both the disease and cancer treatments play a role as stressors that decrease reserves. Furthermore, aging-related changes such as functional decline and comorbidities also influence tolerance to cancer therapy or the risk–benefit ratio of cancer treatment.<sup>[7]</sup> Thus, frailty is more prevalent in older cancer patients than in the general older population. Accordingly, numerous studies have investigated frailty in older adults with cancer because of its association with complications, tolerance to cancer treatments, and negative health outcomes.<sup>[8,9]</sup> A systematic review reported that frailty was prevalent in 42% of individuals aged  $\geq 65$  years with cancer and that frailty in older cancer patients was associated with increased all-cause mortality, the risk of postoperative mortality, and treatment complications.<sup>[9]</sup> Thus, frailty in older adults with cancer may have correlates distinctive from those without cancer.

Previous studies reported that there are multiple factors significantly associated with frailty. For example, a higher body mass index (BMI) and lower physical activity increase the risk of frailty in older breast cancer survivors.<sup>[8]</sup> The female sex, unemployment, and cancer diagnosis are also significantly associated with frailty in older hematologic cancer patients.<sup>[10]</sup> Although older cancer patients are at a high risk of frailty owing to cancer treatments or the disease itself, studies that comprehensively investigate factors and that address the multidimensional impact of frailty are lacking. Considering that frailty in older adults with cancer involves multifaceted changes in aging and diseases, and since the pace or manifestation of those changes vary between individuals,<sup>[7]</sup> modifiable factors that might reduce the progression of frailty need to be comprehensively explored.

Thus, the purpose of this study was to identify the correlates of frailty in community-dwelling older adults with cancer. To this end, we reviewed previous literature to ascertain potential demographic, sociobehavioral, and

health status-related correlates of frailty. In this study, we used the Korean version of the Fatigue, Resistance, Ambulation, Illnesses, Loss of weight (FRAIL) scale to assess frailty.<sup>[11,12]</sup>

## Methods

### Study design, participants, and setting

This was a cross-sectional study using data from the fourth wave of the Living Condition of Elderly Study in South Korea conducted in 2017. The survey comprised interviewing community-dwelling older adults who agreed to participate. Participants were eligible if they were aged  $\geq 65$  years.

In the current study, we analyzed the data of participants who were diagnosed with cancer at the time of data collection. Among the 10,299 individuals who participated in the survey, data of 391 individuals who reported having cancer were analyzed. The Institutional Review Board of K University granted ethical approval.

### Measurements

#### Dependent variables

The frailty score was determined using the Korean version of the FRAIL scale. The 5-item FRAIL scale was originally developed by Moley *et al.*,<sup>[11]</sup> and its Korean version was developed and validated by Jung *et al.*<sup>[12]</sup> The FRAIL scale is a self-reported questionnaire that does not require physical examination. The five items measured are fatigue, resistance, ambulation, illnesses, and loss of weight. Fatigue was assessed with the question “Do you feel full of energy?” in the Geriatric Depression Scale-Short Form (GDS-SF).<sup>[13]</sup> “Yes” and “No” responses were coded as 0 and 1, respectively. Resistance was measured with the question “By yourself and not using aids, do you have any difficulty walking up 10 steps without resting?” Ambulation was evaluated by asking “By yourself and not using aids, do you have any difficulty walking 300 m?” “Yes” and “No” were coded as 1 and 0, respectively. For illnesses, diagnosis with 0–4 of 11 chronic illnesses (i.e., hypertension, diabetes, cancer, chronic lung disease, heart attack, congestive heart failure, angina, asthma, arthritis, stroke, and kidney diseases) was coded as 0, while diagnoses with more than 5 were coded as 1. Loss of weight was defined as an unintended weight loss of at least 5 kg within the recent 6 months. Participants with a total score of 0 were categorized as robust; 1–2 scores, prefrail; and 3–5 scores, frail.

#### Independent variables

Demographic factors included age, sex, level of education ( $\leq$ elementary school/middle school/high school/ $\geq$ college), marital status (married/single or widowed),

and household income in quartiles. Sociobehavioral factors included current smoking (yes/no), alcohol drinking during the past 1 year (none/<1 time per week/ $\geq$ 1 time per week), level of physical activity (metabolic equivalent [MET]), BMI (kg/m<sup>2</sup>), social activity scores, and subjective health rating (poor/fair/good). Health status-related factors included the number of chronic diseases, depression, cognitive function, ADLs, and instrumental ADLs (IADLs).

Physical activity was measured using the International Physical Activity Questionnaire-Short Form.<sup>[14]</sup> The intensity of physical activity was categorized as none, low, moderate, and vigorous based on the amount of physical activity (MET-min/week) during the past 7 days. Nutritional status was assessed using the 10-item DETERMINE Your Nutritional Health Checklist.<sup>[15]</sup> In this scale, the total score ranges from 0 to 21, and scores 0–2 are categorized as good nutritional status; 3–5, moderate nutritional risk; and  $\geq$  6, high nutritional risk.<sup>[15]</sup> The social activity score was generated using a combined frequency of participation in religious activities, fraternity group activities, volunteer activities, educational activities, and political activities. The frequency of each activity was coded as 0 (none), 1 (<1 time/month), 2 (1–2 times/month), 3 (1–3 times/week), and 4 ( $\geq$ 4 times/week). A higher score indicated a greater level of social activity participation.

Depression was measured using the GDS-SF,<sup>[13]</sup> and cognitive function was assessed using the Korean version of the Mini-Mental State Examination (K-MMSE).<sup>[16]</sup> ADLs and IADLs<sup>[17]</sup> were evaluated using self-reported 7-item and 10-item questionnaires, respectively. Each item was coded 0 (no assistance needed) or 1 (assistance needed), with total scores generated by combining each item score, with higher scores indicating greater dependency.

### Statistical analysis

Descriptive statistics were reported using frequency, percentage, and means, and standard deviation (SD). Student's *t*-tests, the Chi-squared tests, and analysis of variance were used to compare variables among the robust, prefrail, and frail groups. Further, frailty classification was dichotomized as 0 (nonfrail or prefrail) or 1 (frail). Bivariate analyses were conducted to compare the characteristics between the robust/prefrail and frail groups. Variables that showed significant differences between the two groups in bivariate analyses were included in the univariate and multivariate regression analyses to identify the correlates of frailty. Because there were many independent variables compared with the number of frailty events, a penalty matrix was added to the model in the sensitivity analysis by performing ridge regression. All measures fell within acceptable ranges of collinearity (variance inflation factors <4). All statistical analyses were performed

using IBM SPSS Statistics for Windows, version 24 (IBM Corp., Armonk, NY, USA). *P* value of 0.05 was considered statistically significant.

## Results

The average participants' age was 73.3 years (SD = 6.15; range, 65–91 years). Of the 391 participants, 77.5% (*n* = 303) of them were male, and 84.5% (*n* = 330) were being treated for cancer at the time. 28.4% (*n* = 111), 50.6% (*n* = 198), and 21.0% (*n* = 82) were categorized as frail, prefrail, and robust, respectively [Table 1]. Most demographic, sociobehavioral, and health status-related characteristics were significantly different between the three groups. However, there were no significant differences in the marital status, household income, BMI, and current smoking status.

As presented in Table 2, the comparison between the robust/prefrail and frail groups showed that the frail group was likely to be older, included more women, did not have a spouse, and had a lower economic status than the robust/prefrail group. With respect to sociobehavioral factors, approximately half (47.3%) of the frail group did not participate in physical activity. In contrast, only 24.9% of the robust/prefrail group were not engaged in physical activity. The frail group was at a markedly higher risk of malnutrition as evidenced by the 49.5% of participants in this group categorized to be at high nutritional risk. Further, 84.7% of the frail participants rated their health as bad, whereas 60.1% of the robust/prefrail group considered their health to be bad. In addition, the frail group engaged in fewer social activities. Regarding health status-related factors, the frail group had more comorbidities and was more cognitively impaired, depressed, and dependent for IADLs than their robust/prefrail counterparts.

The following variables that showed significant bivariate relationships between the two groups were included in the multivariate regression analyses: advanced age, widowed marital status, lower income level, low levels of physical activity, depression, chronic illnesses, and a higher dependency in IADLs, all of which independently increased the risk of frailty. Among these, the strongest four correlates of frailty were depression ( $\beta = 0.126$ , *P* = 0.010), lower levels of physical activity ( $\beta = 0.110$ , *P* < 0.001), a higher dependency in IADL ( $\beta = 0.101$ , *P* = 0.022), and having a greater number of comorbidities ( $\beta = 0.087$ , *P* = 0.001) [Table 3].

## Discussion

Research that comprehensively investigated the correlates of frailty and addressed its multidimensional impact on community-dwelling older adults with cancer is scarce. An in-depth understanding of the influencing

Table 1: Descriptive statistics of demographic, sociobehavioral, and health status-related factors according to frailty categorization (n=391)

Variable	Category	Mean ± SD			t/F/χ <sup>2</sup> (P)
		Robust (n=82), n (%)	Prefrail (n=198), n (%)	Frail (n=111), n (%)	
Age (years)	<75	64 (78.0)	126 (63.6)	47 (42.3)	26.842 (<0.001)
	≥75	18 (22.0)	72 (36.4)	64 (57.7)	
		70.86±4.56	72.93±5.96	75.86±6.64	17.747 (<0.001)
Gender	Male	70 (85.4)	159 (79.9)	74 (66.7)	10.958 (0.004)
	Female	12 (14.6)	40 (20.1)	37 (33.3)	
Education	≤Elementary	29 (35.4)	117 (59.1)	63 (56.8)	18.493 (<0.001)
	Middle	14 (17.1)	31 (15.7)	21 (18.9)	
	High	27 (32.9)	37 (18.7)	20 (18.0)	
	≥College	12 (14.6)	13 (6.6)	7 (6.3)	
Marital status	Married	9 (11.0)	35 (17.7)	18 (16.2)	1.967 (0.377)
	Single/widowed	73 (89.0)	163 (82.3)	93 (83.8)	
Household income (quartile)	Q1	13 (15.9)	44 (22.1)	31 (28.2)	12.235 (0.057)
	Q2	22 (26.8)	53 (26.6)	22 (20.0)	
	Q3	18 (22.0)	47 (23.6)	36 (32.7)	
	Q4	29 (35.4)	55 (27.6)	21 (19.1)	
BMI (kg/m <sup>2</sup> )		23.77±2.47	23.08±3.18	22.87±3.94	1.889 (0.153)
Current smoking	No	75 (91.5)	188 (94.9)	101 (91.0)	2.163 (0.339)
	Yes	7 (8.5)	10 (5.1)	10 (9.0)	
Alcohol drinking (time/week)	None	61 (75.3)	176 (88.4)	93 (83.8)	9.555 (0.049)
	<1	7 (8.6)	4 (2.0)	5 (4.5)	
	≥1	13 (16.0)	5 (4.5)	13 (11.7)	
Physical activity	None	12 (14.8)	58 (29.3)	52 (47.3)	55.458 (<0.001)
	Low	17 (21.0)	51 (25.8)	42 (38.2)	
	Moderate	29 (35.8)	59 (29.8)	12 (10.9)	
	Vigorous	23 (28.4)	30 (15.2)	4 (3.6)	
Nutritional status	Good	44 (54.3)	49 (24.5)	12 (10.8)	57.853 (<0.001)
	Moderate risk	27 (33.3)	93 (46.5)	44 (39.6)	
	High risk	10 (12.3)	58 (29.0)	55 (49.5)	
Number of comorbidities		2.87±1.32	3.42±1.88	4.40±1.72	20.135 (<0.001)
Subjective health	Good	26 (32.1)	17 (8.5)	4 (3.6)	62.344 (<0.001)
	Fair	26 (32.1)	42 (21.1)	13 (11.7)	
	Bad	29 (35.8)	140 (70.4)	94 (84.7)	
Social activities		3.01±2.70	2.24±2.24	1.54±1.75	10.337 (<0.001)
K-MMSE	≥24	74 (90.2)	163 (81.9)	67 (60.4)	28.096 (<0.001)
	<24	8 (9.8)	36 (18.1)	44 (39.6)	
GDS-SF		26.86±2.74	25.89±3.37	24.19±4.16	14.661 (<0.001)
	<6	68 (85.0)	99 (52.4)	30 (27.0)	
	≥6	12 (15.0)	90 (47.6)	81 (73.0)	
ADL		2.41±2.96	5.70±3.97	8.29±4.09	55.002 (<0.001)
IADL		0.02±0.18	0.34±1.31	0.47±0.96	4.286 (0.014)
IADL		0.14±0.57	0.97±2.17	2.61±2.74	35.015 (<0.001)

BMI: Body mass index, K-MMSE: Korean Version of Mini-Mental State Examination, GDS-SF: Geriatric Depression Scale-Short Form, ADL: Activities of daily living, IADL: Instrumental activities of daily living, SD: Standard deviation

factors of frailty will help health-care providers develop interventions to maximize the effectiveness of treatments and improve health outcomes by preventing or delaying the progression to frailty.

The results of this study demonstrated that a greater level of depression was the strongest correlate of frailty in older adults with cancer. The other significant correlates were low levels of physical activity, dependency in IADLs, a greater number of comorbid conditions, an advanced age, a widowed marital status, and a low household income.

Frailty was prevalent in 28.4% of the study participants, and approximately 50.6% of them were in the prefrailty status group.

The prevalence of frailty varies by participant characteristics, settings, and the measurements for identifying frailty. A recent systematic review<sup>[9]</sup> reported that frailty and prefrailty are prevalent in an average of 42% (range, 6%–86%) and 43% (range, 13%–79%) of older cancer patients, respectively, with the prevalence varying widely when measured according to comprehensive

Table 2: Differences in demographic, sociobehavioral, and health status-related factors among robust/prefrail and frail groups (n=391)

Variable	Category	Mean $\pm$ SD		t or $\chi^2$ (P)
		Robust/prefrail (n=280), n (%)	Frail (n=111), n (%)	
Age (years)	<75	190 (67.9)	47 (42.3)	21.601 (<0.001)
	$\geq$ 75	90 (32.1)	64 (57.7)	
Gender	Male	72.33 $\pm$ 5.66	75.86 $\pm$ 6.64	-4.93 (<0.001)
	Female	228 (81.4)	74 (66.7)	
Education	$\leq$ Elementary	52 (18.6)	37 (33.3)	1.969 (0.579)
	Middle	114 (40.7)	53 (47.7)	
	High	50 (17.9)	20 (18.0)	
	$\geq$ College	85 (30.4)	28 (25.2)	
Marital status	Married	31 (11.1)	10 (9.0)	14.488 (<0.001)
	Single/widowed	210 (75.0)	61 (55.0)	
Household income (quartile)	Q1	70 (25.0)	50 (45.0)	9.719 (0.021)
	Q2	57 (20.4)	31 (28.2)	
	Q3	74 (26.4)	22 (20.0)	
	Q4	65 (23.2)	37 (32.7)	
BMI (kg/m <sup>2</sup> )		84 (30.0)	21 (19.1)	
Current smoking	No	23.28 $\pm$ 3.00	22.87 $\pm$ 3.94	1.001 (0.318)
	Yes	263 (93.9)	101 (91.0)	1.017 (0.375)
Alcohol drinking (time/week)	None	17 (6.1)	10 (9.0)	0.077 (0.962)
	<1	237 (84.6)	93 (83.8)	
	$\geq$ 1	11 (3.9)	5 (4.5)	
Physical activity	$\geq$ 1	32 (11.4)	13 (11.7)	43.650 (<0.001)
	None	70 (24.9)	52 (47.3)	
	Low	69 (24.6)	43 (38.2)	
	Moderate	88 (31.3)	12 (10.9)	
Nutritional status	Vigorous	53 (19.2)	4 (3.6)	31.228 (<0.001)
	Good	93 (33.1)	12 (10.8)	
	Moderate risk	119 (42.7)	44 (39.6)	
Number of comorbidities	High risk	68 (24.2)	55 (49.5)	-5.838 (<0.001)
		3.26 $\pm$ 1.75	4.40 $\pm$ 1.72	
Subjective health	Good	43 (15.3)	4 (3.6)	22.501 (<0.001)
	Fair	69 (24.6)	13 (11.7)	
	Bad	168 (60.1)	94 (84.7)	
Social activities		2.47 $\pm$ 2.41	1.54 $\pm$ 1.75	4.187 (<0.001)
K-MMSE	$\geq$ 24	236 (84.3)	67 (60.4)	24.541 (<0.001)
	<24	44 (15.7)	44 (39.6)	
GSD-SF		26.18 $\pm$ 3.22	24.19 $\pm$ 4.16	4.49 (<0.001)
	<6	167 (62.1)	30 (27.0)	
	$\geq$ 6	102 (37.9)	81 (73.0)	
ADL		4.72 $\pm$ 3.99	8.29 $\pm$ 4.09	-7.77 (<0.001)
IADL		0.25 $\pm$ 1.12	0.47 $\pm$ 0.96	-1.821 (0.069)
		0.73 $\pm$ 1.89	2.61 $\pm$ 2.74	-7.765 (<0.001)

BMI: Body mass index, K-MMSE: Korean Version of Mini-Mental State Examination, GDS-SF: Geriatric Depression Scale-Short Form, ADL: Activities of daily living, IADL: Instrumental activities of daily living, SD: Standard deviation

geriatric assessment or phenotype. Study settings included in this review were outpatient, inpatient, surgery, and community. The prevalence of frailty in general older adults who participated from the outpatient or inpatient department of a teaching hospital in South Korea was 17.5%<sup>[12]</sup> when the measurement used was the same as in the current study. Bennett *et al.*<sup>[8]</sup> reported that 18% of breast cancer survivors aged 70–79 years were frail and 50% were prefrail, in contrast to only 11% of the women without a cancer history in the same age group. Because

we targeted community-dwelling participants who have ever been diagnosed with cancer, both cancer survivors and those with active cancer currently treated at the time of data collection were included in the analyses. This could explain the higher prevalence of frailty in the participants of this study than that in cancer survivors or general older adults and the lower prevalence than that in older cancer patients currently being treated in inpatient or surgery units.

A greater level of depression was the strongest correlate of frailty. Older adults with depression were more likely to

Table 3: Correlates of frailty (robust/prefrail vs. frail)

Variable	Category	OR (95% CI)	Type III, <i>P</i>	Penalty matrix added model			
				$\beta$	SE	<i>F</i>	<i>P</i>
Age		1.057 (1.002-1.115)	0.042	0.069	0.025	7.752	0.006
Gender (reference male)	Female	2.057 (0.972-4.356)	0.059	0.027	0.019	1.922	0.166
Marital status (reference married)	Single/ widowed	2.663 (1.164-6.095)	0.020	0.041	0.022	3.633	0.057
Household income (reference Q4)	Q1	1.124 (0.441-2.866)	0.807	0.056	0.021	6.746	<0.001
	Q2	2.610 (1.149-5.927)	0.022				
	Q3	0.760 (0.325-1.779)	0.527				
Subjective health (reference good)	Fair	0.833 (0.220-3.151)	0.280	0.052	0.020	6.799	0.001
	Bad	1.959 (0.578-6.643)	0.788				
Physical activity (reference moderate-vigorous)	None	5.527 (2.692-11.349)	<0.001	0.110	0.020	29.808	<0.001
	Low	3.652 (1.747-7.635)	0.001				
Nutrition risk score (reference good)	Moderate risk	1.540 (0.684-3.467)	0.297	0.053	0.019	7.624	0.001
	High risk	1.624 (0.657-4.014)	0.294				
Social activity		0.851 (0.727-0.997)	0.078	-0.031	0.018	2.945	0.087
GDS-SF		1.105 (1.024-1.192)	0.010	0.126	0.022	33.312	<0.001
K-MMSE		1.015 (0.931-1.107)	0.734	-0.053	0.028	3.579	0.059
Number of comorbidities		1.219 (1.029-1.445)	0.022	0.087	0.021	16.671	<0.001
IADLs		1.293 (1.100-1.518)	0.001	0.101	0.024	17.157	<0.001

$R^2=0.318$ , adjusted  $R^2=0.287$ ,  $F=9.030$  ( $P<0.001$ )

SE: Standard error, K-MMSE: Korean Version of Mini-Mental State Examination, GDS-SF: Geriatric Depression Scale-Short form, IADL: Instrumental activities of daily living, CI: Confidence interval

have a slower gait speed, greater fatigue or exhaustion, a weaker grip strength, or a lower level of physical activity.<sup>[18,19]</sup> Depression in individuals with cancer correlates with a more rapid exacerbation of symptoms, metastasis, and a greater level of pain.<sup>[20]</sup> Further, depression in this population increases the risk of suicide.<sup>[21]</sup> Collectively, our findings and those of previous studies indicate that strategies to prevent or manage depressive symptoms should be included as a major component in frailty interventions.

The second strongest correlate of frailty was low levels of physical activity. In the bivariate analysis, approximately half (47.3%) of the frail participants did not engage in any physical activity, whereas only 14.8% of participants in the robust group reported no physical activity [Table 1]. A previous large-scale study of the elderly population also reported that a sedentary lifestyle was significantly associated with exhaustion, weakness, and slowness in the frailty index.<sup>[18]</sup> Well-known benefits of regular physical exercise in older adults with cancer include improvement in physical functions and quality of life and a decrease in fatigue and complications from cancer treatment.<sup>[22,23]</sup> Indirectly, physical activities help older cancer patients to complete their scheduled cancer treatment.<sup>[22]</sup> However, a previous study reported that only 35.1% of breast cancer survivors performed the recommended amount of physical activity.<sup>[24]</sup> A recent study on preoperative older cancer patients reported that no physical complaints, information that was easy to understand, low-cost programs, and personal preference facilitated the performance of physical

exercise.<sup>[25]</sup> However, it should be noted that older adults are more vulnerable to decline, particularly in physical functions, during and after cancer treatments.<sup>[26]</sup> This vulnerability is further influenced to varying extents by individuals' baseline health status and comorbidities.<sup>[26]</sup> Therefore, physical exercise in this population should be encouraged, but they need to be individualized based on the types and amount of exercise, cancer stage, and baseline health status.

IADL was previously reported to be an indicator of independent living and predictor of mortality and morbidity.<sup>[27]</sup> In the present study, 58.3% of those in the frail group were dependent in one or more instrumental activities, whereas only 17.9% of the robust and prefrail groups had dependency in IADLs. IADLs are significantly associated with cognitive functions, the nutritional status, and falls.<sup>[28]</sup> Disability in IADLs was also reported to be a precedent of dependency in ADLs,<sup>[29]</sup> which often lead to institutionalization. Although the association was not significant, we found a tendency of increasing dependency in ADLs as the degree of frailty increased. Therefore, the assessment for IADLs needs to be included in the evaluation of frailty in older adults with cancer because it may predict an improving or worsening frailty status and disability in ADLs.

The number of comorbidities was another correlate of frailty. Descriptive analysis showed differences in the number and pattern of comorbid conditions between the frail group and the robust/prefrail group. The frail

group had an average of 4.4 comorbidities, with the three most frequently reported comorbid conditions being hypertension, diabetes, and arthritis. Meanwhile, the robust/prefrail groups had a mean of 3.3 comorbidities, and the most frequent were hypertension, hyperlipidemia, and arthritis. A previous study reported that the number of comorbid conditions was also associated with a low level of physical activity.<sup>[18]</sup> These findings indicate that proper prevention or management of comorbid conditions may delay the progress to frailty in this population.

Among demographic factors, age, a widowed marital status, and a low household income were significant correlates of frailty. These findings are consistent with those of previous studies.<sup>[18,30]</sup> Multifaceted aging-related physical, psychological, and social deterioration facilitates frailty. Age was also associated with a quicker progression to frailty.<sup>[30]</sup> These findings suggest that health providers need to intervene in the progression to frailty as early as possible and that health-care services should be available for all strata of society.

Plots of log (odds) of age, GDS-SF, and IADLs with frailty, which showed significant associations, revealed slightly curvilinear relationships between these correlates and frailty. This finding may suggest that frailty cannot be accounted for by only one correlate and that multiple factors are involved in the manifestation of frailty as evidenced previously.<sup>[31]</sup>

This study has some limitations. It was difficult to determine the causal relationship between the significant correlates and frailty owing to the cross-sectional design of the study. Next, all components of frailty were measured using self-reported questionnaires; thus, there could have been recall bias or under- or overestimation of the variables. However, most participants had intact cognition, and thus, there should be few biased responses in this study. Moreover, considering that older adults with terminal cancer are likely to be institutionalized, but 84.5% of participants were currently being treated in this study, the result of this study might underrepresent the prevalence and correlates of frailty in those with terminal cancer. Because this study was conducted only in South Korea, the generalizability of the findings may be limited. Further studies with a longitudinal design and including objective assessments for frailty could provide causality among variables and more accurate estimates. Finally, the number of frailty events was 111; thus, a small power was another limitation of this study.

## Conclusions

This study revealed that the strongest correlate of frailty in community-dwelling older adults with cancer was a greater level of depression, followed by low

levels of physical activity, dependency in IADLs, and a greater number of comorbid conditions. The other significant correlates included an advanced age, a widowed marital status, and a low household income. Given the adverse impact of frailty on health outcomes, health-care providers need to provide interventions that incorporate the management of depression and that encourage physical activities and dependency in IADLs, earlier, to prevent or delay the progression to frailty in this population.

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## Conflicts of interest

There are no conflicts of interest.

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