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Factors Related to Frailty among the Elderly in South Korea: A 3-year Longitudinal Study

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PURPOSE: To examine factors associated with frailty among the young-old elderly (YOE) and old-old elderly (OOE).
METHODS: This longitudinal study with a 3-year follow-up included 486 participants who received home care services.
FINDINGS: Precipitous weight loss and depression in the YOE and worsening of complex mobility and depression in the OOE were associated with worsened frailty over the 3-year period.
CONCLUSIONS: To prevent frailty, we suggest weight-loss prevention programs for the YOE, lower-limb exercise programs for the OOE, and depression management programs for both groups.
Implications for Nursing Practice: The findings may be used by geriatric nurses in developing programs to prevent frailty in the OOE and YOE, and in administering nursing intervention programs at nursing home centers.

Introduction

South Korea is due to become an aged society in 2018, when 14.3% of the total population areexpected to be over 65 years of age; it will become a super-aged society in 2026, when 20.8% of the population arepredicted to be over 65 years (Statistics Korea, 2017). A topic that has received much attention in relation to the growing elderly population in South Korea is frailty among the elderly ("frail elderly"). In the United States, 11% of the elderly population are suspected as being the frail elderly (Collard, Boter, Schoevers, & Oude Voshaar, 2012); in Korea, the frail elderly are reported to comprise approximately 34–37.2% of the community-dwelling elderly (Kim, 2009; Sunwoo, Song, Lee, & Kim, 2004).

Frailty among the elderly influences mortality (Fried et al., 2001), admission to care facilities (McKenzie, Ouellette-Kuntz, & Martin, 2016; Rockwood, Mitnitski, Song, Steen, & Skoog, 2006), and worsening of disabilities (Boyd, Xue, Simpson, Guralnik, & Fried, 2005; Kojima, 2017). If frail elderly peopledonot continuously manage their health, they will eventually require long-term care (Ettinger & Beck, 1984; McKenzie et al., 2016). Accordingly, as Korea becomes an aged society and the number of elderly individuals increases, the frail elderly should be provided with appropriate management to prevent disability, so that the number of elderly, disabled people does not remarkablyincrease and exacerbate problems with long-term care insurance funds. In a framework proposed by Liang in 1986 (Liang, 1986), factors affecting the frail elderly can be categorized into medical, functional, and self-evaluative dimensions. Regarding medical dimensions, physical health variables include chronic disease (Weiss, 2011) and weight loss (Fried et al., 2001; Morley, 2010), while mental health variables include depression (Almeida et al., 2015; Buigues et al., 2015; Mezuk, Edwards, Lohman, Choi, & Lapane, 2011). Elderly functional health variables include cognitive ability (BlanskiGrden et al., 2015; Yeom, 2013), grip strength, vision, hearing, chewing ability (Collard et al., 2012; Hatta, Maeda, Shamoto, & Wakabayashi, 2017), ability to perform activities of daily living (ADLs) (Collard et al., 2012; Guilley et al., 2008), limited physical activity, and level of independence (Boyle, Buchman, Wilson, Leurgans, & Bennett, 2010). Functional indices commonly used to screen the frail elderly include grip strength (Lee et al., 2017; Sunwoo et al., 2004), muscle strength, endurance, balancing (Sunwoo et al., 2004), walking (Lee et al., 2017; Sunwoo et al., 2004), and physical activity (Sunwoo et al., 2004). Functional mobility of the frail elderly is measured by the Timed Up & Go test, which is sometimes used alone for screening (Sunwoo et al., 2004). Finally, self-rated health is a self-assessed variable. Frail elderly people have a low level of self-rated health (Kim, 2009; Lau, Kwan, & Cheung, 2016). Accordingly, thesehealth variables are correlated with one another. Therefore, it is necessary to conduct a longitudinal study that can identify the variables affecting the frail elderly and the structural relationships between such variables, while also examining related factors that can reduce the rate at which elderly frailty is aggravated or progresses into disability.

In developmental theories, the elderly are divided into young-old elderly (under 75 years, YOE) and old-old elderly (75 years or over, OOE) (Newman & Newman, 1991). The rate of underweight individuals is higher in the OOE than in the YOE (Hyun & Lee, 2013; Soenen& Chapman, 2013), and the underweight elderly are frailer compared withthe overweight elderly (Park & Kim, 2014). Additionally, the elderly in Korea show a greatly decreased ability to perform ADLs from the age of 75 years and experience more limitation in performing activities (Hyun & Lee, 2013). Regarding mental and self-evaluated health, compared with theYOE, the OOE are reported to be more depressed (Almeida et al., 2015) and have a lower level of self-rated health (Hyun & Lee, 2013). As described above, health variables related to frailty in the elderly show differences between the YOE and OOE, with the age of 75 years as a cutoff. Based on the finding that the level of frailty is higher in the elderly over 75 years old than those under 70 (Park & Kim, 2014); in the present study, we categorized study subjects as YOE or OOE with the age of 75 years as a cutoff.

Purpose

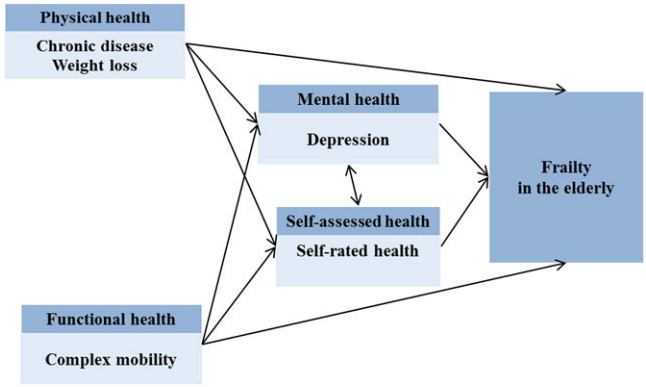
The study aimed to investigate the relationships among longitudinal changes in health-related variables affecting frailty in the YOE and OOE over a 3-year period. The research would provide basic data for developing interventional programs to prevent the frail elderly from developing disability.

Method

Hypothesis Model

As described earlier, factors affecting frailty in the elderly can be considered within the framework proposed by Liang in 1986 (Liang, 1986), which consists of medical, functional, and self-evaluative dimensions. Medical dimensions can be divided into physical health variables and mental health variables. Among the physical health variables, the elderly tend to be frailer if they have had more chronic diseases (Kim, 2009; Weiss, 2011), while weight loss in the elderly is a key indicator for predicting frailty (Artaza-Artabe, Sáez-López, Sánchez-Hernández, Fernández-Gutierrez, & Malafarina, 2016; Fried et al., 2001). Depression is one of the mental health variables, and elderly depression is one of the early signs of frailty (Mezuk et al., 2011), where those who exhibit more signs of depression have higher frailty levels (Almeida et al., 2015; Buigues et al., 2015; Kim, 2009; Lohman, Mezuk, & Dumenci, 2017). Regarding functional dimensions, frail elderly people show a lower level of complex mobility (Lee et al., 2017; Sunwoo et al., 2004), vision, and hearing (Hatta et al., 2017; Kim, 2009) than nonfrail elderly people. Finally, the self-evaluative dimensions are also reported to be lower among frail elderly people (Kim, 2009; Lau et al., 2016). Such variables mutually affect one another, where chronic diseases in the elderly affect depression and self-rated health,

Figure 1. Proposed hypothesis model



while restriction of physical activities and the level of independence in ADLs affect self-rated health (Jensen, Dumas, & Edlund, 2016; Trachte, Geyer, & Sperlich, 2016; Yeom, 2013). Elderly depression also affects self-rated health (Jang et al., 2012; Yeom, 2013). One can therefore predict that physical and functional health variables andfrailty, depression, and self-rated health have mediating effects. Based on these existing studies on elderly frailty, a hypothesis model was conceptualized as shown in Figure 1.

Research Design

Thislongitudinal study with a 3-year follow-up was conducted to examine factors related to frailty among the YOE and OOE. We obtained ethical approval from the Institutional Review Board of the Catholic University of Korea (MC14EISI0001) regarding the study protocol.

Sample

This study analyzed the data of elderly individuals over 65 years old from the Home Visit Health Care Project, which was conducted by 25 public health centers in Seoul, Korea, and followedup for 3 years between 2010 and 2012. Data were collected at 1-year intervals after the 2010 baseline survey.

Data Collection

The total number of elderly individuals over 65 years old who received home-visit health care over the 3-year period was 4,267 (duplicates included). Among nonduplicates, 519 had mostly full data across all 3 years. Among them, 33 were excluded because some responses to the study variables were incomplete, and the 3-year data of 486 individuals (nonduplicates with complete data) were included in the final analysis. In the final sample, 41.8% ($n = 203$) belonged to the YOE, and 58.2% ($n = 283$) to theOOE. The mean age was 70.21 years in the YOE and 79.83 years in the OOE.

Measures

Physical health. Physical health was assessed using the number of chronic diseases (i.e., liver disease, hypertension, diabetes, arthritis, stroke, urinary incontinence, and cancer) and weight loss. It was examined whether or not the subjects were diagnosed by a physician with any of the diseases listed above, and the number of chronic diseases was determined by summing across the diagnosed diseases. Weight was measured in kilograms.

Functional health. Functional health was assessed through examination of complex mobility and difficulties with vision and hearing. Complex mobility was evaluated using the Timed Up & Go, which measures the time (in seconds) from getting up from a chair, walking quickly a distance of 4.8 m, and returning to the chair; the longer the time, the lower the functional health of the elderly person (Ministry of Health & Welfare, 2012). Vision and hearing difficulties were assessed with a single question, i.e., "Do you experience difficulty in everyday life because of low vision (or hearing)?"; a response of "yes" was coded as 1 and "no"as 0 (Ministry of Health & Welfare, 2012).

Mental health. Mental health was assessed via depression, which was measured with the short form of the Korean version of the Geriatric Depression Scale (K-GDS), a scale originally developed by Yesavage and colleagues in 1982 (Yesavage et al., 1982) and translated into Korean and standardized by Kee (Kee, 1996). The depression scale consists of 15 questions with a dichotomous response scale (yes/no), and a higher score indicates a higher level of depression. In a1996 study by Ki, the value of Cronbach's α was .88 (Kee, 1996); here, Cronbach's α was .66 in the 2010 data, .71 in the 2011 data, and .73 in the 2012 data.

Self-evaluated health. Self- evaluated health was measured with a single question, "How do you perceive your health?" which had a 5-point response scale (very bad, bad, average, good, and very good); the higher the score, the better the self-rated health.

Frailty. To measure frailty, we utilized the basic evaluation form for the frail elderly used in the Home Visit Health Care Project (Ministry of Health & Welfare, 2012). The frailty instrument was the "Japanese Frailty Scale," developed by the Japanese Ministry of Health, Labour and Welfare to screen long-term preventive care targets. The instrument consists of 20 questions with a dichotomous response scale in six subdomains: lifestyle functioning (five items), physical exercise (five items), nutritional condition (two items), oral function (three items), social outing (two items), and cognitive function (three items); the higher the score, the higher the level of frailty. Cronbach's α in this study was .776 in the 2010 data, .785 in the 2011 data, and .780 in the 2012 data.

Data Analysis

To investigate the relationships among health-related variables affecting the change in frailty in the YOE and OOE overtime, latent growth modeling (LGM) was performed using AMOS 20 (an additional SPSS module). Additionally,the Sobel test was used to test mediating effects in the model. Model fit was assessed with χ^2(absolute fit index), root mean square error of approximation, and incremental fit indices such as normed fit index, comparative fit index, and Tucker–Lewis index.

Results

Three-Year Changes in Health Variables

The mean number of chronic diseases increased yearly, from 2.96 to 3.00 to 3.03 ($p = .004$) in the YOE and from 3.13 to 3.16 to 3.17 ($p = .020$) in the OOE. On average, the YOE had a weight loss of 1.42 kg (59.65, 59.06, and 58.23 kg; $p<.001$), and the OOE had a weight loss by 2.18 kg (55.23, 54.17, and 53.05 kg; $p<.001$) over 3 years.

The mean performance of the YOE on Timed Up& Go was 8.13 (in 2010), 8.67 (in 2011), and 9.52 s(in 2012) ($p<.001$), and that ofthe OOE was 9.19 (in 2010), 10.28 (in 2011), and 11.05 s(in 2012) ($p<.001$). Complex mobility wasdetermined as abnormal if performance on the Timed Up& Go test waslonger than 8.5 s. Accordingly, in all cases, the mean performance for Timed Up & Go fell into the range of abnormality. Meanwhile, over the 3-year period,vision difficulty was experienced by the YOE at levels of 0.27, 0.32, and 0.35 ($p = .002$) and by the OOE at levels of 0.31, 0.37, and 0.40 ($p<.001$). Hearing difficulty was experienced by the YOE at levels of 0.13, 0.17, and 0.19 ($p = .017$) and by the OOE at levels of 0.26, 0.29, and 0.34 ($p<.001$). Thus, functional health deteriorated in all measures over time.

Depression became more severe with time: the mean score in the YOE was 5.01 in 2010, 5.86 in 2011, and 6.73 in 2012 ($p<.001$), and the mean scores in the OOE were 5.24, 6.30, and 7.34, respectively ($p<.001$).

The self-rated health score decreased over time in both the YOE and OOE. In the YOE, the self-rated health score was 2.93 (in 2010), 2.70 (in 2011), and 2.37 (in 2012) ($p<.001$). In the OOE, the self-rated health score was 2.90 (in 2010), 2.56 (in 2011), and 2.28 (in 2012) ($p<.001$).

The frailty score increased over time in the YOE and OOE. The mean score of the YOE increased from 3.67 (2010) to 4.51 (2011) to 5.65 (2012) ($p<.001$), and that of the OOE increased from 5.00 (2010) to 6.34 (2011) to 7.50 (2012) ($p<.001$; Table 1).

Testing the LGM

The initial mean number of chronic diseases among the YOE was 2.96 ($p<.001$) and this increased by an average of .04 per year ($p<.001$); that for the OOE was 3.14 ($p<.001$),

Table 1. Changes Over Time in Observed Variables

Variables	M±SD	2010 (n = 486) M±SD	2011 (n = 486) M±SD	2012 (n = 486)	F	(N = 1,458) p
Number of chronic diseases	YOE	2.96±.96	3.00±.97	3.03±.97	5.6	.004
	OOE	3.13±.84	3.16±.84	3.17±.84	4.0	.020
Weight(kg)	YOE	59.65±9.67	59.06±9.92	58.23±9.82	40.5	<.001
	OOE	55.23±10.05	54.17±10.05	53.05±10.20	46.3	<.001
Timed up & go (seconds)[a]	YOE	8.13±1.95	8.67±2.08	9.52±2.34	55.3	<.001
	OOE	9.19±3.26	10.28±3.81	11.05±3.98	77.4	<.001
Difficulty with vision[b]	YOE	0.27±.45	0.32±.47	0.35±.48	6.6	.002
	OOE	0.31±.47	0.37±.48	0.40±.49	12.8	<.001
Difficulty with hearing[b]	YOE	0.13±.36	0.17±.37	0.19±.39	4.2	.017
	OOE	0.26±.48	0.29±.45	0.34±.47	8.6	<.001
Depression[c]	YOE	5.01±2.65	5.86±2.97	6.73±3.09	59.2	<.001
	OOE	5.24±2.85	6.30±2.99	7.34±3.16	92.8	<.001
Self-rated health[c]	YOE	2.93±.70	2.70±.75	2.37±.72	53.6	<.001
	OOE	2.90±.73	2.56±.79	2.28±.75	98.5	<.001
Frailty[c]	YOE	3.67±2.74	4.51±2.82	5.65±3.01	83.4	<.001
	OOE	5.00±3.46	6.34±3.75	7.50±3.84	124.2	<.001

M, mean; SD, standard deviation; YOE, Young-old elderly; OOE, Old-old elderly
[a]Timed up & go is a complex movement capability test
[b]Difficulty with vision & Difficulty with hearing : scale of 0-1
[c]Depression: scale of 1-15, Self-rated health: scale of 1-5, Frailty: scale of 1-20

which increased by an average of .01 per year (p<.001). The initial mean weight was 59.55 kg in the YOE (p<.001), which reduced over time by an average of 0.71 kg/year (p<.001); in the OOE, the initial mean weight was 55.24 kg (p<.001), which reduced by an average of 1.09 kg/year (p<.001).

Based on the Timed Up & Go test, the mean performance of the YOE was initially 8.13 s(p<.001), which increased by an average of 0.66 s/year (p<.001); the mean performance of the OOE was initially 9.20 s (p<.001), which increased by an average of 0.92 s/year (p<.001). The mean level of vision difficulty was initially .27 (p<.001) in the YOE and .32 (p<.001) in the OOE. Vision difficulty increased in both the YOE and OOE by an average of .04 per year (p<.001). Regarding hearing difficulty, the mean value in the YOE was initially .14 (p<.001),which increased with time by an average of .03 per year (p<.001); the mean value in the OOE was initially .26 (p<.001), which increased by an average of .04 per year (p<.001).

The mean depression score in the YOE was initially 5.01 (p<.001) and it increased with time by an average of 0.86 per year (p<.001). The mean score in the OOE was initially 5.25 (p<.001), and it increased by an average of 1.05 per year (p<.001).

The mean score for self-rated health in the YOE was 2.93 (p<.001), and it decreased by an average of 0.27 per year (p<.001); in OOE, the mean score was initially 2.90 (p<.001), and it decreased by an average of 0.31 per year (p<.001).

Finally, the mean frailty score was initially 3.63 in the YOE (p<.001), and it increased by an average of 0.99 per year (p<.001). In the OOE, the mean score was initially 5.01 (p<.001), and it increased by an average of 1.25 per year (p<.001) (Table 2).

Multivariate LGM for the Frail Elderly

YOE. For the YOE, the initial level of self-rated health (the mediating variable) decreased as the initial number of chronic diseases increased ($\beta = -.15$, $p = .042$). The elderly experiencing a larger weight loss over time tended to become frailer ($\beta = -.34$, $p = .012$). As the initial level of vision difficulty increased, the elderly became frailer ($\beta = .22$, $p = .002$) and self-rated health was lower ($\beta = -.18$, $p = .016$) on initial measurement. The elderly experiencing more hearing difficulty over time tended to be more depressed ($\beta = .27$, $p = .011$), and, as the initial level of depression was higher, the elderly became frailer ($\beta = .15$, $p = .037$) and self-rated health was lower ($\beta = -.30$, p<.001) on initial measurement. Those who became more depressed over time tended to become frailer ($\beta = .84$, $p = .005$). Last, as self-rated health decreased, the elderly exhibited greater frailty ($\beta = -.33$, p<.001) on initial measurement (Table 3, Figure 2).

OOE. For the OOE, the lower the weight, the frailer they were on initial measurement ($\beta = -.18$, p<.001). Those with lower complex mobility (on Timed Up& Go) showed lower levels of self-rated health ($\beta = -.20$, $p = .003$) and higher levels of depression ($\beta = .18$, $p = .005$) on initial measurement. The elderly experiencing a more precipitous decline in complex mobility over time tended to become frailer ($\beta = .59$, p<.001). Additionally, the more severe the depression, the frailer were the elderly ($\beta = .22$, p<.001) on initial measurement, and those who became more depressed with time tended to be also frailer ($\beta = .65$, p<.001). The OOE with a high initial level of depression showed a lower initial level

Table 2. Latent Growth Model for Observed Variables

Variables		χ^2(df)	*p*	NFI	CFI	RMSEA	TLI	Icept		Slope	
								mean	*p*	Mean	*p*
Number of chronic diseases	YOE	0.05(2)	.974	1.00	1.00	0.00	1.00	2.96	<.001	0.04	<.001
	OOE	1.80(1)	.180	0.99	1.00	0.05	0.99	3.14	<.001	0.01	<.001
Weight (kg)	YOE	1.75(1)	.186	0.99	0.99	0.06	0.99	59.55	<.001	-0.71	<.001
	OOE	0.05(1)	.820	1.00	1.00	0.00	1.00	55.24	<.001	-1.09	<.001
Timed up & go (seconds)[a]	YOE	4.44(1)	.035	0.98	0.99	0.13	0.97	8.13	<.001	0.66	<.001
	OOE	2.35(1)	.125	0.99	0.99	0.06	0.99	9.20	<.001	0.92	<.001
Difficulty with vision	YOE	0.36(1)	.549	0.99	1.00	0.00	1.00	0.27	<.001	0.04	<.001
	OOE	0.81(1)	.370	0.99	1.00	0.00	1.00	0.32	<.001	0.04	<.001
Difficulty with hearing	YOE	0.47(1)	.492	0.99	1.00	0.00	1.00	0.14	<.001	0.03	<.001
	OOE	0.76(1)	.385	0.99	1.00	0.00	1.00	0.26	<.001	0.04	<.001
Depression	YOE	0.08(1)	.928	1.00	1.00	0.00	1.00	5.01	<.001	0.86	<.001
	OOE	0.01(1)	.919	1.00	1.00	0.00	1.00	5.25	<.001	1.05	<.001
Self-rated health	YOE	2.49(1)	.114	0.98	0.99	0.08	0.98	2.93	<.001	-0.27	<.001
	OOE	0.94(1)	.333	0.99	1.00	0.00	1.00	2.90	<.001	-0.31	<.001
Frailty	YOE	2.02(1)	.155	0.99	0.99	0.07	0.99	3.63	<.001	0.99	<.001
	OOE	0.79(1)	.375	0.99	1.00	0.00	1.00	5.01	<.001	1.25	<.001

χ^2, absolute fit index; NFI, Normed Fit Index; CFI, Comparative Fit Index; TLI, Tucker–Lewis Index; RMSEA, Root Mean Square Error of Approximation; YOE, Young-old Elderly; OOE, Old-old elderly, Icept, Intercept
[a]Timed up & go is a complex movement capability test

of self-rated health ($\beta = -.18$, $p = .012$). Last, the lower the initial level of self-rated health, the higher the initial level of frailty ($\beta = -.39$, $p<.001$), and those who rated their health as lower over time tended to be frailer ($\beta = -.40$, $p = .021$) (Table 3, Figure 2).

Mediating Effects

Mediating effects were identified in the frail elderly model for the YOE. Initial self-rated health indirectly influenced the path from initial vision difficulty to initial frailty ($\beta = .37$, $p = .034$), and the path from initial depression to initial frailty ($\beta = .08$, $p = .014$). A high level of self-rated health in the YOE has a mediating effect mitigating the negative effects of vision difficulty and depression on frailty (Table 4).

Regarding the mediating effects identified in the frailty structural model for the OOE, initial self-rated health ($\beta = .08$, $p = .008$) and initial depression ($\beta = .05$, $p = .029$) indirectly influenced the path from initial complex mobility to initial frailty. Initial self-rated health also showed an indirect effect on the path from initial depression to initial frailty ($\beta = .10$, $p = .018$). A high level of self-rated health and a low level of depression in the OOE mitigatedthe negative effect of complex mobility on frailty (Table 4).

Discussion

To identify long-term factors affecting frailty in the elderly, we conducted thislongitudinal study to examine how, in the YOE and OOE, changes in frailty over time are affected by changes in health-related variables. Weight loss in the elderly can be caused by decreased appetite due to diverse diseases or deficits in metabolic function and is therefore a crucial indicator of frailty (Sunwoo et al., 2004). Particularly in the YOE, weight loss accounted for34.9% of worsening frailty, thus indicating that the elderly with more weight loss were frailer. Therefore, a strategy to prevent weight loss is essential in any frailty prevention program for the elderly.Specifically, geriatrics nurses who provide care for the community-dwelling elderly should thoroughly assess and manage weight loss in the YOE to prevent the development of frailty. To prevent weight loss in the elderly, sufficient calorie consumption(Gammack & Sanford, 2015), protein supplements(Potter, Roberts, McColl, & Reilly, 2001), andoral liquid nutritional supplements(Whiteman, Ward, Simmons, Sarkisian, & Moore, 2008) have been reported to be effective. Thus, in intervening for weight loss in the frail elderly, geriatric nurses should display a stronger nursing leadership (or supervisory role) in staffing and planning and provide educational, environmental, and interdisciplinary interventions to the elderly(Dyck, Schumacher, & Friedrich, 2013).

In severalstudies, walking ability was reported as an important predictor of frailty in the elderly (Fried et al., 2001; Lau et al., 2016; Lawrence & Jette, 1996; Montero-Odasso et al., 2011). In the present study, we used the Timed Up & Go test to measure walking ability in the elderly. However, changes in Timed Up & Go for the YOE did not show a linear trend over time, and thus, the Timed Up & Go variable was not included in the final frailty model for the YOE. In the OOE, however, worse results for Timed Up & Go inferred greater frailty at the initial level. Moreover,the elderly showed that the decreasing slop in complex mobility over time tended to be frailer. Of many studies that used exercise interventions to increase muscle strength in the frail elderly, some reported that resistance exercises reduced the

Table 3. Effects of Variables Related to Elderly Frailty

Endogenous variables		Exogenous variables	Path coefficient	SE	β[a]	C.R.[†]	*p*
YOE	Frailty-Icept	Number of chronic diseases-Icept	-0.33	0.17	-.12	-1.85	.064
		Weight-Icept	-0.03	0.01	-.12	-1.93	.053
		Difficulty with vision-Icept	1.39	0.44	.22	3.13	.002
		Depression-Icept	0.16	0.08	.15	2.08	.037
		SRH-Icept	-1.50	0.36	-.33	-4.16	.001
	Frailty-Slope	Weight-Slope	0.14	0.06	-.34	-2.50	.012
		Depression-Slope	-0.51	0.18	.81	2.83	.005
		SRH-Slope	9.72	15.06	.46	0.64	.519
	Depression-Icept	Difficulty with vision-Icept	0.78	0.47	.13	1.67	.095
	Depression-Slope	Difficulty with vision-Icept	0.37	0.19	.21	1.91	.055
		Difficulty with hearing-Icept	-0.61	0.24	.27	2.52	.011
	SRH-Icept	Number of chronic diseases-Icept	0.08	0.04	-.15	-2.03	.042
		Weight-Icept	0.01	0.01	.12	1.73	.082
		Difficulty with vision-Icept	-0.25	0.11	-.18	-2.39	.016
		Depression-Icept	-0.07	0.02	-.30	-3.99	<.001
OOE	Frailty-Icept	Weight-Icept	-0.06	0.02	-.18	-3.39	<.001
		Timed up & go-Icept	0.04	0.06	.03	0.66	.507
		Difficulty with Hearing-Icept	0.82	0.44	.10	1.86	.062
		Depression-Icept	0.32	0.09	.22	3.50	<.001
		SRH-Icept	-2.43	0.42	-.39	-5.83	<.001
	Frailty-Slope	Weight-Slope	0.06	0.06	.16	0.97	.329
		Timed up & go-Slope	0.29	0.06	.59	4.87	<.001
		Depression-Slope	0.42	0.12	.65	3.54	<.001
		SRH-Slope	-1.07	0.47	-.40	-2.30	.021
	Depression-Icept	Timed up & go-Icept	0.13	0.05	.18	2.78	.005
	SRH-Icept	Timed up & go-Icept	-0.03	0.01	-.20	-2.96	.003
		Depression-Icept	-0.04	0.02	-.18	-2.49	.012

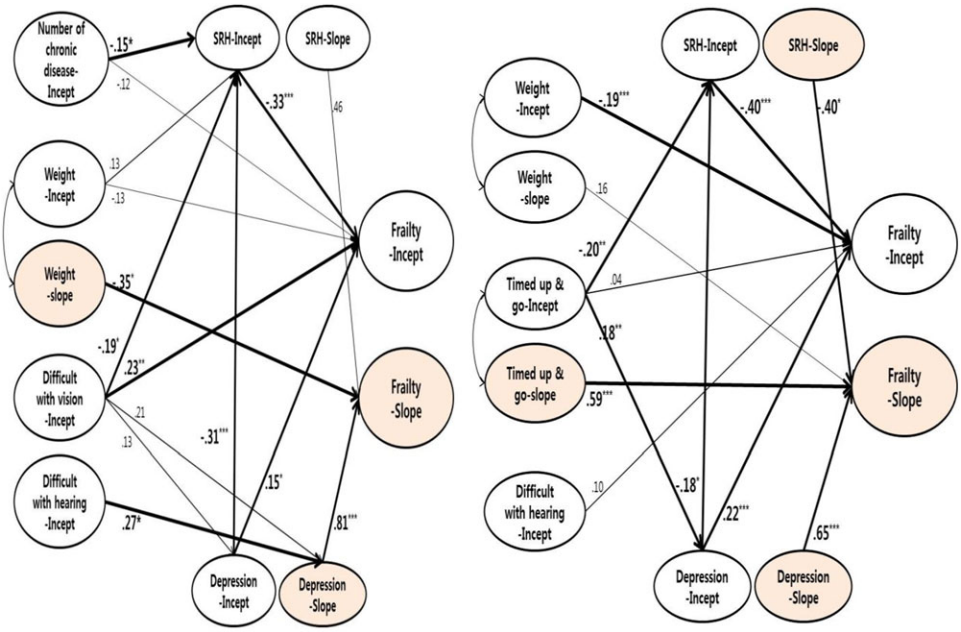
YOE, Young-old elderly; OOE, Old-old elderly; SRH, Self-rated health; Icept, intercept
[a]β, Standardized regression weight, [†]C.R., Critical ratio for regression weight

number of health problems (Câmara, Bastos, & Volpe, 2012), and some other reported that consistent walking exercise improved balance and gait ability (Shimada, Uchiyama, & Kakurai, 2003). To prevent frailty in the elderly in an aggressive manner, geriatric nurses should develop exercise programs based on the evidence presented in previous studies and utilize the programsin the care of the elderly, whether they visit them in the community or care for them at the hospital.

Depression, the variable of mental health measured in this study, influences the ability to perform ADLs and self-rated health (Yeom, 2013) and is an important variable closely associated with frailty in the elderly (Almeida et al., 2015; Buigues et al., 2015; Mezuk et al., 2011). Moreover, inthe present study, the higher the initial level of depression, the higher the initial level of frailty in both the YOE and OOE. Particularly, the elderly who became more depressed over time tended to be frailer. Furthermore, more depressed elderly people rated their health as lower, and specifically amongthe OOE, depression lowered complex mobility, thus further increasing frailty indirectly. Therefore,geriatric nurses should develop programsto prevent frailty and promote health in the elderly considering their community, to prevent the occurrence and worsening of depression.

In this study, we found that the lower the initial level of self-rated health, the higher the initial level of frailty in both the YOE and OOE, and frailty worsened more remarkablyin the elderly with a precipitous decrease in self-rated health over time. Thisfinding isconsistentwith the previous finding that self-rated health was lower in the elderly with a higher level of frailty (Ettinger & Beck, 1984; Lee, 2010). Specifically, self-rated health was an important variable indirectly influencing frailty in the elderly, which mediated several pathways from physical, functional, and mental health to frailty. Self-rated health in the elderly can change according to levels of social activity and social support for elderly people (Nam & Jung, 2011). Hence, one could infer that to promote self-rated health in the elderly, it is important to encourage them to engage in social activities and heighten interest in and support thereof. However, according to a longitudinal study that followed Korean elderly people for 6 years (Min, 2013), social participation, other than work engaged, did not significantly enhance self-rated health. Therefore, to develop a self-rated health promotion program for the Korean elderly, a strategy that considers individual preferences and various socioeconomic conditions is needed, rather than simply encouraging social participation. To increase self-rated health in the elderly, geriatric nurses should proactively use a strategy to promote social activities in the care

Figure 2. Multivariate latent growth model for the frail elderly



χ^2=421.38(df=16, p<.001), RMSEA=0.09, CFI=0.95, IFI=0.95, TLI=0.93

(A) YOE

χ^2=378.90(df=120, p<.001), RMSEA=0.08, CFI=0.94, IFI=0.97, TLI=0.93

(B) OOE

χ^2, absolute fit index; NFI, Normed Fit Index; CFI, Comparative Fit Index; TLI, Tucker-Lewis Index; RMSEA, Root Mean Square Error of Approximation; YOE, Young-Old Elderly; OOE, Old-Old Elderly
* p<.05, ** p<0.1, *** p<.001

Table 4. Test for Mediating Effects on the Frail Elderly Model

	Mediated pathway	β†	Z	p
YOE	Number of chronic disease-Icept→ SRH-Icept→ Frailty-Icept	−.08	−1.33	.183
	Weight-Icept→ SRH-Icept→ Frailty-Icept	−.01	−1.55	.120
	Difficulty with vision-Icept→ SRH-Incep→ Frailty-Icept	.37	2.11	.034
	Depression-Icept→ SRH-Incep → Frailty-Icept	.08	2.45	.014
	Difficulty with vision-Icept→ Depression-Icept→ Frailty-Icept	.11	1.23	.219
	Difficulty with vision-Icept→ Depression-Slope→ Frailty-Slope	−.15	−0.94	.348
	Timed up & go-Slope→ Depression-Slope→ Frailty-Slope	−.60	−0.91	.362
	Timed up & go-Icept→ Depression-Icept→ Frailty-Icept	.02	1.29	.197
OOE	Timed up & go-Icept→ SRH-Icept → Frailty-Icept	.09	2.67	.008
	Depression-Icept→ SRH-Icept→ Frailty-Icept	.11	2.36	.018
	Timed up & go-Icept → Depression-Icept→ Frailty-Icept	.06	2.17	.029

YOE, Young-old elderly; OOE, Old-old elderly; SRH, self-rated health; Icept, intercept

of the elderly people, and such strategy should include diverse programs in which individual preferences are factored in.

The study has limitations because factors related to elderly persons' social health, economic status, and health promotion behavior were excluded. In the future, a more extensive follow-up study should be conducted, including various factors associated with frailty among the elderly. Despite these limitations, this study is significant because frailty in the elderly was examined in terms oflongitudinal

relationships among changes in physical, functional, mental, and self-rated health.

Conclusions

This study was conducted to investigate long-term factors affecting frailty in the elderly. In the YOE, as the initial levels of vision difficulty and depression increased and self-rated health was lower, the initial level of frailty increased. Moreover, the elderly experiencing more precipitous weight loss and worsening of depression across the 3-year study period showed greater worsening of frailty. In the OOE, increased levels of frailty were associated with decreased weight, which was linked to increased levels of depression and a subsequent decrease in the level of self-rated health on initial measurement. Furthermore, the elderly experiencing greater worsening of complex mobility and depression over the 3-year period showed a steeper increase in frailty.

Implications for Nursing Knowledge

Based on the study findings, we recommend that geriatric nurses incorporateweight-loss programs for the YOE, lower-limb strengthening exercises for the OOE, and depression management programs for both groups, when developing programs to prevent frailty in the elderly or providing nursing interventions at nursing home centers.

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