JAMDA 24 (2023) 504–510

JAMDA

journal homepage: www.jamda.com

Original Study

# Association of Depressive Mood and Frailty With Mortality and Health Care Utilization: Korean National Cohort Study

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*Keywords:*
Older people
depression
frailty
mortality
health care utilization

A B S T R A C T

*Objectives:* To investigate the association of depressive mood and frailty with mortality and health care utilization (HCU) and identify the coexisting effect of depressive mood and frailty in older adults.
*Design:* A retrospective study using nationwide longitudinal cohort data.
*Setting and Participants:* A total of 27,818 older adults age 66 years from the National Screening Program for Transitional Ages between 2007 and 2008, part of the National Health Insurance Service–Senior cohort.
*Methods:* Depressive mood and frailty were measured by the Geriatric Depression Scale and Timed Up and Go test, respectively. Outcomes were mortality and HCU, including long-term care services (LTCS), hospital admissions, and total length of stay (LOS) from the index date to December 31, 2015. Cox proportional hazards regression and zero-inflated negative binomial regression were performed to identify differences in outcomes by depressive mood and frailty.
*Results:* Participants with depressive mood and frailty represented 50.9% and 2.4%, respectively. The prevalence of mortality and LTCS use in the overall participants was 7.1% and 3.0%, respectively. More than 3 hospital admissions (36.7%) and total LOS above 15 days (53.2%) were the most common. Depressive mood was associated with LTCS use [hazard ratio (HR) 1.22, 95% confidence interval (CI) 1.05–1.42] and hospital admissions [incidence rate ratio (IRR) 1.05, 95% CI 1.02–1.08]. Frailty had associations with mortality risk (HR 1.96, 95% CI 1.44–2.68), LTCS use (HR 4.86, 95% CI 3.45–6.84), and LOS (IRR 1.30, 95% CI 1.06–1.60). The coexistence of depressive mood and frailty was associated with increased LOS (IRR 1.55, 95% CI 1.16–2.07).
*Conclusions and Implications:* Our findings highlight the need to focus on depressive mood and frailty to reduce mortality and HCU. Identifying combined problems in older adults may contribute to healthy aging by reducing adverse health outcomes and the burden of health care costs.


Health-related problems in older adults have become more apparent with the increase in the aging population. Depression and frailty, particularly, cause distress and burden.[1] The prevalence of depression in older adults was estimated to be 9.3%–31.7% globally,[2,3] and 13.87%–18.36% in South Korea, increasing with age.[4] Moreover, frailty negatively affects older adults' health, mobility, and quality of life.[5,6] A meta-analysis of the prevalence of frailty in 62 countries indicated that 12% of older adults were frail.[7] The older the individual, the higher the prevalence of frailty[7,8]; thus, many researchers have focused on this phenomenon in aging societies. However, there are various definitions, standards, and criteria for frailty.[9] Fried and colleagues defined the phenotype of frailty as unintentional weight loss, self-reported exhaustion, weakness, slow walking speed, and low physical activity.[10] Frailty can be screened using the Timed Up and Go (TUG) test, which is fast, effective, and easy to conduct.[11,12]

This work was supported by the Basic Science Research Program through the National Research Foundation of Korea funded by the Ministry of Education (No. 2020R1A6A1A03041989) and by the Brain Korea 21 FOUR Project funded by National Research Foundation of Korea, Yonsei University College of Nursing. Yesol Kim and Mihui Kim received a scholarship from Brain Korea 21 FOUR Project funded by National Research Foundation of Korea, Yonsei University College of Nursing.
The authors declare no conflicts of interest.
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https://doi.org/10.1016/j.jamda.2023.01.025

Depression and frailty, prevalent in the older adult population, negatively affect health. In previous studies, mortality risk was associated with depression[13,14] and frailty.[15,16] Furthermore, health care utilization (HCU) was likely to increase owing to depression[17,18] and frailty.[19] Recent studies investigating the effects of depression and frailty on mortality and HCU have been conducted independently. However, depression and frailty are not clearly distinct concepts but have similar and mutually influencing relationships. The prevalence of the co-occurrence of depression and frailty among older adults was found to be 16.4%–31.0%.[20] Further, a cross-sectional study identified a positive correlation between depression and frailty in community-dwelling older adults.[21] A meta-analysis also demonstrated that older adults with frailty were 4.42 times more at risk of depression than those without; those with depression had a 4.07 times higher risk of frailty compared with those without.[22] Depression and frailty in older adults have common pathophysiological mechanisms such as subclinical cerebrovascular disease, chronic inflammation, hypothalamic-pituitary-adrenal axis dysregulation, and accelerated cellular aging.[20] Furthermore, a combination of the 2 symptoms has been associated with increased mortality risk in older adults.[23]

Despite the importance of the combined effects of depressive mood and frailty, the coexisting effect of these 2 symptoms on mortality and HCU has not yet been fully investigated. Therefore, we aimed to investigate the association of depressive mood and frailty with mortality and HCU in older adults. Furthermore, we aimed to assess the coexisting effect of older adults' depressive mood and frailty on mortality and HCU using nationwide longitudinal cohort data of South Korea.

## Methods

### *Data Source*

The data were obtained from the National Health Insurance Service (NHIS)–Senior cohort, a nationwide administrative retrospective study in South Korea.[24] The NHIS–Senior cohort comprised 558,147 participants age 60 years or older selected by 10% random sampling in 2002, followed up until 2015. This cohort included eligibility, health screening, HCU, health care provider, and long-term care insurance databases. In addition, the health screening database contains the National Screening Program for Transitional Ages (NSPTA), which targets people age 40 years or 66 years.[25] As the NHIS–Senior cohort was targeted at older adults, only the NSPTA for those age 66 years from 2007 to 2008 was included in this data. This study was approved by the Institutional Review Board of the Yonsei University Health System (number 4-2022-0896) with a waiver of informed consent.

### *Study Population*

The participant selection process is shown in Figure 1. Among the NHIS–Senior cohort (n = 558,147), those who did not participate in the NSPTA during 2007–2008 (n = 516,015) were excluded. Subsequently, participants who did not respond to questions pertaining to depressive mood and frailty (n = 9697) and covariates (n = 4604) were excluded. Those who died or initiated long-term care services (LTCS) on or before the index date, defined as the day of health screening, were also excluded (n = 13). Finally, 27,818 participants were included.

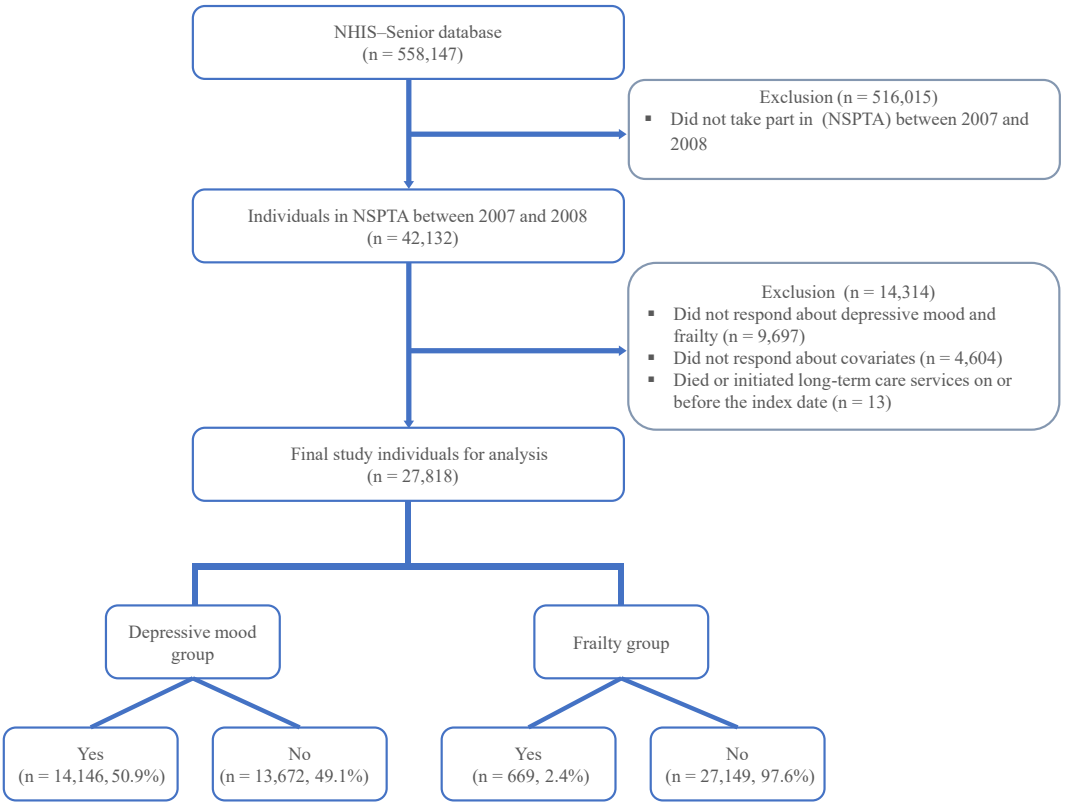


**Fig. 1.** Flow chart of the participant selection process.

*Definition of Depressive Mood and Frailty*

Depressive mood was classified according to 3 items from the Geriatric Depression Scale.[26] Participants who answered "yes" to one or more items were considered to experience depressive mood. Frailty was distinguished by the TUG test as a physical aspect.[11,12] Participants in the NSPTA took the TUG test on the day of health screening. The TUG test measured the time to get up from a chair, walk 3 meters, and return to the chair; those exceeding 10 seconds were considered to have frailty.

*Covariates*

Covariates included gender, residential region, health insurance type, income level, and disability from the eligibility database. We also assessed body mass index using height and weight, regular physical activity, cognitive impairment screened by the Korean Dementia Screening Questionnaire, and fall experience within 6 months from the NSPTA database. In addition, the Charlson Comorbidity Index was calculated by the *International Classification of Diseases 10th revision* codes using the HCU database within one year of the index date.[27,28]

*Outcome Variables*

The outcome variables were mortality and HCU from the index date to December 31, 2015. Survival time was defined as the difference between the index date and date of death. The HCU consisted of LTCS and inpatient service utilization. In South Korea, LTCS are public services operated by the NHIS, introduced in 2008.[29] After classifying the qualifications according to the care needs of older adults, benefits are provided to receive services at home or in facilities according to the grade.[30] LTCS utilization included the type of benefits and the period until first use, calculated as the difference between the index date and the start date of LTCS. Inpatient service utilization was defined as the total number of hospital admissions and the total length of stay (LOS) per participant.

*Statistical Analyses*

Descriptive statistics on the index date were performed using means, standard deviations, frequencies, and percentages. Participant characteristics on the index date according to depressive mood and frailty groups were compared using the $\chi^2$ test for categorical variables and the Wilcoxon rank sum test for continuous variables because continuous variables were not normally distributed. To compare mortality and LTCS utilization among the groups, Kaplan–Meier survival curves, the log-rank test, and multivariate Cox proportional hazards regression were performed. The proportional hazards assumption was verified using log-log plots. Hazard ratios (HRs) and 95% confidence intervals (CIs) were used to estimate the risk of mortality and LTCS utilization between the groups. Multivariate Cox proportional hazards regression was performed after adjusting for covariates. In this study, the number of hospital admissions and LOS were forms of count data with highly skewed distributions and a high proportion of zeros (approximately 25%). As over dispersion was identified in the zero-inflated Poisson model, zero-inflated negative binomial regression (ZINBR) was performed after adjusting for covariates to compare the number of hospital admissions and LOS among the groups. Incidence rate ratios (IRRs) and 95% CIs were used to estimate the risk of the number of hospital admissions and LOS. In addition, to assess the interaction effect of depressive mood and frailty on outcomes, multivariate Cox proportional hazards regression and ZINBR were conducted by adding the interaction term of these 2 variables. Statistical significance was set at $P < .05$. All statistical analyses were performed using SAS v 9.4 (SAS Institute Inc).

## Results

Participant general characteristics on the index date are shown in Table 1. A total of 27,818 participants were classified according to their depressive mood or frailty. Among the participants, those with depressive mood or frailty totaled 14,146 (50.9%) and 669 (2.4%), respectively. More than one-half of the participants were women; most were insured and had no disabilities. More than 50% of the participants participated in regular physical activity. Of the participants, 22.3% had cognitive impairment, and 14.2% had experienced a fall during the last six months. The mean Charlson Comorbidity Index was $1.08 \pm 1.29$.

In addition, Table 1 shows mortality and HCU, the outcomes of this study, during the follow-up period. The overall mortality was 7.1%, while that for participants with frailty was 14.2%, significantly higher than the mortality for those without frailty. Regarding HCU, 3.0% of the participants utilized LTCS, and 89.4% received in-home benefits. Participants with frailty had the highest proportion of LTCS use (16.3%). Of the participants, 25.6% had never been hospitalized; those with 1, 2, and more than 3 hospital admissions represented 20.4%, 17.2%, and 36.7%, respectively. Among participants who experienced hospital admissions, the proportion of those with a total LOS of 15 or more days was the highest (53.2%). Except for mortality according to depressive mood, outcomes showed statistically significant differences depending on whether participants had depressive mood or frailty ($P < .05$).

Regarding mortality, the survival rate decreased in participants with frailty (log-rank $P < .001$; Figure 2B). For LTCS utilization, survival curves showed that participants with depressive mood or frailty had a higher cumulative incidence than those without (log-rank $P < .001$; Figure 3).

Multivariate Cox proportional hazards regression analyses were performed for mortality and LTCS after adjusting for covariates (Table 2). Participants with frailty had a higher mortality risk (HR = 1.96, 95% CI 1.44–2.68) than those without frailty. In contrast, mortality risk among those with depressive mood ($P = .61$) or both conditions ($P = .68$) was not significant. The risk of LTCS utilization in participants with depressive mood (HR = 1.22, 95% CI, 1.05–1.42) or frailty (HR = 4.86, 95% CI 3.45–6.84) was significantly higher than in those without. However, the interaction between depressive mood and frailty was not statistically significant for LTCS use ($P = .45$).

Multivariate ZINBR analyses were also conducted for the number of hospital admissions and total LOS (Table 2). The rate of hospital admissions among participants with depressive mood was 1.05 times higher than among those without (95% CI 1.02–1.08). The total LOS among participants with frailty was 1.30 times higher than among those without (95% CI 1.06–1.60). In addition, the total LOS among those with both depressive mood and frailty was 1.55 times higher (95% CI 1.16–2.07).

## Discussion

The current study was designed to investigate the effect of the association between depressive mood and frailty on mortality and HCU for older adults age 66 years using 8-year South Korean national longitudinal cohort data. In this study, participants were community-dwelling older adults who participated in the NSPTA at age 66 years.[24] As these people voluntarily visited clinics, hospitals, and public health centers for health screening,[25] they could be considered a relatively healthy population. Therefore, the results can contribute to healthy aging as risks of mortality and HCU were observed for 8 years by reflecting baseline characteristics including depressive mood and frailty among 66-year-olds.

Regarding their characteristics, older adults with depressive mood and frailty accounted for 50.9% and 2.4% of participants, respectively. The prevalence rates of depressive mood and frailty in this study were

**Table 1**
General Characteristics and Outcomes of the Participants ($N = 27,818$)

| | Total | Depressive Mood | | | Frailty | | |
|---|---|---|---|---|---|---|---|
| | | Yes | No | *P* value* | Yes | No | *P* value* |
| Participants | 27818 (100.0) | 14146 (50.9) | 13672 (49.1) | | 669 (2.4) | 27,149 (97.6) | |
| Gender | | | | | | | |
| Men | 13123 (47.2) | 6440 (45.5) | 6683 (48.9) | <.001 | 276 (41.3) | 12,847 (47.3) | <.001 |
| Women | 14695 (52.8) | 7706 (54.5) | 6989 (51.1) | | 393 (58.7) | 14,302 (52.7) | |
| Residential region | | | | | | | |
| Capital city | 5755 (20.7) | 3078 (21.8) | 2677 (19.6) | <.001 | 83 (12.4) | 5672 (20.9) | <.001 |
| Metropolitan | 7155 (25.7) | 3678 (26.0) | 3477 (25.4) | | 179 (26.8) | 6976 (25.7) | |
| Others | 14908 (53.6) | 7390 (52.2) | 7518 (55.0) | | 407 (60.8) | 14,501 (53.4) | |
| Health insurance type | | | | | | | |
| Self-employed/employee insured | 27485 (98.8) | 13997 (98.9) | 13488 (98.7) | .020 | 655 (97.9) | 26,830 (98.8) | .030 |
| Medical aid | 333 (1.2) | 149 (1.1) | 184 (1.3) | | 14 (2.1) | 319 (1.2) | |
| Income levels (percentile) | | | | | | | |
| ≤20$^{th}$ | 4774 (17.2) | 2327 (16.4) | 2447 (17.9) | <.001 | 112 (16.7) | 4662 (17.2) | .11 |
| 21st–50th | 5512 (19.8) | 2707 (19.1) | 2805 (20.5) | | 141 (21.1) | 5371 (19.8) | |
| 51st–80th | 8836 (31.8) | 4550 (32.2) | 4286 (31.3) | | 233 (34.8) | 8603 (31.7) | |
| 81st–100th | 8696 (31.3) | 4562 (32.2) | 4134 (30.2) | | 183 (27.4) | 8513 (31.4) | |
| Disability | | | | | | | |
| Yes | 43 (0.2) | 21 (0.1) | 22 (0.2) | .79 | 4 (0.6) | 39 (0.1) | <.001 |
| No | 27775 (99.8) | 14125 (99.9) | 13650 (99.8) | | 665 (99.4) | 27,110 (99.9) | |
| BMI (kg/m$^2$) | 24.22 ± 2.99 | 24.26 ± 3.02 | 24.19 ± 2.95 | .07 | 24.51 ± 3.36 | 24.22 ± 2.98 | .10 |
| <23 | 9531 (34.3) | 4826 (34.1) | 4705 (34.4) | .33 | 227 (33.9) | 9304 (34.3) | .19 |
| 23–24.9 | 7759 (27.9) | 3908 (27.6) | 3851 (28.2) | | 169 (25.3) | 7590 (28.0) | |
| ≥25 | 10528 (37.8) | 5412 (38.3) | 5116 (37.4) | | 273 (40.8) | 10,255 (37.8) | |
| Regular physical activity | | | | | | | |
| Yes | 15898 (57.2) | 7693 (54.4) | 8205 (60.0) | <.001 | 335 (50.1) | 15,563 (57.3) | <.001 |
| No | 11920 (42.8) | 6453 (45.6) | 5467 (40.0) | | 334 (49.9) | 11,586 (42.7) | |
| Cognitive impairment | | | | | | | |
| Yes | 6216 (22.3) | 2772 (19.6) | 3444 (25.2) | <.001 | 201 (30.0) | 6015 (22.2) | <.001 |
| No | 21602 (77.7) | 11374 (80.4) | 10228 (74.8) | | 468 (70.0) | 21,134 (77.8) | |
| Fall in 6 months | | | | | | | |
| Yes | 3952 (14.2) | 2499 (17.7) | 1453 (10.6) | <.001 | 144 (21.5) | 3808 (14.0) | <.001 |
| No | 23866 (85.8) | 11647 (82.3) | 12219 (89.4) | | 525 (78.5) | 23,341 (86.0) | |
| CCI of 1 y[†] | 1.08 ± 1.29 | 1.12 ± 1.30 | 1.05 ± 1.27 | <.001 | 1.53 ± 1.59 | 1.07 ± 1.28 | <.001 |
| 0 | 11312 (40.7) | 5552 (39.2) | 5760 (42.1) | <.001 | 206 (30.8) | 11,106 (40.9) | <.001 |
| 1 | 8754 (31.5) | 4487 (31.7) | 4267 (31.2) | | 199 (29.7) | 8555 (31.5) | |
| 2 | 4367 (15.7) | 2300 (16.3) | 2067 (15.1) | | 111 (16.6) | 4256 (15.7) | |
| ≥3 | 3385 (12.2) | 1807 (12.8) | 1578 (11.5) | | 153 (22.9) | 3232 (11.9) | |
| Outcomes[‡] | | | | | | | |
| Mortality | 1973 (7.1) | 1038 (7.3) | 935 (6.8) | .11 | 95 (14.2) | 1878 (6.9) | <.001 |
| Health care utilization | | | | | | | |
| LTCS | 834 (3.0) | 488 (3.4) | 346 (2.5) | <.001 | 109 (16.3) | 725 (2.7) | <.001 |
| Facility benefits | 88 (10.6) | 44 (9.0) | 44 (12.7) | | 12 (11.0) | 76 (10.5) | |
| In-home benefits | 746 (89.4) | 444 (91.0) | 302 (87.3) | | 97 (89.0) | 649 (89.5) | |
| Number of hospital admissions | | | | | | | |
| 0 | 7132 (25.6) | 3486 (24.6) | 3646 (26.7) | <.001 | 152 (22.7) | 6980 (25.7) | <.001 |
| 1 | 5678 (20.4) | 2826 (20.0) | 2852 (20.9) | | 114 (17.0) | 5564 (20.5) | |
| 2 | 4786 (17.2) | 2441 (17.3) | 2345 (17.2) | | 114 (17.0) | 4672 (17.2) | |
| ≥3 | 10222 (36.7) | 5393 (38.1) | 4829 (35.3) | | 289 (43.2) | 9933 (36.6) | |
| Total length of stay (d)[§] | | | | | | | |
| 0–7 | 6422 (31.0) | 3230 (30.3) | 3192 (31.8) | .013 | 109 (21.1) | 6313 (31.3) | <.001 |
| 8–14 | 3253 (15.7) | 1651 (15.5) | 1602 (16.0) | | 72 (13.9) | 3181 (15.8) | |
| ≥15 | 11011 (53.2) | 5779 (54.2) | 5232 (52.2) | | 336 (65.0) | 10,675 (52.9) | |

BMI, body mass index; CCI, Charlson Comorbidity Index.
The results are reported as number (%) for categorical variables or mean ± standard deviation for continuous variables.
*$P$ value as $\chi^2$ test for categorical variables or Wilcoxon rank sum test for continuous variables.
[†]Calculated within 1 year of the index date.
[‡]During the 8-year follow-up period.
[§]Participants who experienced hospital admissions (n = 20,686) are included.

different from those found in other studies in South Korea.[4,31] In this study, depressive mood was screened using the 3 items of the Geriatric Depression Scale; the prevalence was higher than in Kim et al.,[4] which reported a 13.87% prevalence of depression diagnosed using the *International Classification of Diseases 10th revision* codes in older adults age 60–79 years. Meanwhile, the prevalence of frailty, classified as a physical aspect using the TUG test, was relatively lower than in Jung et al[31] who reported a 7.5% prevalence of frailty classified based on 5 frailty phenotypes[10] in healthy community-dwelling older adults age 70–84 years. Considering these characteristics, it is necessary to pay attention to the interpretation of the findings and direct comparisons with other studies.

Our results indicate that older adults with frailty had a high risk of mortality after adjusting for covariates. Those with depressive mood or frailty also had a high risk of LTCS utilization. Furthermore, depressive mood was associated with the number of hospital admissions. In addition, frailty and the coexistence of depressive mood and frailty were significantly associated with the total LOS.

Our results found that the risk of mortality in older adults with frailty classified by the TUG test was 1.96 times higher than in those

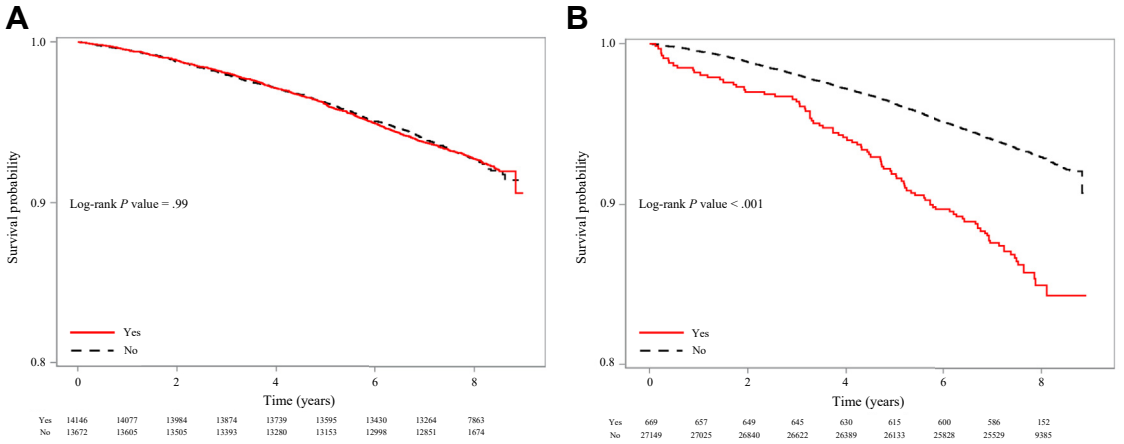


**Fig. 2.** Kaplan-Meier curves for mortality according to (A) depressive mood and (B) frailty during the 8-year follow-up period.

without. Kojima et al[32] conducted a systematic review and meta-analysis and showed an association between frailty and mortality. Similarly, we reaffirmed a significant association between them. These findings are similar to those of a Peruvian cohort study, which indicated that the slower the time on the TUG test, the higher the mortality risk.[33] Frailty has been identified as a risk factor affecting mortality in various settings, including community and hospital.[15,16] Moreover, frailty has been associated with appetite loss, malnutrition, sarcopenia, and multimorbidity,[34-36] indicating that these increase the risk of mortality by reducing physical activity and functional capacity.[37] These findings suggest that screening for frailty using the TUG test and providing population-level frailty management interventions may reduce older adults' mortality.

In the present study, depressive mood and frailty were found to be significant risk factors for LTCS use in HCU. Older adults with depressive mood had a 1.22 times higher risk of LTCS use, slightly lower than in a study in Belgium that found older adults with depression at a 1.45 times higher risk of LTCS use.[38] In this Belgian study, the mean age of participants was 73.9–80.1 years, higher than in our study.[38] As depressive symptoms are associated with a decrease in functional status, depressed older adults are more likely to have greater care needs[39,40]; this may affect the high risk of LTCS use. Notably, our findings highlight that older adults with frailty had a 4.86 times higher risk of using LTCS for 8 years. These findings show a slightly higher LTCS risk than a study in Australia that conducted various measurements of frailty in 2087 older adults (HR 3.2–4.1).[41] A possible explanation could be that LTCS in the present study included in-home benefits, whereas previous studies in other countries included only the use of LTCS facilities.[38,41] In addition, frailty has been indicated to limit functional ability, exacerbate difficulty performing activities of daily living, and increase dependence,[42,43] which may be associated with the increased use of LTCS in older adults. Therefore, it is necessary to screen and manage those at high risk of LTCS use by considering depressive mood and frailty among community-dwelling older adults.

There have been inconsistent results on the influence of older adults' depressive mood or frailty on hospitalization, including the number of hospital admissions and LOS. In the case of depressive mood, Williams et al[44] reported that there was no significant association between depression and increased hospitalizations among cancer survivors age 65 years or older. In this study, although depressive mood was not significantly associated with the total LOS, it was significantly associated with the number of hospital admissions over 8 years. The results of this study show a similarity to those found in previous studies on the association between depressive mood and hospitalization.[17,18] An increase in hospitalization might be explained by the tendency of older adults with depressive mood to experience more psychosomatic symptoms and their association with various comorbidities.[18] Regarding frailty, our results showed that it was not significantly associated with hospital admission but with an increase

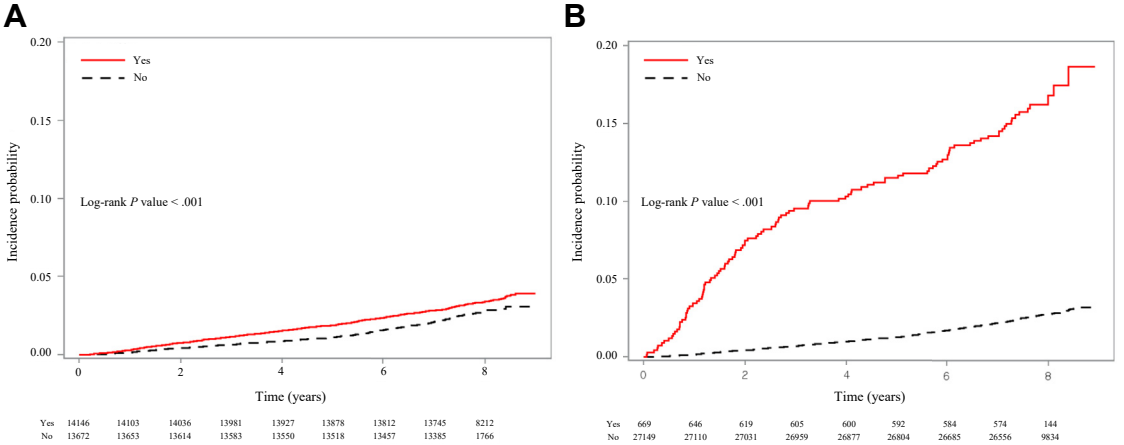


**Fig. 3.** Kaplan-Meier curves for long-term care services use according to (A) depressive mood and (B) frailty during the 8-year follow-up period.

**Table 2**
Adjusted Associations of Depressive Mood and Frailty With Mortality and Health Care Utilization

| | Mortality | | Health Care Utilization | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Long-term Care Services | | Number of Hospital Admissions | | Total Length of Stay | |
| | HR (95% CI) | *P* Value | HR (95% CI) | *P* Value | IRR (95% CI) | *P* Value | IRR (95% CI) | *P* Value |
| Depressive mood | 1.02 (0.93, 1.12) | .61 | 1.22 (1.05, 1.42) | .009 | 1.05 (1.02, 1.08) | <.001 | 1.04 (0.99, 1.09) | .09 |
| Frailty | 1.96 (1.44, 2.68) | <.001 | 4.86 (3.45, 6.84) | <.001 | 1.09 (0.96, 1.24) | .16 | 1.30 (1.06, 1.60) | .013 |
| Depressive mood* frailty | 0.92 (0.61, 1.39) | .68 | 1.18 (0.77, 1.80) | .45 | 1.07 (0.90, 1.27) | .42 | 1.55 (1.16, 2.07) | .003 |

Gender, residential region, income levels, disability, body mass index, regular physical activity, cognitive impairment, falls in the past 6 months, and Charlson Comorbidity Index for the past one year were adjusted.
*Indicating interaction between depressive mood and frailty.

in the total LOS. Several studies support a significant association between frailty and hospitalization among older adults,[15,44] which could be explained by the fact that frailty is related to disability and comorbidities.[45] Considering our findings, further studies are suggested to identify the associations between depressive mood and frailty and hospitalization.

Notably, this study demonstrates a significant association between the coexistence of depressive mood and frailty and an increase in the LOS in older adults. Compared with older adults with frailty (IRR = 1.30), the risk for a prolonged LOS in those with a coexistence of depressive mood and frailty was higher (IRR = 1.55). These findings are similar to those of recent studies that reported significant associations between the coexistence of these 2 variables and LOS among kidney transplant recipients[46] and older adults who underwent spinal surgery.[47] This seems that disability in both psychological and functional status affects older adults' increased LOS, which causes an increase in the burden of health care costs. Therefore, the burden of health care costs for the entire medical system may be reduced by identifying older adults with coexisting depressive mood and frailty through a screening program in the early stage of older adulthood and providing them with interventions.

This study had several limitations. First, we used depressive mood instead of clinically diagnosed depression as older adults with depression tended to be underdiagnosed in South Korea.[48] For this reason, there may be different characteristics between participants in this study and those diagnosed with depression in hospitals. Hence, it is necessary to interpret and compare results carefully by distinguishing between depressive mood and depression. Second, because the data used did not have any specific measurement for frailty, we regarded frailty as a case where the result of the TUG test exceeded 10 seconds.[11,12] There is, thus, the possibility of frailty having been overestimated because it was defined as a single criterion related to the physical domain. There are various measurements and aspects related to frailty, such as cognitive and social as well as physical frailty.[8,49,50] Therefore, future studies should consider these aspects of frailty. Third, we investigated mortality and HCU for all causes without distinguishing a specific cause. This has the potential to weaken the causal relationship between the independent variable and outcomes. Therefore, further studies should confirm disease-specific as well as all-cause outcomes. Finally, the data analyzed in this study had a temporal difference from the current point in time. As the NHIS–Senior cohort data we used were followed up from 2007 to 2015, care should be taken in interpreting the results.

## Conclusions and Implications

During a relatively long follow-up period of 8 years, depressive mood was significantly associated with LTCS use as well as the number of hospital admissions. Frailty had a significant association with a high risk of mortality, LTCS use, and total LOS. Moreover, the coexistence of depressive mood and frailty was significantly associated with increased LOS. Our findings highlight the need for researchers and health care providers to pay attention to depressive mood that affects HCU and frailty that affects mortality and HCU in the early stages of older adulthood. Furthermore, we suggest that identifying depressive mood and frailty in community-dwelling young older adults may contribute to healthy aging by reducing adverse health outcomes and burdens of health care costs.

## Acknowledgments

The authors acknowledge the National Health Insurance Service in Korea for their cooperation in using their data.

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