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Burden of Depressive Symptoms Over Two Decades and Risk of Nursing Home Placement in Older Women

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Abstract

Objectives—To determine association between cumulative burden of depressive symptoms and risk of nursing home placement over two decades.

Design—Prospective cohort study with data linked to Medicare Claims Files.

Setting—Clinic sites in Baltimore, Maryland; Minneapolis, Minnesota; and the Monongahela Valley near Pittsburgh, Pennsylvania.

Participants—3646 initially community-dwelling women 65 years and older.

Measurements—Depressive symptom burden was defined by the Geriatric Depression Scale measured over 18 years to calculate accumulation of burden. Nursing home placement was defined by Medicare claims data.

Results—In Fine-Gray proportional hazards analyses, including demographics, medical comorbidities, functional impairment and recent depression exposure, and accounting for competing risk of death, women with low depressive symptom burden were twice as likely to experience nursing home placement compared to those with minimal burden (hazard ratio (HR) = 1.92, 95% confidence interval (CI) = 1.16–3.20), while women with moderate and high depressive symptom burden had over 2- and 3-fold increased risk (HR = 2.62, 95% CI = 1.59–4.31 and HR =

3.08, 95% CI = 1.87–5.08, respectively). The addition of antidepressant use to this model only slightly attenuated the hazard ratios.

Conclusions—In older women, cumulative burden of depressive symptoms over nearly two decades is associated with a greater risk of transitioning from community-living to a nursing home irrespective of recent depression exposure, medical comorbidities, functional impairment, and the competing risk of death. This work supports the need for improving recognition, monitoring, and treatment of depressive symptoms early on, which may reduce or delay nursing home placement.

Keywords

care transitions; institutionalization; aging; depression; epidemiology

INTRODUCTION

Nearly 20% of older community-dwelling women have persistently high depressive symptoms or increasing depressive symptoms over time.¹ As a chronic illness, it is important to determine how cumulative exposure to depression or depressive symptoms over time impacts adverse health outcomes in late life such as nursing home placement, which, to our knowledge, has not been previously studied. Considering over 1.5 million Americans currently reside in nursing facilities, a number that is expected to rise dramatically due to projected expansion of the older population, and considering increased cost of care,^{2–4} greater understanding of extent to which depression and depressive symptoms, which are remediable conditions, are associated with long-term care use into very late life is imperative.

Previous studies have examined prevalence and adverse outcomes of major and minor depression among nursing home residents,^{5–9} as well as depressive symptoms as a risk factor for acute care, such as hospitalization.^{10–14} Few prior studies have examined the relationship of depression or depressive symptoms and risk of nursing home placement, with most assessing depression symptomatology or diagnosis at one time point.^{15–19} Thus, next to nothing is known about the influence of cumulative exposure to depressive symptoms over time, which may better capture the chronic course of depressive symptoms and their impact on nursing home placement than a measure at a single time point. However, indications traditionally considered for nursing home care are generally impairments in physical and cognitive function.^{20,21} Considering the huge cost of long-term care, which is largely paid by the public,³ it is critical to consider such factors as depression that if adequately monitored and treated may reduce need for nursing home placement.

The purpose of our study was to determine whether cumulative burden of depressive symptoms increases risk of transitioning from community-living to residence in a nursing home over two decades. We hypothesized that higher cumulative burden of depressive symptoms in late life is associated with an increased risk of nursing home placement, independent of important comorbidities and physical and cognitive impairment, and after accounting for recent depression level and competing risk of death.

METHODS

Study Population and Linkage to Medicare Claims

The Study of Osteoporotic Fractures (SOF) is a prospective cohort study of women age 65 years and older, originally recruited between September 1986 and October 1988. The SOF study included 9,704 women from population-based listings in 4 areas of the U.S.: Baltimore, MD; Minneapolis, MN; and Monongahela Valley near Pittsburgh, PA; and Portland, OR. Women were excluded from participation if they were unable to walk without help or had a bilateral hip replacement. The study was initially limited to white women since rate of hip fractures is very low in other race groups. Using validated methods detailed in previous publications,^{22,23} linkage of the SOF cohort to Medicare Claims Files (first available 1/1/1991) was completed by submitting participant social security and/or Medicare numbers to the Centers for Medicare and Medicaid Services.

The current study sample included 3646 SOF women who had at least two depression scale measures over nearly 20 study years (baseline and at least one at follow up), were enrolled in Medicare fee-for-service plan (Parts A and B alone and not Part C), and did not have an indicator for nursing home residence at study baseline. In addition, women from Portland were excluded, because they were enrolled through the Center for Health Research of Kaiser Permanente Northwest, a health maintenance organization. Figure 1 summarizes the participant flow diagram. All women provided written informed consent. The study was approved by the committees on human research at each site. In addition, study analyses were approved by the institutional review board of the University of California, San Francisco, and the San Francisco Veterans Affairs Medical Center.

Measures

Depressive Symptoms—We evaluated depressive symptoms using the Geriatric Depression Scale (GDS), a 15-item questionnaire (scores ranging 0–15) assessing number of depressive symptoms based on binary item responses (i.e., ‘yes’ or ‘no’), with higher scores indicating more symptoms of depression. The GDS was initially administered during year 2 (defined as current study baseline) and was routinely administered at follow-up years 6, 10, 16, and 20. The instrument is a validated and reliable self-report scale in older participants,²⁴ because it is structured to minimize measurement of common but nonspecific factors in older adults (e.g., fatigue, sleep disturbance, and poor concentration).²⁵

Estimating Cumulative Burden of Late-Life Depressive Symptoms—Cumulative depressive symptom burden was characterized using GDS measures over 18 years, resulting in a measure analogous to “pack-years” of tobacco exposure. This required imputation of GDS values between study visits, as well as between age 66 and the first study visit, so that cumulative burden could be estimated from age 66 forward for all participants. To perform the imputation, we implemented a statistical approach used in previous published work.²⁶ Specifically, we first modeled the average trajectory of the GDS scores across the age range using an unadjusted Poisson model with random slopes and intercepts. To allow for non-linearity in the trajectory, the effect of age was modeled using a 3-knot cubic spline. Then, based on the fitted model, we obtained best linear unbiased predictions (BLUPs) of the

trajectory for each participant, spanning years from age 66 to end of her follow-up. Next, we calculated areas under the resulting curves for each participant, as time-dependent measures of cumulative depressive symptom burden; we explain below how these AUCs were used in the Fine-Gray model for time to nursing home placement. Finally, the time-dependent AUCs were categorized into time-dependent Quartiles (assessed at participant's increasing age), with Quartile 1 = minimal, Quartile 2 = low, Quartile 3 = moderate, and Quartile 4 = high depressive symptom burden. Figure 2 presents quartiles by age. Fitted GDS scores largely increased over time for almost all women (19% stayed in same quartile). Compared to simpler methods such as linear interpolation or last value carried forward, our approach to imputing GDS values should perform better for participants with fewer or variable scores, and can back project trend between age 66 and each participant's first visit.

Nursing Home Placement—Incident long-term nursing home placement was defined by a modified version of a previously published algorithm that uses Medicare claims data to differentiate between short-term (usually intended for purposes of post-hospital rehabilitation, Medicare Part A) and long-term (usually for custodial residence, Medicare Part B) nursing home stays.^{27,28} Since Medicare does not cover long-term nursing home stays, the algorithm uses billing information for outpatient services that are delivered to nursing home residents. We first identified a month with a carrier or outpatient bill that did not occur during Part A-covered nursing home stay and examined up to the following 12 months for subsequent Part B outpatient services delivered in the nursing home. For participants with fewer than 13 months of Medicare claims during this period because of mortality or end of study, all available months were considered in the algorithm. Nursing home placement was defined based on proportion of eligible months that had Part B claims submitted during the follow-up period. We defined a participant as having nursing home placement if she had a Part B nursing home claim submitted for 40% or more of eligible follow-up months as long as no Part A nursing home claims were submitted during this period (months with a Part A nursing home claim were not considered eligible months). For example, if a participant had a total of 5 eligible months, she was considered to have met the criteria for nursing home placement if Part B claims were submitted for two of the 5 months. This definition has high predictive validity (sensitivity 87%, specificity 96%) of custodial residence in a nursing home.²⁷

Other Variables—Information on participants' age and education was collected at baseline. Time-dependent assessments at follow-up were collected on all other variables, including marital status, living arrangement, and comorbidities. Information on medical conditions, including diabetes, stroke, myocardial infarction (MI), hypertension, congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), cancer, and obesity (BMI ≥ 30), was obtained through medical history collected in SOF and inpatient Medicare claims using the International Classification of Diseases, Ninth Revision (ICD-9 codes). Global cognitive function was assessed by the modified version of the Mini-Mental State Examination (mMMSE)²⁹ with a maximum score of 26. Scores of less than 23 indicated cognitive impairment (equivalent to at least 1.5 standard deviations below mean).³⁰ Functional limitations were assessed for each of 5 instrumental activities of daily living (IADL) (i.e., walking 2–3 blocks, climbing 10 steps without resting, preparing meals,

shopping, and doing heavy housework). Finally, participants were asked about current antidepressant use (within past 30 days); reports of current use were checked by examining labels of drugs.

Data were complete at baseline for all variables and at follow up for depression symptom burden and nursing home placement. For any other variables with missing values at follow up, last observation carried forward was used.

Statistical Analyses

To describe the sample, we compared prevalence and mean \pm standard deviation (SD) of baseline characteristics across depressive symptom quartiles estimated at baseline. We then used Fine-Gray proportional hazards regression to estimate effect of depressive symptom burden on cumulative risk of long-term nursing home placement, accounting for competing risk of death;³¹ follow-up was censored at disenrollment from Medicare fee-for-service, loss to follow-up, or end of study. This approach can attenuate the estimated effect of risk factors that are also associated with death, by taking into account reductions in time at risk for the primary outcome. Our Fine-Gray model used age as the time-scale, and incorporated the AUCs for GDS scores as time-dependent covariates, lagged by two years. The purpose of lagging was to reduce risk of an effect-cause artifact, in which the prospect of nursing home placement causes depressive symptoms. To illustrate the lagging, consider the “risk set” defined by long-term nursing home placements occurring at age 80. For this risk set, time-dependent GDS AUC for each participant was estimated by summing her annual fitted BLUP estimates of expected GDS levels from 66 to age 78. Then in the subsequent risk set for placements at age 81, sums were taken from age 66 to age 79, and so on. Note that sums used in each risk set are taken over same age range. In a final step, the AUCs for each risk set were categorized in quartiles.

To determine whether the association was influenced by changing demographics and comorbidities with time, we adjusted for groups of important potential confounders. In Model 1, we adjusted for demographic factors (i.e., education and changing marital and living alone status). In Model 2, we examined the association adjusting additionally for time-dependent comorbidities (i.e., diabetes, stroke, MI, hypertension, CHF, COPD, cancer, and obesity). In Model 3, we further adjusted for time-dependent functional impairment (i.e., cognitive impairment and functional limitations). In Model 4, we additionally adjusted for most recent time-dependent depression based on GDS ≥ 6 . Finally, we considered further adjustment for antidepressant use with results similar to Model 4.

Proportional hazards assumptions were evaluated graphically and statistically and determined to be satisfied for all models. Statistical tests for models were two-tailed with $P < .05$ defining statistical significance. All analyses were performed using SAS version 9.4 software (SAS Institute Inc, Cary, North Carolina).

RESULTS

In comparing women who were included versus those who were excluded from current study, women who were included were more likely to have comorbid diabetes, myocardial

infarction, obesity, and physical impairment as well as less hypertension at baseline. Also, they were significantly younger, slightly less educated, and less likely to be married at baseline, although absolute differences were quite small. In addition, statistical differences of mean GDS scores at baseline were non-significant ($P = .75$).

The final sample was 99.8% Caucasian, with baseline age of 72.6 ± 4.6 years. Of the 3646 women, 1849 died over the study and 28.8% had been placed in a nursing home. In Table 1, women with greater depressive symptom burden at baseline tended to be older, and were more likely to live alone, less likely to be married, and have more comorbid medical conditions and functional impairment.

In assessing competing risk models, we examined association between time-dependent depressive symptom burden and risk of nursing home placement adjusting for time-dependent covariates; accounting for salient changes over time that particularly impact nursing home placement. Table 2 shows that greater cumulative depressive symptom burden was associated with increased risk of nursing home placement over the 18 years. After adjusting for demographic factors and accounting for competing risk of death (Model 1), women with low depressive symptom burden were over twice as likely to experience nursing home placement (hazard ratio (HR) = 2.06, 95% confidence interval (CI) = 1.27–3.33), while women with moderate and high depressive symptom burden had 3-fold increased risk (HR = 2.91, 95% CI = 1.81–4.66) and 4-fold increased risk (HR = 4.04, 95% CI = 2.53–6.44) of nursing home placement. The addition of medical comorbidities (Model 2) and cognitive impairment and IADL functional limitations (Model 3) to this model slightly attenuated hazard ratios for low and moderate depressive symptom burden groups with more substantial attenuation for the high burden group (HR = 3.24, 95% CI = 1.97–5.33). Further adjustment for most recent clinically-relevant depression (GDS ≥ 6) reduced magnitude of the association somewhat (Model 4). Of note, for most recent clinically-relevant depression (GDS ≥ 6), the hazard ratio was 1.23 (95% CI = 1.02–1.49). Models also adjusting for antidepressant use showed similar results to Model 4.

DISCUSSION

In this study of community-dwelling older women, those who had low to high cumulative exposure to depressive symptom burden had a 2- to 4-fold increased risk of nursing home placement over two decades compared with women who had minimal depressive symptom burden. Furthermore, these associations remained after accounting for competing risk of death and most recent clinically-relevant depression, as well as demographics, comorbidities, and functional impairment. These findings indicate that cumulative burden of depressive symptoms over nearly two decades contributes very strongly and importantly to transitioning from community-living to residence in a nursing home above and beyond recent exposure.

The magnitude and strength of our findings are consistent with results from studies of older patients who are cognitively impaired or demented or reliant on home care services. In one study of cognitively impaired older adults aged 71 years or older, the authors found that specific neuropsychiatric symptoms, which included depression, were associated with a 3-

fold increased risk of institutionalization during the 5-year study period.³² A systematic review identifying most consistent predictors of nursing home admission in persons with dementia determined, after reviewing 80 relevant studies, that depression was one of the prominent predictors, which also included severity of cognitive impairment, Alzheimer disease, basic activity of daily living dependencies, and behavioral symptoms.³³ Finally, a longitudinal study using data from the European Aged in Home Care (AdHOC) database found that depression was associated with increased risk of nursing home admission at one-year follow up, with this association increasing with severity of depression.¹⁹ In contrast to these clinically-oriented studies, our study is community based, documenting saliency and robustness of depression symptom burden over long term to alter an older adults' independent living.

The few prior studies investigating predictors of nursing home placement in community-dwelling older adults had mixed results related to depression and depressive symptoms. A recent systematic review of predictors of nursing home placement in the general population of developed countries determined that depression was one of the predictors with inconsistent results.³⁴ Although limited in studies considered for depression, the authors concluded that predictors of nursing home placement were primarily based on underlying cognitive and functional impairment and associated lack of support and assistance in daily living. In contrast, two recent longitudinal studies from Germany³⁵ and the U.S.³⁶ suggested that depression and depression symptom trajectories may be important predictors of nursing home admission, assessed largely by self report of short-term stays, along with dementia, functional impairments, and frailty.

Finding that depressive symptom burden is associated with risk of nursing home placement above and beyond recent depression, comorbidities, and functional impairment has important implications. These findings suggest that if left unresolved depressive symptoms will lead to very high burden in older adults and costly consequences. This could potentially be explained by a high concentration of exposure to depressive symptoms over time accelerating physical³⁷ and cognitive decline³⁸ and institutionalization. Given we adjusted for time-dependent functional limitations and cognitive impairment in this study, a likely pathway may be that such cumulative depression burden impairs an older adult's ability to compensate for developing physical and cognitive impairments that warrant institutionalization. It is also possible that cumulative depressive symptom burden increases disability from other sources, such as the accumulation of poorer health behaviors.³⁹ Moreover, our results have implications for increasing recognition, treatment, and monitoring in older adults across practices and services in order to reduce depressive symptoms over long term. It is documented that as few as 30% of community-dwelling older adults with mental health conditions actively seek help, with most of them consulting general medical services.^{40,41} Finally, in comparing women included (Medicare fee-for-service) versus those excluded from current study, any absolute differences in demographics and comorbidity were quite small and there was no statistical difference in baseline depressive symptom scores; suggesting these findings may be generalized to older U.S. women beyond Medicare fee-for-service enrollees.

There are some limitations of this study. The results are not generalizable to men, nonwhite older adults, or less healthy women. Also, we had limited information on non-pharmacologic depression treatment, and, therefore, we were unable to investigate impact of treatment on reducing depressive symptom burden and decreasing risk of nursing home placement. Finally, although we adjusted for functional limitations in IADLs, we did not have information available on more basic activities of daily living, which may influence association.

The strengths of this study include a large sample of community-dwelling older women and information on depressive symptoms over nearly 20 years. In addition, lagging our time-dependent cumulative burden measure by two years makes it less likely that associations found are artifacts of increases in depressive symptoms driven by prospect of impending nursing home placement.

Conclusions

The transition from community living to a nursing facility is a profoundly important event associated with negative consequences for older persons, families, and health systems. Considering projected expansion of the older adult population and increased life expectancy, the potential public health burden of late-life depressive disorders and future health and economic costs implicated by this study are concerning. Depression is a treatable disorder, and these findings emphasize the importance of improving evaluation, recognition, monitoring and treatment of depressive symptoms into late life across healthcare practices, programs, and services.

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Conflicts of interest: The authors have no competing interests, including specific financial interests or relationships or affiliations relevant to the subject of this manuscript.

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Disclaimer/Sponsor's Role: We acknowledge that the original collector of the data, sponsoring organizations, agencies, or the U.S. government bear no responsibility for use of the data or for interpretations or inferences based upon such uses. The views and opinions expressed in this report are those of the authors and should not be construed otherwise.

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Impact Statement

1. We certify that this work is confirmatory of recent novel clinical research.^{35,36}
2. The potential impact of this research on clinical care or health policy includes the following: Interrupting the chronic course of depressive symptoms is vital and may reduce need for nursing home placement. Furthermore, the potential public health significance of reducing the occurrence of depressive disorders sooner than later is huge, as transitioning into a nursing facility is a major life event associated with great social, emotional, and economic burden.

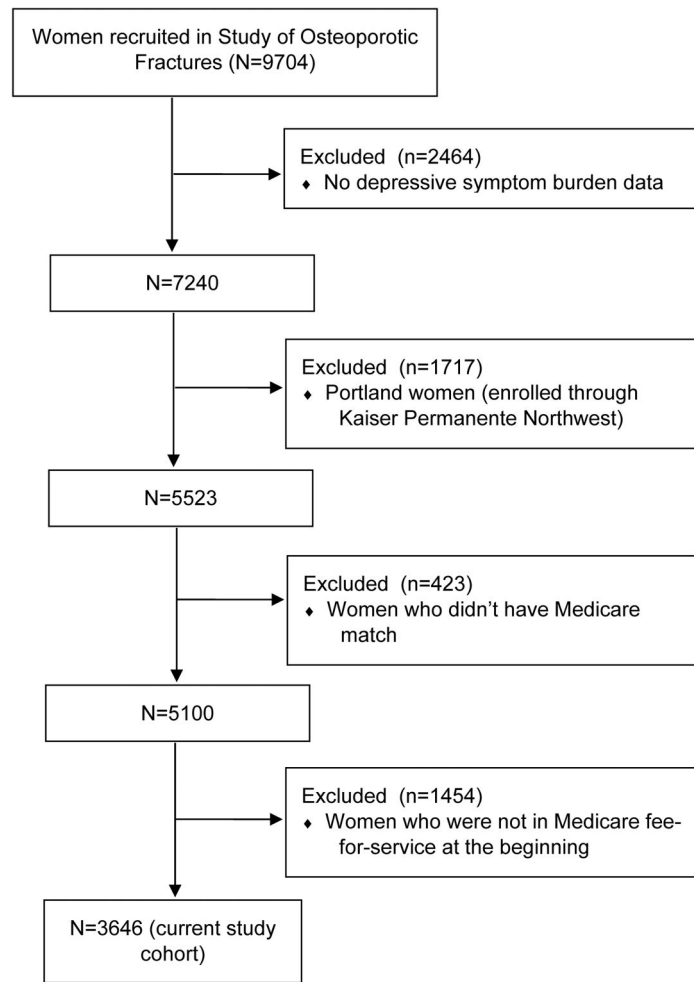


Figure 1.
Flow Diagram of Study Inclusion and Exclusion Criteria

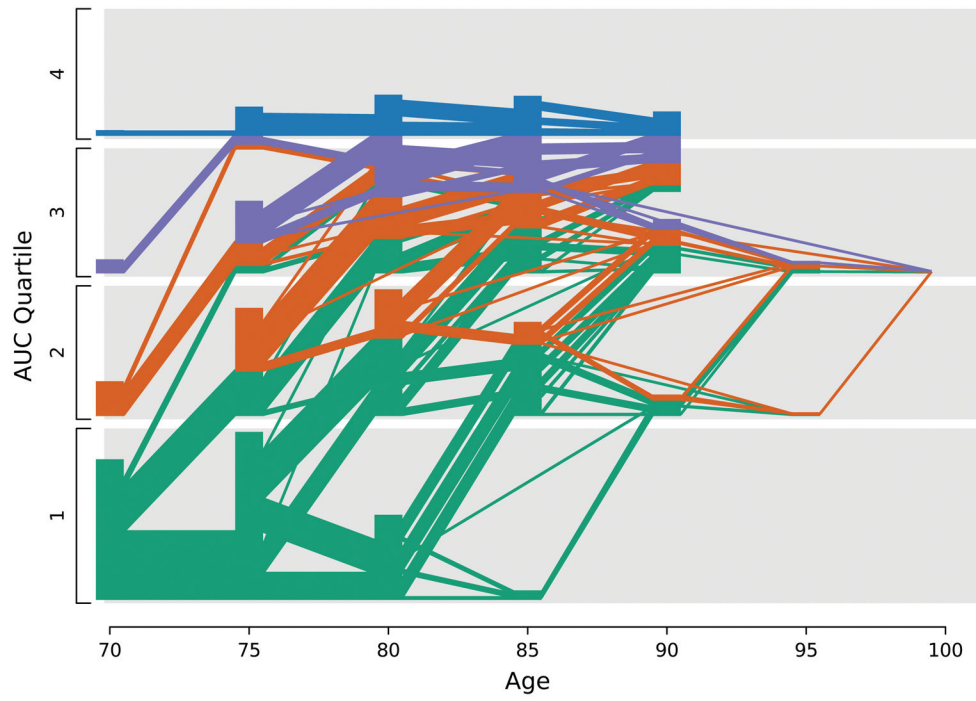


Figure 2. Quartiles of Depressive Symptom Burden Over Time by Age (Quartile 1 to 4 = Minimal to High Burden)

Table 1

Baseline Characteristics of 3646 Older Women According to Depressive Symptom Burden

Characteristic	Depressive Symptom Burden at Baseline ^a				P Value ^b
	Minimal, n = 911	Low, n = 912	Moderate, n = 912	High, n = 911	
Demographic					
Age, years, mean ± SD	69.2 ± 2.0	71.5 ± 3.3	73.5 ± 4.2	76.2 ± 5.2	<.001
Education, years, mean ± SD	13.1 ± 2.5	12.7 ± 2.7	12.6 ± 2.7	12.1 ± 3.1	<.001
Married, n (%)	464 (58.1)	408 (50.8)	376 (46.2)	271 (33.2)	<.001
Living Alone, n (%)	276 (34.6)	321 (40.0)	367 (45.1)	450 (55.2)	<.001
Comorbidity, n (%)					
Diabetes	32 (3.5)	49 (5.4)	74 (8.1)	89 (9.8)	<.001
Stroke	6 (0.7)	19 (2.1)	27 (3.0)	34 (3.8)	<.001
Myocardial Infarction	23 (2.9)	41 (5.3)	55 (7.0)	82 (10.9)	<.001
Hypertension	221 (24.3)	303 (33.2)	305 (33.4)	376 (41.3)	<.001
Congestive Heart Failure	4 (0.5)	8 (1.0)	22 (2.9)	31 (4.2)	<.001
COPD	59 (6.6)	57 (6.3)	96 (10.7)	100 (11.3)	<.001
Cancer	38 (4.2)	47 (5.2)	37 (4.1)	41 (4.5)	.95
Obesity	134 (16.2)	171 (20.4)	201 (23.4)	211 (24.5)	<.001
Functional Impairment, n (%)					
Cognitive Impairment	35 (3.9)	60 (6.6)	80 (8.8)	132 (14.6)	<.001
IADL Functional Limitations	141 (16.2)	254 (28.6)	371 (41.6)	558 (62.8)	<.001
Antidepressant Use, n (%)	8 (0.9)	15 (1.7)	10 (1.1)	34 (3.8)	<.001

Abbreviations: SD = standard deviation; COPD = Chronic Obstructive Pulmonary Disease; IADL = Instrumental Activities of Daily Living.

^aDepressive Symptom Burden defined by Quartiles (Quartile 1 to 4 = Minimal to High Burden).^bP-values by ANOVA test for continuous variables and Mantel-Haenszel test for categorical variables.

Table 2

Competing Risk Models Examining Association between *Time-dependent* Depressive Symptom Burden and Risk of Nursing Home Placement adjusting for *Time-dependent* Covariates

Depressive Symptom Burden	Hazard Ratio (95% Confidence Interval)			
	Model 1 ^a	Model 2 ^b	Model 3 ^c	Model 4 ^{d,e}
Minimal (Reference)	1	1	1	1
Low	2.06 (1.27, 3.33)	1.94 (1.17, 3.23)	1.92 (1.16, 3.20)	1.92 (1.16, 3.20)
Moderate	2.91 (1.81, 4.66)	2.70 (1.64, 4.45)	2.61 (1.59, 4.31)	2.62 (1.59, 4.31)
High	4.04 (2.53, 6.44)	3.57 (2.18, 5.85)	3.24 (1.97, 5.33)	3.08 (1.87, 5.08)

Abbreviations: MI = Myocardial Infarction; CHF = Congestive Heart Failure; COPD = Chronic Obstructive Pulmonary Disease; IADL = Instrumental Activities of Daily Living; GDS = Geriatric Depression Scale.

^aModel 1 = Adjusted for demographics (education, married, living alone).

^bModel 2 = Adjusted for demographics + comorbidity (diabetes, stroke, MI, hypertension, CHF, COPD, cancer, obesity).

^cModel 3 = Adjusted for demographics + comorbidity + functional impairment [cognitive impairment, functional limitations (difficulties on any of 5 activities, IADLs)].

^dModel 4 = Adjusted for demographics + comorbidity + functional impairment + most recent Depression (GDS ≥ 6).

^eResults additionally adjusted for antidepressant use were similar to Model 4.