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## Research article

### Care Preferences of Elderly People Living Alone in Japan

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#### Abstract

While social isolation amongst older people has emerged as a major concern for health policy, no prior study has examined the care preferences of socially isolated elderly people who live alone. Most elderly people living alone in Japan are likely to die alone and remain undiscovered if they cannot receive the long-term care insurance (LTCI) service when needing care. However, demand for the LTCI service exceeds supply in urban areas, and health issues arising from social isolation could lead to longer waiting times for LTCI services in Japan. To determine the care preferences of elderly people living alone in relation to the degree of social isolation, I used data drawn from the 2014 Cabinet Office survey of elderly people living alone in Japan. Taking into account aspects of *Kodokushi* or a lonely death, the generalized structural equation models (GSEMs) were estimated. Results of the GSEMs showed that elderly people with a higher degree of social isolation tended not to prefer receiving care services at their own or relatives' homes when needing care. They preferred care workers as primary caregivers. The preferred care places were influenced by the feeling that a lonely death was imminent. In contrast, a smaller capacity of care facilities for population aged  $\geq 75$  years was positively associated with a preference for home care. Elderly people in an urban area understood that it was difficult to receive care services at the facilities due to the small capacity. Considering the excess demand for the LTCI service in urban areas, to prevent social isolation, there is a need for interventions promoting social activity among elderly people living alone.

Key words: care preferences, depression, generalized structural equation model, living alone, lonely death

#### Introduction

There is strong evidence that social isolation is a risk factor for poor mental and physical health [1], and is associated with increased mortality [2,3]. The most commonly studied outcomes of social isolation or loneliness are depression and cardiovascular health [1]. The risks of social isolation depend not only on who you are, but also on where you live [4], especially in urban areas, where there tends to be more elderly people with a higher degree of social isolation. Therefore, care problems arising from social isolation have emerged as a major concern for health policy.

In Japan, the number of elderly people living alone has grown. In 2015, the proportion among those aged  $\geq 65$  years was 13.3% in males, and 21.1% in females. The proportion of elderly people living alone increased from 9.6% in 2000 to 15.5% in 2015. Most elderly living alone are likely to be socially isolated and to die alone if unable to receive long-term care insurance (LTCI) services when needing care.

Demand for the LTCI service exceeds supply in urban areas. Staff shortage in the care sector has been found to be related to both the shortage of human resources and high land prices [5].

Moreover, excess demand for labor in the care sector depends on delayed adjustment of nursing care costs set by the Japanese government [6]. Thus, overcoming supply constraints in the care sector is considered difficult. Social isolation exacerbates the health issues of elderly persons who live alone, resulting in longer waiting times for LTCI services in Japan.<sup>1</sup>

Previous studies have found care preferences relating to individual healthcare or nursing care needs. Residents of a country with a strong national healthcare infrastructure are less likely to prefer family-based care [7]. In a previous study, nursing home care was most preferred for dementia care [8]. Another study pointed out that old, frail, and reclusive people who live alone may require home care [4].

<sup>1</sup> The use of LTCI services in Japan has grown considerably, with LTCI costs doubling from 4.6 trillion yen in FY2001 to 9.2 trillion yen in FY2014. According to the 2014 Survey on Long-term Care Benefit Expenditures, 49.3% of costs are for in-home services, including those related to preventive nursing care. Approximately 34.1% of costs are for facility services, 11.6% for community-based services such as communal daily long-term care for a dementia patient, and 5.0% for in-home care support services.

Despite previous research on elderly persons' care preferences, no prior study has examined the care preferences of socially isolated elderly people who live alone. This study aims to determine the care preferences of elderly people who live alone, in relation to the degree of social isolation. I used data drawn from the 2014 Cabinet Office survey of elderly persons living alone in Japan. Taking into account aspects of feeling *Kodokushi* or a lonely death, generalized structural equation models (GSEMs) were estimated.

## Methods

### Research question and hypotheses

Elderly people who live alone are more likely to lack social contact with their families and neighbors. Using the Kessler Psychological Distress Scale (K6), Yamanashi et al. [9] found that males living alone in a single-household family structure tended to obtain higher K6 scores and to be frail. The K6 is a six-item screening instrument developed by Kessler et al. [10], assessing psychological distress. Feng et al. [11] found a positive association between frailty and higher levels of depression, although no decisive significant associations were found between living alone and frailty. Social isolation and loneliness remained predictive of mortality when accounting for individuals reporting poorer health, with increased loneliness or social isolation [2]. Thus, increased social isolation presumably causes *Kodokushi* or lonely death.

Based on previous findings, I present four hypotheses below. I made the following two assumptions pertaining to the analysis of both a direct effect and indirect effects of social isolation on care preferences: (A1) Depression is influenced by the degree of social isolation, (A2) Feeling that a lonely death is imminent is associated with a higher degree of social isolation. (H1) Elderly peoples who live alone, with a higher degree of social isolation, prefer care workers and care facilities. (H2) Feeling that a lonely death is imminent is associated with depression. (H3) Depression has a direct effect on care preferences. (H4) Preferred places of care are influenced by aspects of feeling that a lonely death is imminent.

Previous studies have explained differences in care preferences with regard to places and main caregivers according to demographic factors. Taking into account regional differences in LTCI service provision in Japan, men or people residing with spouses or partners tended to prefer home care, and individuals who had experienced informal caregiving preferred care at facilities [12]. Individuals with a low socio-economic status typically depended on their children as main caregivers [13]. Healthy people preferred their own homes as the place of death [14]. In Germany, preferences for places of care are reportedly influenced by spouses [15]. Considering differences in socio-economic status, I examined four hypotheses in the present paper.

## Data

### Characteristics of sample

The nationally representative study comprised a sample of 1,480 participants, 67% of whom were female. People aged 80 years and older made up 26% of the sample (30% of female participants, 18% of male participants). In the 2014 Comprehensive Survey of Living Conditions, the proportion of individuals aged 80 years and older was 36.9% among females, and 25.1% in males. The proportion of persons aged 80 years and older in this sample was lower than that in the general population.

### Care preferences

Assuming three support/assistance levels of activities of daily living, the 2014 Cabinet Office survey of elderly persons living alone in Japan obtained the following information regarding care preferences from the respondents: (a) a slight decrease in the ability to perform activities of daily living, and needing support, (b) instability standing up or while walking, and needing assistance, and (c) inability to stand up or walk, and needing assistance with all activities, such as excretion. I defined variables of care preferences (preferred places and preferred care workers) as places where individuals prefer to receive care service when care is needed. A dummy variable of preferred places assumed a value of zero when individuals did not prefer receiving care services at their own or relatives' homes, irrespective of support/assistance levels. In contrast, dummy variables of preferred places were assigned values of 1–3 if support/assistance level was (a), (b), and (c), when the individuals preferred receiving care services at their own or relatives' homes. A dummy variable of preferred care workers was assigned a value of 1 if main caregivers were children; 2 if they were friends or family members, such as brothers, sisters, or a son- or daughter-in-law; 3 if they were care workers; and 0 if unknown.

### Depression

The 2014 Cabinet Office survey of elderly persons living alone in Japan used the Geriatric Depression Scale-5 (GDS-5) as a screening/assessment tool for identifying depression in the older population. The GDS-5 can help identify whether an individual is depressed or not. Respondents were required to answer the following five questions relating to the past 7 days: 1. Are you basically satisfied with your life? (No/Yes) 2. Do you often get bored? (No/Yes) 3. Do you often feel helpless? (No/Yes) 4. Do you prefer to stay at home rather than going out and doing new things? (No/Yes) 5. Do you feel pretty worthless the way you are now? (No/Yes). One point was assigned to each answer of "Yes" ("No" = 0 points) to questions 2–5. Responses to the five items were summed up to yield a GDS-5 score of 0 to 5. Higher scores indicate a greater predisposition to mental illness, indicated by a score of 2 or higher. I defined an individual as depressed when obtaining a GDS-5 score  $\geq 2$ , based on Wada et al. [16].

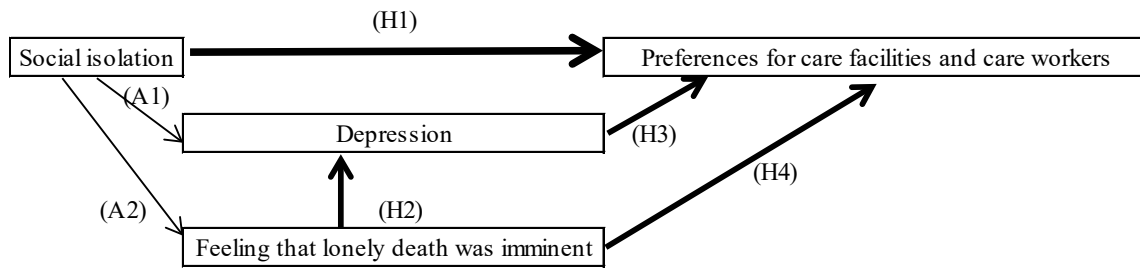


Figure 1. Direct and indirect effects of social isolation on care preferences

**Social isolation**

Based on Gale et al.’s [17] procedures, I obtained a score for social isolation, assigning one point for each of the following: (a) having no children, (b) being unmarried or not cohabiting, (c) the frequency of communication with each of one’s children, other members of the family, and friends being less than a month. Responses to the three items were summed up to yield a social isolation score of 0 to 3.

**Empirical strategy**

Assuming a positive relationship between unobserved variables that explain depression and aspects of anticipating a lonely death, I used the Stata cmp module [18] to estimate multivariate ordered probit models through the simulated maximum likelihood method.

$$y_{jit}^* = \mathbf{x}'_{1it} \boldsymbol{\beta}_1 + \varepsilon_{1it}$$

$$y_{2it}^* = \mathbf{x}'_{2it} \boldsymbol{\beta}_2 + \varepsilon_{2it}$$

(1)

where  $y_{jit}$ ,  $j=1,2$  represents depression and the social isolation score (0–3),  $y_{jit}^*$ ,  $j=1,2$  represents latent variables,  $x_{jit}$ ,  $j=1,2$  are explanatory variables, and  $\beta_j$ ,  $j=1,2$  are estimated vectors. Explanatory variables of Equation (1) were gender, self-assessed physical health, age, the social isolation score, care level, funds for living expenses, such as benefits covered under the National Pension, and the size of each respondent’s residential area.

I estimated Generalized Structural Equation Models (GSEMs) representing a generalization of SEMs by allowing the use of discrete variables and non-Gaussian distributions. These combine observed (or manifest) and latent variables representing unmeasured constructs. The latent factor denotes an unmeasured confounding variable. A latent variable of the GSEMs was aspects of feeling that a lonely death is imminent. Three regression equations (fz, fw, fv) in Eq. (2) show the relationships between the variables on the left-hand side.

$$z=fz(w,x,\mu,\varphi)$$

$$w=fw(v,x,\mu,\delta)$$

$$v=fv(x,\mu,\varepsilon)$$

(2)

where  $x$  represents observed variables and  $\mu$  is a latent variable. The disturbances in each equation are  $\varphi$ ,  $\delta$ , and  $\varepsilon$ . The three variables on the left-hand side ( $v$ ,  $w$ , and  $z$ ) are depression,

preferences regarding places, and preferences regarding the main caregiver. It was assumed that the preferred care places were influenced by aspects of feeling that a lonely death is imminent. The effect was estimated as random effects in this model. Exogenous variables of Equation (2) were gender, self-assessed physical health, age, the social isolation score, own house, care level, funds for living expenses, such as benefits covered under the National Pension, and the size of each respondent’s residential area.

A dummy variable for brothers (or sisters) residing nearby was used as an exclusion variable whose correlations with care preferences were marginal. To capture regional differences in the LTCI service provision, I created two variables, (1) the long-term care (LTC) facilities density, and (2) the LTC beds density (see Appendix).

**Results and Discussion**

The prevalence of needing no support and needing support or care was 4% and 13%, respectively, which includes unknown care or support levels. Eighty percent of the elderly did not apply for LTCI certification. The majority of this sample was widowed (73% among female participants). The prevalence of depression was 31% among female participants, and 37% among males.

The mean score for social isolation was 1.289, with SD at 0.589. The frequencies of social isolation scores from 0 to 3 were 55, 992, 383, and 50, respectively. The frequency of communication with each of one’s children, other members of the family, and friends was less than a month for 139 elderly persons.

Table 2 shows the relationships between care preferences (places and main caregiver) and social isolation score. There were significant correlations between the degree of social isolation and preferred places of care. The higher the social isolation score, the higher the likelihood of care facilities being preferred places (23.29→34.73→52.0). It is also worth noting that change in the degree of social isolation from a low to moderate degree increased the proportion of care workers, irrespective of support/assistance levels of activities of daily living, although home care by children had the highest representation among individuals with a low degree of social isolation (36.19 = 13.51 + 8.77 + 13.91). Changes in the degree of social isolation may increase the demand for in-home services of LTCI.

**Table 1.** Characteristics of Elderly Persons Living Alone in Japan

Variables	Defination	N	Mean	SD	Min	Max	Females Mean	Males Mean
<i>Preferences</i>								
Preference for main caregiver	Main caregiver = 1 if children, = 2 if family, such as sister, = 3 if care workers, = 0 unknown	1,480	2.06	1.05	0	3	2.03	2.13
Preference for home care	At own home or relative's home (= 1 when needing some support, = 2 when needing some care, = 3 when needing whole care) ↔ = 0 at facilities	1,480	1.31	1.09	0	3	1.36	1.19
<i>Mental health status</i>								
Geriatric Depression Scale-5 (GDS-5)		1,480	1.25	1.31	0	5	1.18	1.38
Depression	Depressed = 1 if GDS-5 ≥ 2, = 0 if GDS-5 = 0 or 1	1,480	0.33	0.47	0	1	0.31	0.37
<i>Demographic variables</i>								
Gender	Females = 1	1,480	0.67	0.47	0	1		
Having no children		1,480	0.25	0.43	0	1	0.20	0.36
Age 65–69		1,480	0.23	0.42	0	1	0.20	0.31
Age 70–74 (Reference)		1,480	0.26	0.44	0	1	0.24	0.31
Age 75–79		1,480	0.24	0.43	0	1	0.26	0.19
Age ≥ 80 years		1,480	0.26	0.44	0	1	0.30	0.18
Widowed (Reference)		1,480	0.62	0.49	0	1	0.73	0.39
Never married		1,480	0.16	0.36	0	1	0.11	0.24
Divorced		1,480	0.21	0.41	0	1	0.15	0.33
Married		1,480	0.02	0.14	0	1	0.01	0.04
Having a partner		1,480	0.04	0.18	0	1	0.01	0.08
Own house		1,480	0.63	0.48	0	1	0.67	0.56
Social isolation	Social isolation score	1,480	1.29	0.59	0	3	1.23	1.40
Anticipating a lonely death	LD = 4 if “Kodokushi” was imminent, ... = 1 if for no such anticipation	1,430	2.39	0.99	1	4	2.38	2.41
<i>Care levels, support levels, and self-assessed health</i>								
Yoshien	Needing support level	1,480	0.05	0.22	0	1	0.06	0.03
Care 1	Care level 1	1,480	0.04	0.19	0	1	0.04	0.02
Care 2	Care level 2	1,480	0.02	0.14	0	1	0.02	0.02
Care 3–5	Care level 3 or over	1,480	0.01	0.08	0	1	0.01	0.01
Jiritsu	Needing no support level	1,480	0.04	0.19	0	1	0.04	0.05
Unknown	Unknown for care or support level	1,480	0.03	0.16	0	1	0.03	0.02
Unknown certification	Unknown for LTCI certification status	1,480	0.01	0.12	0	1	0.01	0.02
Under the application	Under the application for LTCI certification	1,480	0.01	0.08	0	1	0.01	0.00
Self-assessed physical health	SAPH = 5 if excellent, ... = 1 if poor	1,480	3.37	1.19	1	5	3.35	3.40
<i>Lifestyle</i>								
Frequency of daily conversation	FDC = 6 if every day, ... = 1 if seldom	1,479	5.04	1.43	1	6	5.21	4.69
Frequency of going out	FGO = 5 if almost every day, ... = 1 not wanting to go out	1,477	3.83	1.29	0	5	3.66	4.17

<i>Funds for living expenses (multiple answers)</i>								
Salary Income		1,480	0.10	0.30	0	1	0.08	0.14
Business Income		1,480	0.05	0.22	0	1	0.03	0.08
Benefit covered under the National Pension		1,480	0.33	0.47	0	1	0.40	0.20
Benefit covered Employees' Pension Insurance systems (Reference)		1,480	0.66	0.47	0	1	0.66	0.67
Rental fee of housing and land		1,480	0.04	0.20	0	1	0.05	0.03
Dividend income		1,480	0.01	0.11	0	1	0.01	0.01
Public assistance service		1,480	0.06	0.24	0	1	0.05	0.09
Remittances		1,480	0.01	0.12	0	1	0.02	0.01
<i>Density of care facilities in respondents' residential areas (logged variables)</i>								
LTC facilities density	Capacity of long-term care facilities per population aged 75 years and older (national average/ regional average)	1,480	0.01	0.08	-0.25	0.08	0.01	0.02
LTC beds density	Long-term care beds per population aged 75 years and older (national average/ regional average)	1,480	0.02	0.30	-0.41	0.54	0.01	0.05
<i>Size of respondents' residential areas</i>								
Large cities	Ordinance-designated cities or Tokyo Special Ward	1,480	0.31	0.46	0	1	0.30	0.34
City		1,480	0.39	0.49	0	1	0.40	0.35
Small-sized city	Cities with a population below 100,000	1,480	0.21	0.41	0	1	0.21	0.21
Town or village		1,480	0.09	0.29	0	1	0.09	0.10

Note: Long-term care facilities include intensive care homes for the elderly, long-term care health facilities, sanatorium medical facilities for elderly persons requiring long-term care, and group homes for elderly dementia patients. The logged proportion of the national average density of care facilities to the density of regional care facilities was used as the density of care facilities variables. Sources: The 2014 Cabinet Office survey of the elderly living alone in Japan. The 2014 Survey of Institutions and Establishments for Long-term Care (Ministry of Health, Labour and Welfare), The 2014 Survey of Medical Institutions and Hospital Report (Ministry of Health, Labour and Welfare).

**Table 2.** Preferences for places and main caregivers by social isolation score

Social isolation score = 1 (N = 992)					
Preferences for places					
Preferences for main caregiver	Facilities	Home (1)	Home (2)	Home (3)	Total
Unknown	1.71	1.71	0.71	1.01	5.14
Children	7.16	13.51	8.77	13.91	43.35
Family, such as sisters	1.41	2.32	1.21	1.92	6.85
Care worker	13.0	18.85	5.24	7.56	44.66
Total	23.29	36.39	15.93	24.4	100.0
Social isolation score = 2 (N = 383)					
Preferences for places					
Preferences for main caregiver	Facilities	Home (1)	Home (2)	Home (3)	Total
Unknown	6.53	2.61	0.78	1.04	10.97
Children	1.31	1.31	0.26	2.61	5.48
Family, such as sisters	3.39	7.05	2.35	4.96	17.75
Care worker	23.5	26.37	7.57	8.36	65.8
Total	34.73	37.34	10.97	16.97	100.0
Social isolation score = 3 (N = 50)					
Preferences for places					
Preferences for main caregiver	Facilities	Home (1)	Home (2)	Home (3)	Total
Unknown	8.0	0.0	0.0	2.0	10.0
Family, such as sisters	0.0	0.0	0.0	2.0	2.0
Care worker	44.0	28.0	12.0	4.0	88.0
Total	52.0	28.0	12.0	8.0	100.0



**Table 3.** Determinants of depression and anticipating a lonely death

	N = 1430	
Estimation method	Probit	Ordered probit
Variables	Depression	Anticipating a lonely death
Gender (Females = 1)	-0.218*** (0.0799)	0.0363 (0.0637)
Self-assessed physical health	-0.313*** (0.0326)	-0.181*** (0.0260)
Age 65–69	-0.0206 (0.103)	-0.0138 (0.0808)
Age 75–79	-0.0008 (0.104)	-0.0172 (0.0817)
Age ≥80	-0.0515 (0.107)	-0.205** (0.0847)
Social isolation	0.212*** (0.0627)	0.145*** (0.0503)
Yoshien	-0.00969 (0.168)	0.142 (0.137)
Care 1	0.548*** (0.189)	-0.174 (0.157)
Care 2	0.686*** (0.257)	-0.0741 (0.212)
Care 3–5	0.313 (0.419)	0.354 (0.381)
Unknown care or support level	1.019*** (0.332)	-0.241 (0.257)
Jiritsu	0.221 (0.183)	0.0459 (0.146)
Salary income	-0.248* (0.131)	-0.0941 (0.0979)
Business income	-0.294 (0.181)	-0.249* (0.132)
Benefit covered under the National Pension	0.104 (0.0793)	-0.0996 (0.0631)
Rental fee of housing and land	-0.00714 (0.186)	0.188 (0.144)
Dividend income	-0.441 (0.364)	-0.0745 (0.264)
Public assistance service	0.370** (0.159)	0.170 (0.130)
Remittances	0.342 (0.282)	0.0730 (0.232)
Large cities	-0.227** (0.0889)	0.0497 (0.0699)
Small-sized city	-0.125 (0.0955)	-0.00262 (0.0775)
Town or village	-0.322** (0.135)	-0.136 (0.106)
Constant (Probit)	0.442** (0.185)	
Atanh $\rho$	0.113** (0.0503)	

Note: Under the application for the LTC service, and own house (single-family house) were included as explanatory variables; however, they were not statistically significant.

Standard errors in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

Depression was evidently influenced by the degree of social isolation (Table 3). Feeling that a lonely death was imminent was associated with a higher degree of social isolation. These results demonstrate support for the two assumptions shown in Figure 1. A poor physical health status was associated with depression and the feeling of an imminent lonely death. There

was a positive relationship between unobserved factors such as a low nutritional health status, which causes frailty.

Since the proportion of persons aged  $\geq 80$  years in this sample was lower than that in the population, I estimated two types of GSEMs. Table 4 shows the results using all age groups. Table 5 shows the results using the sample excluding the  $\geq 80$ -year-old age group.

Results of the GSEMs showed that elderly people with a higher degree of social isolation tended not to prefer receiving care services at their own or relatives' homes when needing care. They also preferred a care worker as a primary caregiver. The preferred care places were influenced by aspects of feeling that a lonely death was imminent. However, depression did not have a direct effect on care preferences. The density of LTC facilities (the logged proportion of the average national density of care facilities to the density of regional care facilities) was positively associated with preference for home care. This implies that a smaller capacity of care facilities per population aged 75 years and older was positively associated with the preference for home care. Thus, elderly people in an urban area understood that it was difficult to receive care services at the facilities because of their small capacity. The density of LTC beds was excluded from the equation of preferences for places, as it was not statistically significant. The density of LTC facilities was also excluded from the equation of preferences for the main caregiver.

The absolute values of estimated coefficients of social isolation were smaller, compared to those in the results shown in Table 4 (Table 5). Thus, the effect of social isolation on elderly persons aged  $\geq 80$  years was the strongest age groups. This tendency also applied to the effect of anticipating a lonely death on elderly persons aged  $\geq 80$  years. In contrast, the estimated coefficients of the density of LTC facilities were larger, compared to those in the results shown in Table 4. The finding suggested that older care recipients tended not to prefer home care. Depression had negative effects on preferences for places, although it was significant at the 10% level. Among participants aged less than 80 years, a poor mental health status could change preferred care places when care is needed.

Findings showed major effects of social isolation on care preferences. This study supported three hypotheses, namely, (H1), (H2), and (H4). Care problems arising from social isolation should be noted because elderly people who lived alone, with a higher degree of social isolation, preferred care workers and care facilities.

Forsman et al. [19] found that compared to no intervention, social activities significantly reduced depressive symptoms among participants. These authors recommended longer interventions as these showed a statistically significant effect on depressive symptoms and dichotomous depression outcomes, compared to shorter interventions. Thus, longer interventions are seems to be effective for socially isolated older persons when they are depressed.

The results of Equation (1) showed that a poor physical

**Table 4.** Determinants of depression and preferences for places and main caregiver

N = 1430			
Variables	Preferences for main caregiver	Preferences for places	Depression
Preferences for places	-0.141*** (0.0289)		
Depression	-0.0529 (0.0732)	-0.0972 (0.0684)	
Gender (Females = 1)	0.0457 (0.0695)	0.123* (0.0653)	-0.265*** (0.0835)
Self-assessed physical health	0.0297 (0.0292)	0.0322 (0.0275)	-0.285*** (0.0344)
Age 65–69	0.151* (0.0897)	0.0910 (0.0823)	-0.0669 (0.107)
Age 75–79	-0.0260 (0.0890)	-0.00178 (0.0828)	-0.0232 (0.107)
Aged ≥80	-0.146 (0.0911)	0.147* (0.0863)	-0.0478 (0.112)
Social isolation	0.359*** (0.0585)	-0.206*** (0.0519)	0.207*** (0.0659)
Own house (single-family house)	0.0144 (0.0709)	0.161** (0.0666)	0.138 (0.0860)
Yoshien	0.130 (0.147)	-0.0426 (0.140)	0.00397 (0.173)
Care 1	0.409** (0.173)	0.401** (0.160)	0.607*** (0.193)
Care 2	0.174 (0.229)	0.234 (0.216)	0.781*** (0.278)
Care 3–5	0.343 (0.429)	1.138*** (0.438)	0.258 (0.474)
Unknown care or support level	-0.343 (0.269)	0.113 (0.259)	1.093*** (0.350)
Unknown for LTCI certification status	-0.492*** (0.187)	-0.229 (0.183)	0.455** (0.224)
Density of LTC facilities		0.980** (0.403)	
Brothers (sisters) live nearby			-0.162* (0.0859)
Constant (Probit)			0.412 (0.251)
<i>Latent variables</i>			
Anticipating a lonely death	1 (0)	-1.059** (0.473)	2.933*** (1.063)

Standard errors in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$

health status exacerbated depression and anticipation of a lonely death. Due to support for the hypothesis that preferred places of care were influenced by aspects of feeling that a lonely death was imminent, self-assessed poor physical health indirectly affected care preferences. The path is not shown in Figure 1. Due to the limited cross-sectional data, I could not make inferences about the causal mechanism between social isolation and self-assessed poor physical health. Because social isolation is a risk factor for poor physical health, future studies should take into account a reverse causal path from self-as-

sessed poor physical health to social isolation when analyzing the effects of social isolation on care preferences.

## Conclusion

This study examined care preferences of elderly people living alone in relation to the degree of social isolation. The results of the GSEMs showed that elderly people who lived alone, with a higher degree of social isolation, preferred care workers and care facilities. The preferred care places were influenced by aspects of feeling that a lonely death was imminent. Feelings of an imminent lonely death were associated with a higher degree of social isolation. The effect of social isolation was the strongest among elderly persons aged  $\geq 80$  years, compared to other age groups. Therefore, health issues arising from social isolation could increase the demand for LTCI services in Japan. Considering the excess demand for LTCI services in urban areas, to prevent social isolation among elderly people living alone, there is a need for longer interventions aimed at promoting social activity among this group. Taking into account the path from self-assessed poor physical health to social isolation, future studies should explore the effects of social isolation on care preferences.

## Appendix

### LTC facilities density

I created the following two variables per population aged 75 years and older, explaining regional differences in LTCI service provision: (1) the density of LTC facilities and (2) the density of LTC beds. The former was the logged proportion of the average national density of care facilities to the density of regional care facilities. By definition of the variables, the value of LTC facilities' density was negative when the density of regional care facilities was below that of the national average. Long-term care facilities include intensive home care for the elderly, long-term healthcare facilities, sanatorium medical facilities for elderly people requiring long-term care, and group homes for elderly dementia patients. Using the same procedure, I determined the density of LTC beds. Data were drawn from The 2014 Survey of Institutions and Establishments for Long-term Care (Ministry of Health, Labour and Welfare), and The 2014 Survey of Medical Institutions and Hospital Report (Ministry of Health, Labour and Welfare).

The Cabinet Office categorized the locations under study, which was as follows: (1) Hokkaido, (2) Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima, (3) Ibaraki, Tochigi, Gunma, Saitama, Chiba, Tokyo, Kanagawa, (4) Niigata, Toyama, Ishikawa, Fukui, (5) Yamanashi, Nagano, Gifu, (6) Shizuoka, Aichi, Mie, (7) Shiga, Kyoto, Osaka, Hyogo, Nara, Wakayama, (8) Tottori, Shimane, Okayama, Hiroshima, Yamaguchi, (9) Tokushima, Kagawa, Ehime, Kochi, and (10) Fukuoka, Saga, Nagasaki, Kumamoto, Oita, Miyazaki, Kagoshima, Okinawa.

**Table 5.** Determinants of depression, preferences for places, and main caregiver (Excluding ≥80 years).

	N = 1062		
Variables	Preferences for main caregiver	Preferences for places	Depression
Preferences for places	-0.132*** (0.0347)		
Depression	-0.0806 (0.0865)	-0.152* (0.0801)	
Gender (Females = 1)	-0.00310 (0.0801)	0.182** (0.0744)	-0.320*** (0.0955)
Self-assessed physical health	0.0202 (0.0341)	0.0338 (0.0317)	-0.297*** (0.0397)
Social isolation	0.290*** (0.0639)	-0.183*** (0.0566)	0.163** (0.0719)
Own house (single-family house)	0.104 (0.0811)	0.201*** (0.0757)	0.0974 (0.0989)
Yoshien	0.0856 (0.246)	-0.0177 (0.226)	0.0518 (0.274)
Care 1	0.427 (0.273)	0.437* (0.243)	0.186 (0.303)
Care 2	0.249 (0.369)	0.653* (0.339)	0.544 (0.442)
Care 3–5	5.670 (3.330)	0.521 (0.833)	6.035 (4.007)
Unknown care or support level	-0.371 (0.538)	-0.360 (0.552)	0.509 (0.801)
Unknown for LTCI certification status	-0.672*** (0.222)	-0.207 (0.222)	0.526* (0.270)
Density of LTC facilities		1.207*** (0.460)	
Brothers (sisters) live nearby			-0.246** (0.0980)
Constant (Probit)			0.624** (0.268)
<i>Latent variables</i>			
Anticipating a lonely death	1 (0)	-0.843* (0.452)	2.622** (1.037)

Standard errors in parentheses. \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

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**Competing interests**

The author has no competing interests.

**Table 6.** Determinants of depression and preferences for places and main caregiver. (Table 4 continued)

	N = 1430		
Variables	Preferences for main caregiver	Preferences for places	Depression
Salary income	0.0306 (0.108)	0.0272 (0.0989)	-0.246* (0.136)
Business income	0.0769 (0.144)	-0.0467 (0.133)	-0.220 (0.187)
Benefit covered under the National Pension	-0.104 (0.0680)	-0.0259 (0.0647)	0.127 (0.0836)
Rental fee of housing and land	-0.112 (0.151)	0.0959 (0.145)	-0.0778 (0.195)
Dividend income	0.446 (0.316)	-0.0585 (0.271)	-0.572 (0.415)
Public assistance service	0.300* (0.154)	-0.306** (0.136)	0.327** (0.166)
Remittances	-0.514** (0.240)	0.200 (0.238)	0.347 (0.288)
Large cities	-0.0865 (0.0766)	0.0637 (0.0716)	-0.244*** (0.0930)
Small-sized city	-0.132 (0.0837)	0.0520 (0.0794)	-0.114 (0.0999)
Town or village	-0.0639 (0.116)	-0.121 (0.109)	-0.323** (0.143)

Note: Under the application for LTCI certification, jiritsu and savings as funds for living expenses were included as explanatory variables; however, they were not statistically significant. Standard errors in parentheses. \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1

**Table 7.** Determinants of being depressed and preferences for places and main caregiver (Excluding ≥80 years) (Table 5 continued)

	N = 1062		
Variables	Preferences for main caregiver	Preferences for places	Depression
Salary income	-0.0159 (0.112)	0.0755 (0.103)	-0.244* (0.142)
Business income	0.0866 (0.154)	0.0851 (0.142)	-0.295 (0.206)
Benefit covered under the National Pension	-0.163** (0.0810)	0.0499 (0.0766)	0.147 (0.0999)
Rental fee of housing and land	-0.213 (0.188)	0.168 (0.181)	-0.371 (0.264)
Dividend income	0.251 (0.384)	-0.122 (0.337)	-0.401 (0.515)
Public assistance service	0.259 (0.175)	-0.187 (0.157)	0.302 (0.190)
Remittances	-0.406 (0.309)	0.248 (0.305)	0.599 (0.371)
Large cities	-0.0631 (0.0901)	0.00233 (0.0842)	-0.334*** (0.111)
Small-sized city	-0.101 (0.0980)	0.0698 (0.0919)	-0.150 (0.117)
Town or village	0.0718 (0.140)	-0.174 (0.128)	-0.273 (0.167)

Note: Under the application for LTCI certification, jiritsu, and savings as funds for living expenses were included as explanatory variables; however, they were not statistically significant. Standard errors in parentheses. \*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1



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