ORIGINAL ARTICLE

Social isolation, loneliness, and their correlates in older Japanese adults

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Abstract

Background: Loneliness and social isolation are elevated in older adults and associated with a range of detrimental outcomes. Despite this, there has been little research on these phenomena or on similarities and differences in their occurrence or combination in older Japanese adults. The current study aims to (i) determine what factors are associated with social isolation and loneliness among older adults in Japan; and (ii) describe the characteristics of individuals who are socially isolated but not lonely, as well as those who feel lonely but are not socially isolated.

Methods: Data were analysed from 13 766 adults aged ≥65 years who participated in the 2019 wave of the Japan Gerontological Evaluation Study. Poisson regression analysis was used to examine associations.

Results: Among older Japanese adults, the attributes of higher age, male gender, lower socioeconomic status, being a welfare recipient, and having depressive symptoms were associated with social isolation, while lower socioeconomic status, unemployment, welfare receipt, and poor physical and mental health were associated with loneliness. In addition, better educated, and mentally and physically healthy people were less likely to feel lonely even when socially isolated, while people who were not working and who had mental or physical health problems were more likely to feel lonely even if they were not socially isolated.

Discussion: Our results indicate that in order to reduce unwanted social isolation and loneliness among older Japanese adults, in the first instance the focus should be on those individuals who are socioeconomically disadvantaged and unhealthy.

INTRODUCTION

Social isolation is considered an objective individual status that reflects a lack of social relationships or infrequency of social contact, while loneliness is regarded as a subjective indicator of feelings of isolation.[1] Socially isolated people have a greater risk of becoming lonely, and networking meaningful relationships is essential for feeling socially embedded and for the relief of loneliness.[2] However, socially isolated people are not necessarily lonely, and vice versa. In addition, not only the size of the personal network but also the composition and functioning of the network are also important for the relationship between social isolation and loneliness.[2]

Previous research has established that social isolation and loneliness have harmful effects on the health of older people.[3–5] An empirical study by Steptoe and colleagues reported that both social isolation and loneliness were associated with all-cause mortality in older people.[6] Furthermore, a systematic review concluded that a lack of social connections increases health risks to the same extent as smoking 15 cigarettes a day or having an alcohol use disorder.[7] In addition, the combined effects of social isolation and loneliness on health outcomes such as all-cause mortality, ER visits, and memory have also been reported.[8–10] Hence, considering social isolation and loneliness together may have important health implications. However, few studies have examined the characteristics of those who are both socially isolated and lonely.

Growing evidence on the detrimental effects of loneliness and social isolation has led to specific policy responses by some governments. In the United Kingdom for example, a 'minister for loneliness' has been appointed and various strategies have been implemented in order to tackle social isolation and loneliness (e.g. encouraging/facilitating support and connecting with friends, neighbours and community groups, through volunteering and participation activities).[11]

Social isolation and loneliness can occur in individuals of any age, but are particularly prevalent among older adults in many countries.[12] This may be linked to the fact that older people are more likely to experience a variety of life events that can lead to a reduction in social contacts, including retirement, living alone, the loss of family or friends, chronic illness, and sensory impairments.[3] Indeed, it is possible that individual and social issues attributable to social isolation and loneliness will increase in the coming years in the wake of current global trends in population ageing.[13]

Japan, currently the most aged country in the world, has long suffered from an 'epidemic' of loneliness and social isolation, and there is some evidence that this situation may have been further exacerbated after the global COVID-19 outbreak in 2019.[14,15] Thus, in 2021, the Japanese Cabinet Office appointed a minister for loneliness and isolation[16] and published a 'priority plan for measures against social isolation and loneliness',[17] which highlighted that there was still a lack of empirical evidence on the social distribution of, and risk factors for, loneliness and isolation among older adults in the country.[18] Specifically, although several Japanese studies have reported that social isolation and loneliness are associated with future health risk behaviours, poorer physical functioning, chronic diseases, and mortality among older adults in Japan,[19] that the coexistence of social isolation and a lower frequency of going out synergistically increased the risk of mortality,[20] and that emotional support was associated with loneliness,[21] these studies were restricted to specific areas or conducted with small samples.[22] To the best of our knowledge, there has been little research on the factors associated with loneliness and social isolation in older adults in Japan using nationwide data or on similarities and differences in their occurrence or combination. Thus, in line with the government's 'priority plan' one of the most urgent tasks that still remains to be done is to gain a better understanding of the actual situation of social isolation and loneliness in Japan.[17]

Against this backdrop, this study aimed to identify the sociodemographic and other characteristics of loneliness, social isolation, and the combinations of these phenomena, using data from a large-scale nationwide cohort of older Japanese adults.

METHODS

Study population

Data were drawn from the 2019 wave of the Japan Gerontological Evaluation Study (JAGES). The JAGES is an ongoing nationwide cohort study where information is obtained from self-report questionnaires every 3 years in order to investigate the social determinants of healthy ageing among people aged 65 years and older in Japan. In the 2019 wave, which ran from December 2019 to January 2020, questionnaires were mailed to 345 356 community-dwelling individuals in 60 selected municipalities, with 240 889 people responding (response rate: 69.8%). A subset of the 2019 wave provided data on loneliness. This study included participants without missing answers for any of the relevant variables (*N* = 13 766). The JAGES was approved by the Ethics Committees on Human Subjects at the National Center for Geriatrics and Gerontology (No. 992), the Faculty of Medicine at Chiba University (No. 2493), the Faculty of Medicine at the University of Tokyo (No. 10555), and the Graduate School and Faculty of Medicine at Kyoto University (No. R3153). Written informed consent was assumed with the voluntary return of the

questionnaire. The ethics committees approved the use of assumed consent upon return of the completed questionnaire.

Measures

Social isolation

Social isolation was assessed using a modified version of the Social Isolation Index. This measure has been widely used in previous research both in Western countries and Japan.[23–26] The index is composed of five items that inquire whether respondents (i) are unmarried or living alone, (ii) have poor interaction with their children (did not live with their children or had no one to provide emotional or instrumental social support), (iii) have poor interaction with relatives (did not have immediate family members to provide emotional or instrumental social support), (iv) have poor interaction with friends (less than monthly contact or have no friends who could provide emotional or instrumental social support), and (v) have an absence of social participation (did not participate in any social or religious groups). The overall summed score ranges from 0 to 5 with higher scores indicating greater social isolation. As the distribution was positively skewed, the score was dichotomized by the top quintile in line with a previous study,[6] with individuals with a score of ≥3 being categorised as socially isolated.

Loneliness

Loneliness was measured using the Japanese version of the three-item short form of the Revised UCLA Loneliness Scale,[27,28] which has been previously validated in Japan.[27,29] The scale includes three questions: (i) How often do you feel that you lack companionship? (ii) How often do you feel left out? and (iii) How often do you feel isolated from others? The response options are 'hardly ever', 'some of the time', and 'often'; the summed score could range from 3 to 9 with higher scores indicating greater loneliness. As the scores were positively skewed, the top quintile was used to dichotomize responses with a score of ≥5 being used to categorise loneliness.

Explanatory variables

Using previous literature as a guide,[19] the following factors were selected as covariates. Information was obtained on age (65–69, 70–74, 75–79, 80–84, 85+),

sex (male vs. female), education (≤9 years vs. >9 years, as 9 years of education is mandatory in Japan), equivalized annual household income (divided by 10 000 Japanese yen: <100, ≥100 to <200, ≥200 to <300, ≥300 to <400, and ≥ 400), working status (currently working, retired, never worked), and receipt of public assistance (no vs. yes) with those who responded 'applying for public welfare assistance' being excluded from the analysis given their small number (0.03%). Information was obtained on instrumental activities of daily living (IADL) with five questions that inquired about (i) using public transportation, (ii) shopping for daily necessities, (iii) boiling water, (iv) paying bills, and (v) handling banking deposits. The summed scores were dichotomized into ≤4 and 5. A score of five was considered as having full functional ability. Medical conditions were measured by summing the number of 16 diagnosed diseases/health conditions (range: 0–16): hypertension; stroke (e.g., brain haemorrhage); heart disease; diabetes; hyperlipidaemia; respiratory disease (e.g., pneumonia, bronchitis); gastrointestinal, liver, or gallbladder disease; kidney or prostate gland disease; musculoskeletal disease (e.g., osteoporosis, arthrosis); traumatic injury (e.g., fall, fracture); cancer; blood or immune system disease; dementia (e.g., Alzheimer's disease); Parkinson's disease; eye disease; and ear disease. The score was categorised into three groups: having 0 conditions, 1 or 2 conditions, and 3 or more conditions. Depressive symptoms were assessed with the Japanese short version of the Geriatric Depression Scale (GDS) with 15 binary questions.[30,31] The overall summed score (range: 0–15) was dichotomized, and individuals with a score of ≥5 were categorised as having depressive symptoms. This cut-off point has been validated to screen for major depressive symptoms against the Structured Clinical Interview for the Diagnostic and Statistical Manual of Mental Disorders, Third Edition, Revised, as the gold standard.[32] This measure had a good level of internal consistency (Cronbach's alpha was 0.81 in the current study).

Statistical analysis

The characteristics of the study sample stratified by loneliness/social isolation status were initially calculated. Next, Poisson regression analysis with a robust variance estimator was used to examine the factors associated with social isolation and loneliness. For

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each analysis, five models were constructed. Model 1 included only the demographic variables of age and sex. Model 2 additionally included the socioeconomic variables education and equivalent household income. Model 3 included the same variables as Model 2 and also working status and receipt of public assistance. Model 4 included the same variables as Model 3 and additionally adjusted for physical health variables, namely IADL and medical conditions. The fully adjusted Model 5 had the same variables as in Model 4 and further included depressive symptoms. Results are presented as prevalence ratios (PRs) with 95% confidence intervals (CIs).

Using the same model building process as described above, we then conducted two subgroup analyses, stratifying by the presence of social isolation. Specifically, we then used Poisson regression analysis with a robust variance estimator to examine (i) the characteristics of not feeling lonely among individuals who are socially isolated, and (ii) the characteristics of loneliness among individuals who are *not* socially isolated. Results are presented as PRs with 95% CIs. The level of statistical significance was $P < 0.05$ (two-tailed) for all analyses.

To adjust for possible geographical variation, the individual municipalities were included in the analysis as dummy variables. This allowed us to control for unobserved municipal heterogeneity, such as variations in geographical, cultural, historical, and social conditions at the time of the data collection. All of the analyses were conducted with STATA 16.1 MP (Stata Corp., College Station, Texas, USA).

RESULTS

Compared to the other categories (i.e., individuals who are not socially isolated or lonely, lonely but not socially isolated, or socially isolated but not lonely) people who were socially isolated and lonely tended to be male, have lower levels of education and income, not be working, be welfare recipients, have more medical conditions, and more depressive symptoms (Table 1). The characteristics of those who were lonely but not socially isolated and those who were socially isolated but not lonely were quite similar, except for oldest age group (5% vs. 10%), receipt of public assistance (1% vs. 2%), IADL (50% vs. 57%), more than three medical conditions (25% vs. 18%), and depressive symptoms (47% vs. 21%).

Factors associated with social isolation among older people in Japan are shown in Table 2. Individuals who were socially isolated were more likely to be older, male and have a lower socioeconomic status (SES; education and equivalized household income). Furthermore, public assistance recipients and those with depressive symptoms were 1.74 times (95% CI: 1.49, 2.03) and 1.75 times (95% CI: 1.64, 1.87) more likely to be social isolated, respectively, while those with the highest IADL score had a 1.14 times (95% CI: 1.06, 1.23) higher PR in the fully adjusted model (Model 5).

Factors associated with loneliness among older Japanese adults are presented in Table 3. Adults who were lonely were more likely to be younger, male, have a lower SES (less education and lower equivalized household income), be receiving public assistance, and physically unhealthy (lower IADL and more medical conditions). In addition, in the fully adjusted model, those with depressive symptoms were 3.42 times (95% CI: 3.23, 3.63) more likely to feel lonely.

Individuals who were older, had a higher education, and who did not have physical and mental diseases/illness tended not to feel lonely even when they were socially isolated (Table 4). Among the non-socially isolated, younger age, lower SES (education, income), being retired, and being mentally and physically unhealthy were associated with loneliness (Table 5). In particular, depressive symptoms were an especially strong indicator of loneliness among the non-socially isolated (PR: 3.62; 95% CI: 3.36, 3.89).

DISCUSSION

In this study of Japanese older adults, we found that loneliness and social isolation were common in the study population with over 8% of these older adults being both lonely and socially isolated. We also found that older age, male sex, lower SES, receiving public assistance, higher IADL, and depressive symptoms were associated with being socially isolated, while younger age, male gender, lower SES, receiving public assistance, and poor physical and mental health were associated with being more lonely. In addition, further analyses examining the combination of social isolation and loneliness revealed that older, better-educated, and mentally and physically healthy individuals were less likely to feel

Table 1 Demographic characteristics of the analytic sample

	Not socially isolated or lonely (N = 8728)	Lonely but not socially isolated (N = 2126)	Socially isolated but not lonely (N = 1808)	Socially isolated and lonely (N = 1104)
Age				
65–69	28.54	29.02	24.00	27.45
70–74	32.48	30.53	29.65	28.17
75–79	23.51	23.05	22.29	21.47
80–84	11.46	11.95	13.99	13.68
85+	4.01	5.46	10.07	9.24
Sex				
Male	52.36	55.03	57.02	59.51
Female	47.64	44.97	42.98	40.49
Education				
≤9 years	16.29	22.72	24.00	31.70
>9 years	83.71	77.28	76.00	68.30
Equivalized annual household income (JPY 10 000)				
<100	7.23	13.03	13.16	13.77
≥100 to <200	33.01	37.16	39.99	47.28
≥200 to <300	24.82	23.42	24.67	20.11
≥300 to <400	19.89	16.18	12.39	10.96
≥400	15.05	10.21	9.79	7.88
Working status				
Working	33.39	27.52	30.59	26.63
Retired	61.41	66.79	62.56	66.76
Never worked	5.20	5.69	6.86	6.61
Receipt of public assistance				
No	99.58	99.01	98.12	96.01
Yes	0.42	0.99	1.88	3.99
Complete IADL				
≤4	41.61	50.28	43.03	47.01
5	58.39	49.72	56.97	52.99
Medical conditions				
None	24.55	16.93	22.90	18.12
1 or 2	59.35	58.42	59.07	55.07
3+	16.10	24.65	18.03	26.81
Depressive symptoms				
No	88.69	52.78	78.76	40.22
Yes	11.31	47.22	21.24	59.78

Abbreviation: IADL, instrumental activities of daily living.

lonely even though they were socially isolated, while people who were younger, had lower SES, were not working, and were mentally and physically unhealthy were more likely to feel lonely even though they were not socially isolated.

The characteristics that were associated with social isolation in older Japanese adults, including male gender,[33–35] lower education,[36] lower income,[35] and depressive symptoms,[23] are in line with those from previous studies both in Japan and in other countries. In addition, although a recent systematic review reported that the evidence was mixed,[19] in this study higher IADL was associated with social isolation. Although it is unclear what underlies this latter association, it is possible that this might be connected to the fact that in Japan the long-term care insurance system systematically connects people who need care to the necessary care services, which might increase the opportunities for older adults with higher levels of functional disability to come into contact with others. Also, as people with health problems are more generally likely to use health services, this might also be preventing them from experiencing social isolation.

In this study older adult loneliness was linked to both low SES and poor physical and mental health, which has also been found in other counties.[37] While a previous review reported that the relationship

Table 2 Factors associated with social isolation among older Japanese adults, examined by Poisson regression (N = 13 766)

	Model 1		Model 2		Model 3		Model 4		Model 5	
	PR	(95%CI)	PR	(95%CI)	PR	(95%CI)	PR	(95%CI)	PR	(95%CI)
Age (Ref: 65–69)										
70–74	0.94	(0.87, 1.02)	0.92	(0.85, 1.01)	0.93	(0.85, 1.01)	0.92	(0.84, 1.01)	0.94	(0.86, 1.03)
75–79	0.96	(0.89, 1.05)	**0.88**	(0.80, 0.97)	**0.89**	(0.81, 0.99)	**0.89**	(0.81, 0.98)	0.94	(0.85, 1.03)
80–84	1.02	(0.92, 1.13)	1.06	(0.95, 1.18)	1.07	(0.96, 1.19)	1.06	(0.95, 1.19)	1.10	(0.98, 1.22)
85+	**1.23**	(1.08, 1.39)	**1.66**	(1.48, 1.87)	**1.69**	(1.50, 1.91)	**1.70**	(1.50, 1.92)	**1.72**	(1.52, 1.94)
Female (Ref: Male)	**0.90**	(0.85, 0.96)	**0.82**	(0.76, 0.87)	**0.82**	(0.76, 0.87)	**0.78**	(0.72, 0.84)	**0.78**	(0.72, 0.84)
Education >9 years (Ref: ≤9 years)			**0.73**	(0.68, 0.79)	**0.74**	(0.69, 0.80)	**0.73**	(0.68, 0.79)	**0.77**	(0.71, 0.83)
Equivalized annual household income (JPY 10 000; Ref: <100)										
≥100 to <200			**0.87**	(0.79, 0.95)	**0.90**	(0.81, 0.99)	**0.89**	(0.81, 0.98)	0.93	(0.84, 1.02)
≥200 to <300			**0.69**	(0.62, 0.77)	**0.72**	(0.64, 0.80)	**0.71**	(0.64, 0.80)	**0.77**	(0.69, 0.86)
≥300 to <400			**0.49**	(0.43, 0.56)	**0.52**	(0.45, 0.59)	**0.51**	(0.45, 0.59)	**0.57**	(0.50, 0.65)
≥400			**0.51**	(0.44, 0.58)	**0.53**	(0.46, 0.61)	**0.53**	(0.45, 0.61)	**0.59**	(0.51, 0.68)
Working (Ref: Yes)										
Retired					0.96	(0.89, 1.04)	0.96	(0.89, 1.03)	**0.92**	(0.85, 0.99)
Never worked					1.09	(0.95, 1.26)	1.09	(0.95, 1.25)	1.04	(0.90, 1.20)
Receipt of public assistance (Ref: no)					**1.95**	(1.68, 2.27)	**1.90**	(1.64, 2.21)	**1.74**	(1.49, 2.03)
Complete IADL (Ref: ≤4)							**1.12**	(1.03, 1.20)	**1.14**	(1.06, 1.23)
Medical conditions (Ref: None)										
1 or 2									1.00	(0.92, 1.08)
3+									1.04	(0.94, 1.15)
Depressive symptoms (Ref: No)									**1.75**	(1.64, 1.87)

Note: Results in bold font are statistically significant. Abbreviations: CI, confidence interval; IADL, instrumental activities of daily living; PR, prevalence ratio; Ref, reference category.

Table 3 Factors associated with loneliness among older Japanese adults, examined by Poisson regression (N = 13 766)

	Model 1		Model 2		Model 3		Model 4		Model 5	
	PR	(95%CI)	PR	(95%CI)	PR	(95%CI)	PR	(95%CI)	PR	(95%CI)
Age (Ref: 65–69)										
70–74	0.94	(0.87, 1.02)	**0.89**	(0.82, 0.97)	**0.87**	(0.80, 0.94)	**0.84**	(0.78, 0.91)	**0.89**	(0.83, 0.96)
75–79	0.96	(0.89, 1.05)	**0.87**	(0.79, 0.94)	**0.83**	(0.76, 0.90)	**0.78**	(0.71, 0.85)	**0.87**	(0.80, 0.94)
80–84	1.02	(0.92, 1.13)	0.91	(0.82, 1.01)	**0.86**	(0.77, 0.95)	**0.78**	(0.70, 0.87)	**0.83**	(0.75, 0.92)
85+	**1.23**	(1.08, 1.39)	1.09	(0.96, 1.24)	1.02	(0.89, 1.16)	0.91	(0.80, 1.04)	0.92	(0.81, 1.04)
Female (Ref: Male)	**0.90**	(0.85, 0.96)	**0.87**	(0.82, 0.92)	**0.85**	(0.80, 0.91)	0.94	(0.88, 1.01)	**0.93**	(0.87, 0.99)
Education >9 years (Ref: ≤9 years)			**0.75**	(0.70, 0.81)	**0.75**	(0.70, 0.81)	**0.76**	(0.71, 0.82)	**0.85**	(0.80, 0.91)
Equivalized annual household income (JPY 10 000; Ref: <100)										
≥100 to <200			**0.83**	(0.76, 0.91)	**0.85**	(0.77, 0.93)	**0.85**	(0.78, 0.93)	0.93	(0.86, 1.01)
≥200 to <300			**0.68**	(0.62, 0.76)	**0.70**	(0.63, 0.78)	**0.71**	(0.64, 0.79)	**0.85**	(0.77, 0.94)
≥300 to <400			**0.61**	(0.54, 0.68)	**0.64**	(0.57, 0.72)	**0.64**	(0.57, 0.72)	**0.82**	(0.73, 0.91)
≥400			**0.54**	(0.47, 0.62)	**0.58**	(0.50, 0.66)	**0.58**	(0.50, 0.66)	**0.76**	(0.67, 0.87)
Working (Ref: Yes)										
Retired					**1.20**	(1.12, 1.29)	**1.16**	(1.08, 1.25)	1.05	(0.98, 1.13)
Never worked					**1.24**	(1.07, 1.42)	**1.19**	(1.03, 1.37)	1.07	(0.94, 1.22)
Receipt of public assistance (Ref: no)					**1.57**	(1.32, 1.87)	**1.51**	(1.27, 1.80)	**1.24**	(1.05, 1.46)
Complete IADL (Ref: ≤4)							**0.85**	(0.79, 0.91)	**0.89**	(0.84, 0.95)
Medical conditions (Ref: None)										
1 or 2							**1.26**	(1.15, 1.37)	**1.19**	(1.10, 1.29)
3+							**1.71**	(1.55, 1.88)	**1.40**	(1.28, 1.53)
Depressive symptoms (Ref: No)									**3.42**	(3.23, 3.63)

Note: Results in bold font are statistically significant. Abbreviations: CI, confidence interval; IADL, instrumental activities of daily living; PR, prevalence ratio; Ref, reference category.

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Table 4 Factors associated with not feeling lonely among older Japanese adults who are socially isolated, examined by Poisson regression (N = 2912)

	Model 1		Model 2		Model 3		Model 4		Model 5	
	PR	(95% CI)	PR	(95% CI)	PR	(95% CI)	PR	(95% CI)	PR	(95% CI)
Age (Ref: 65–69)										
70–74	1.06	(0.98, 1.15)	1.08	(0.99, 1.17)	**1.09**	(1.01, 1.18)	**1.11**	(1.02, 1.20)	**1.09**	(1.01, 1.18)
75–79	1.07	(0.98, 1.16)	**1.10**	(1.01, 1.19)	**1.12**	(1.02, 1.22)	**1.15**	(1.06, 1.26)	**1.10**	(1.01, 1.19)
80–84	1.06	(0.96, 1.16)	1.08	(0.98, 1.19)	**1.11**	(1.01, 1.23)	**1.15**	(1.04, 1.27)	**1.11**	(1.01, 1.22)
85+	1.09	(0.98, 1.21)	1.11	(0.99, 1.24)	**1.15**	(1.02, 1.28)	**1.20**	(1.07, 1.35)	**1.17**	(1.05, 1.31)
Female (Ref: Male	1.04	(0.98, 1.10)	1.05	(0.99, 1.11)	1.04	(0.99, 1.11)	1.03	(0.97, 1.09)	1.03	(0.98, 1.10)
Education >9 years (Ref: ≤9 years)			**1.15**	(1.07, 1.24)	**1.15**	(1.06, 1.23)	**1.15**	(1.07, 1.24)	**1.09**	(1.02, 1.17)
Equivalized annual household income (JPY 10 000; Ref: <100)										
100–200			0.95	(0.87, 1.05)	0.94	(0.86, 1.03)	0.94	(0.86, 1.03)	0.92	(0.84, 1.01)
200–300			1.09	(0.99, 1.20)	1.06	(0.96, 1.17)	1.06	(0.96, 1.17)	0.98	(0.90, 1.08)
300–400			1.05	(0.94, 1.18)	1.01	(0.90, 1.14)	1.01	(0.90, 1.14)	0.93	(0.83, 1.03)
400+			1.07	(0.95, 1.20)	1.03	(0.91, 1.16)	1.03	(0.92, 1.16)	0.94	(0.84, 1.05)
Working (Ref: Yes)										
Retired					**0.92**	(0.86, 0.99)	0.94	(0.88, 1.01)	0.99	(0.93, 1.05)
Never worked					0.94	(0.83, 1.07)	0.97	(0.85, 1.10)	1.01	(0.90, 1.14)
Receipt of public assistance (Ref: no)					**0.75**	(0.58, 0.96)	**0.76**	(0.60, 0.98)	0.80	(0.64, 1.01)
Complete IADL (Ref: ≤4)							1.04	(0.98, 1.10)	1.02	(0.96, 1.08)
Medical conditions (Ref: None)										
1 or 2							0.94	(0.88, 1.01)	0.96	(0.91, 1.02)
3+							**0.78**	(0.71, 0.86)	**0.87**	(0.79, 0.95)
Depressive symptoms (Ref: No)									**0.50**	(0.46, 0.54)

Note: Results in bold font are statistically significant. Abbreviations: CI, confidence interval; IADL, instrumental activities of daily living; PR, prevalence ratio; Ref, reference category.

between age/sex and loneliness in older adults can vary between study settings,[37] our study found that younger age and male gender were associated with loneliness. We can only speculate what underlies these associations. For example, it is possible that retirement might be important in this context. Specifically, in Japan, traditional gender division norms are still prevalent in the sphere of employment, where men mainly engage in paid employment outside the home—which results in the workplace providing the only meaningful social connections for some Japanese men, while many women remain at home where they are responsible for all aspects of family life.[38] As retirement can result in the sudden cutting of social ties that may, in some instances, have existed for decades, then it might explain why younger men were more likely to be lonely in this study. This supposition gains support from the fact that retirement was of borderline statistical significance in the loneliness analysis and was significantly associated with loneliness in individuals who were not socially isolated. Indeed, this might also help explain why non-employment and receiving public assistance were also associated with loneliness as

employment status is important for forging and maintaining social connections within society.

The first subgroup analysis revealed that those who were older, better educated, and did not have mental and physical health problems were less likely to feel lonely even if they were socially isolated. It is possible that people with these characteristics might be able to choose whether they want to be connected to others or not and move back to being non-socially isolated if/when they so decide because they are free of health problems and have the economic freedom to connect to society on their own terms,[39] which one author has termed 'solitude'.[40] In addition, another study which defined solitude as 'when [individuals] wanted others nearby but no interaction', or 'when they wanted to be alone', reported that solitude-seeking had more positive ramifications for older adults.[41] Thus, it is possible that solitude and health might be bidirectionally related.

In the second subgroup analysis, we found that people who are retired and have mental and physical health problems are more likely to feel lonely even though they are not socially isolated. Various factors might be involved in this finding. For example, it

Table 5 Factors associated with loneliness among older Japanese adults who are not socially isolated, examined by Poisson regression (N = 10 976)

	Model 1		Model 2		Model 3		Model 4		Model 5	
	PR	(95%CI)	PR	(95%CI)	PR	(95%CI)	PR	(95%CI)	PR	(95%CI)
Age (Ref: 65–69)										
70–74	0.96	(0.86, 1.06)	0.91	(0.82, 1.01)	**0.88**	(0.80, 0.98)	**0.85**	(0.77, 0.94)	**0.91**	(0.82, 0.99)
75–79	0.99	(0.89, 1.10)	**0.89**	(0.80, 0.99)	**0.84**	(0.75, 0.94)	**0.78**	(0.70, 0.87)	**0.87**	(0.78, 0.97)
80–84	1.02	(0.90, 1.17)	0.91	(0.80, 1.04)	**0.84**	(0.74, 0.97)	**0.76**	(0.66, 0.87)	**0.81**	(0.71, 0.92)
85+	**1.26**	(1.06, 1.50)	1.13	(0.95, 1.35)	1.03	(0.86, 1.23)	0.91	(0.76, 1.08)	0.94	(0.79, 1.11)
Female (Ref: Male)	**0.92**	(0.85, 0.99)	**0.88**	(0.82, 0.95)	**0.86**	(0.79, 0.93)	1.01	(0.92, 1.11)	0.97	(0.89, 1.06)
Education >9 years (Ref: ≤9 years)			**0.79**	(0.72, 0.87)	**0.78**	(0.71, 0.86)	**0.80**	(0.73, 0.88)	**0.88**	(0.80, 0.96)
Equivalized annual household income (JPY 10 000; Ref: <100)										
100–200			**0.73**	(0.65, 0.82)	**0.74**	(0.65, 0.83)	**0.74**	(0.66, 0.83)	**0.83**	(0.74, 0.93)
200–300			**0.64**	(0.56, 0.73)	**0.65**	(0.57, 0.74)	**0.65**	(0.57, 0.74)	**0.79**	(0.70, 0.89)
300–400			**0.57**	(0.49, 0.65)	**0.58**	(0.50, 0.67)	**0.58**	(0.51, 0.67)	**0.75**	(0.65, 0.85)
400+			**0.48**	(0.41, 0.57)	**0.51**	(0.43, 0.60)	**0.51**	(0.43, 0.60)	**0.68**	(0.58, 0.79)
Working (Ref: Yes)										
Retired					**1.25**	(1.14, 1.37)	**1.20**	(1.10, 1.32)	**1.10**	(1.01, 1.20)
Never worked					**1.29**	(1.07, 1.55)	**1.24**	(1.03, 1.48)	1.12	(0.94, 1.33)
Receipt of public assistance (Ref: no)					**1.51**	(1.07, 2.11)	**1.44**	(1.03, 2.00)	1.21	(0.88, 1.66)
Complete IADL (Ref: ≤4)							**0.77**	(0.70, 0.84)	**0.83**	(0.76, 0.90)
Medical conditions (Ref: None)										
1 or 2							**1.33**	(1.20, 1.49)	**1.26**	(1.14, 1.39)
3+							**1.80**	(1.60, 2.04)	**1.47**	(1.31, 1.65)
Depressive symptoms (Ref: No)									**3.62**	(3.36, 3.89)

Note: Results in bold font are statistically significant. Abbreviations: CI, confidence interval; IADL, instrumental activities of daily living; PR, prevalence ratio; Ref, reference category.

might be linked to the fact that in Japan, in addition to substantial welfare services for older people and the long-term care insurance system, people with physical health problems have an increased possibility of using health services, leading to social connections which may act to prevent social isolation. However, although they maintain social connections with formal health and welfare services and sources of instrumental social support, they may lack necessary social connections that can provide emotional support to alleviate loneliness.[42] In addition, the World Health Organization has defined healthy ageing as 'the process of developing and maintaining the functional ability that enables wellbeing in older age'.[43] Being unhealthy and not working might therefore act to undermine older adults' functional ability. In relation to this, we found that lower functional ability was associated with loneliness among those who were not socially isolated, which might stem from the fact that people with functional disabilities may have more problems with mobility, and have a greater probability of being housebound, and are thus unable to participate in social events.[44] Finally, our finding that having one or more medical conditions was associated with loneliness in all older adults and in those who were not socially isolated accords with the result from an earlier study that linked multimorbidity with an increased risk for loneliness.[45]

In light of our findings measures should be promoted to tackle both social isolation and loneliness among older adults in Japan. However, rather than working within a standard framework with uniform definitions, consideration should be given to the fact that there are differences among the various combinations of these phenomena and it is necessary to be cognizant of this in order to successfully address both loneliness and social isolation and to reduce harmful loneliness and isolation.[17] In addition, future research is also needed to examine the influence of the combined effects of social isolation and loneliness on the health of older Japanese adults.

To the best of our knowledge, this is the first study to present factors associated with both social isolation and loneliness among older adults in Japan, while also examining factors associated with the combination of these phenomena, using data from a nationwide cohort. However, this study has some limitations. First, as this is a cross-sectional study, the directionality of the observed associations could not be determined. Second, because information on loneliness was only collected from part of the total sample, the analytic sample was relatively small. Therefore, we cannot discount the possibility that different results might have been obtained if we had used data from the full sample. Third, since data were self-reported, there is the possibility that reporting bias and non-response bias may have been an issue, as in the case of socially desirable responding, for example. Fourth, there is a possibility of survivor bias. As previous studies have reported that loneliness and social isolation increase the risk of both illness and death, it is possible that those cohort members with the most severe feelings of loneliness and social isolation may have already died or become too sick to participate in the survey, which would mean that our findings might be underestimated. Fifth, we used the top quintile of scores as cut-offs for the social isolation and loneliness variables, following the lead of a previous study.[6] However, this may have been problematic as there is no agreed way to dichotomize these measures. Finally, we measured loneliness at one point in time; however, according to a recent report by the Kaiser Family Foundation, many Japanese adults can experience loneliness for a decade or more.[46] Hence, we may have an incomplete picture of this phenomenon in older adults and more research will be needed across time to better understand it.

Conclusion

This study suggests that the tailored promotion of measures to tackle the different combinations of social isolation and loneliness may be needed. In the first instance, our results indicate that when it comes to reducing unwanted social isolation and loneliness, the main focus should be on socioeconomically disadvantaged and unhealthy older adults in Japan.

AUTHOR CONTRIBUTIONS

CONFLICT OF INTEREST

The authors have nothing to declare.

DATA AVAILABILITY STATEMENT

The dataset supporting the conclusions of this article is available in response to the request from the researchers admitted by the JAGES committee (dataadmin.ml@jages.net).

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