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Cross-national comparison of social isolation and mortality among older adults: A 10-year follow-up study in Japan and England

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Aim: Existing evidence links social isolation with poor health. To examine differences in the mortality risk by social isolation, and in socio-economic correlates of social isolation, we analyzed large-scale cohort studies in Japan and England.

Methods: Participants were drawn from the Japan Gerontological Evaluation Study (JAGES) and the English Longitudinal Study of Ageing (ELSA). We analyzed the 10-year mortality among 15 313 JAGES participants and 5124 ELSA respondents. Social isolation was measured by two scales, i.e., scoring the frequency of contact with close ties, and a composite measurement of social isolation risk. We calculated the population attributable fraction, and Cox regression models with multiple imputations were used to estimate hazard ratios (HRs) for mortality due to social isolation.

Results: The proportion of those with contact frequency of less than once a month was 8.5% in JAGES and 1.3% in ELSA. Males, older people, those with poor self-rated health, and unmarried people were significantly associated with social isolation in both countries. Both scales showed that social isolation among older adults had a remarkably higher risk for premature death (less frequent contact with others in JAGES: hazard ratio [HR] = 1.18, 95% confidence interval [CI]: 1.05–1.33, in ELSA: HR = 1.27, 95% CI: 0.85–1.89; and high isolation risk score in JAGES: HR = 1.30, 95% CI: 1.12–1.50, in ELSA: HR = 2.05, 95% CI: 1.52–2.73). The population attributable fraction showed less frequent contact with close ties was attributed to about 18 000 premature deaths annually in Japan, in contrast with about 1800 in England.

Conclusions: Negative health impacts of social isolation were higher among older Japanese compared with those in England. **Geriatr Gerontol Int 2021; 21: 209–214**.

Keywords: cross-national comparative study, mortality, population attributable risk, social isolation, social network.

Introduction

Along with becoming a super-aged society, Japan is experiencing a rapid increase in the number of never-married persons. Social isolation among older adults is an important issue in social work and public health in the context of social disconnection. Although several social gerontological theories have mentioned positive aspects of the aging process (e.g., disengagement theory,[1] socioemotional selectivity theory[2] and voluntary isolation[3]), social isolation among the aged is known to be linked with poor social support, loneliness, depressive symptoms, suicide, as well as physical inactivity and restricted mobility.[4,5] Berkman and Krishna reported that adequate social networks might influence health behaviors, psychological health, and physiological health through social support, social influence, norms around health, opportunities for social participation and social engagement, and access to material goods, resources and services.[6]

An overview of systematic reviews reported consistent evidence linking social isolation to all-cause mortality.[5] The influence of adequate social relationships on mortality risk is comparable with quitting smoking.[7] However, health impacts of social isolation might differ by nation, because the prevalence and aspects of social isolation differ by nation. For example, England is a more advanced country in this topic than Japan. In 2003, the Organisation for Economic Co-operation and Development (OECD) reported the proportion of respondents who rarely or never spent time with their close ties was different across countries, at 15.3% in Japan and 5.0% in the United Kingdom.[8] A recent report also showed social isolation among older adults is more severe in Japan than in England.[9] In England, some classic sociological studies[10,11] and systematic review of interventions targeting social isolation[12] have been performed. Disconnected communities are said to cost the United Kingdom economy as much as £32 billion per year.[13] Through those findings, the prime minister established a "minister of loneliness" in 2018 to tackle the social issues caused by social isolation and introducing social prescribing, in which general practitioners refer people experiencing loneliness to community activities.

There are different aspects of social isolation between Japan and England, but the differences in mortality risk and health impact of social isolation between Japan and England has been unknown. In addition, we cannot find any reports that directly measured social isolation by multiple scales with rich social demographic information. Therefore, the aim of this paper was to examine differences in the effects of social isolation on mortality and the socio-economic correlates of social isolation between Japan and England using large-scale prospective cohort data with the same statistical model. We also estimated the population attributable fraction of social isolation in Japan and England to interpret the role of social isolation closely in both countries.

Methods

Study design, participants and setting

We used longitudinal datasets collected from the Japan Gerontological Evaluation Study (JAGES) and the English Longitudinal Study of Ageing (ELSA). The JAGES delivered a self-administered questionnaire via a postal survey to older people who were aged ≥65 years and not eligible to receive long-term healthcare insurance benefits in Japan. In total, 15 313 respondents from the first wave in 2003 were randomly selected from six municipalities in Aichi Prefecture, located in central Japan. The study population in the ELSA who were aged ≥50 years and independently living in England were drawn from the Health Survey for England, which is described elsewhere.[14] We analyzed 5124 ELSA participants aged ≥65 years who participated from the first wave in 2002. According to census data, at the baseline survey, the proportion of older adults is higher in Japan (17.3% as of 2000) than England (15.9% as of 2001), and the population size of older adults is remarkably higher in Japan (about 22 million people) than England (about 8 million people).

The JAGES study protocol and informed consent procedure were approved by the Ethics Committee on the Research of Human Subjects at Nihon Fukushi University (10-05). Ethical approval for the ELSA was granted from the Multicentre Research and Ethics Committee (MREC/01/2/91).

Measures

Mortality

In the JAGES, information on mortality was obtained from official records of the public long-term care insurance system, which is run by municipal governments. The ELSA was linked to official records of hospital episode statistics and NHS central register (mortality) data.[14] Maximum survival time for both datasets was unified into 3436 days. The proportion of deceased people in the follow-up period was 25.4% in the JAGES and 40.1% in the ELSA.

Social isolation

Social isolation is referred to as having few contacts with family, friends or neighbors as primary social groups and has been treated as an objective condition.[10] We adopted two scales to capture social isolation: counting the frequency of social contact[4,10,11,15–17] and a multidimensional risk score.[4,18–20]

First, we used items asking the frequency of face-to-face and non-face-to-face contact with children, relatives or friends. These were measured by six categories from three or more times a week to less than once a year or never in the ELSA, and by seven categories from almost every day to none in the JAGES. We converted the items into number of monthly contacts, based on 4.3 weeks per month. The response items were then coded as none = 0, almost none = 0.1, once or twice a month = 1.5, once a week = 4.3, two or three times a week = 10.8 and up to almost every day = 21.5. All converted responses were added up and categorized into seven categories of less than once a month (≤1.0) to almost every day or more (≥38.7). We used the average score of contact with children and relatives in the ELSA for consistency with the JAGES questionnaire because they were all treated as family in the JAGES.

Second, considering previous indices[18–20] and comparable variables between the two surveys, we identified four dimensions of social isolation risk: unmarried, less regular contact with children living separately and relatives, less regular contact with friends and no social participation. Less regular contact was defined as less than two to three times a year based on summated face-to-face and non-face-to-face contact. Social participation included participation in any socially organized or religious groups, such as political organizations or groups, volunteer groups, senior citizen clubs, sports groups or clubs, neighborhood associations and hobby activity groups. We counted these applicable items, and classified them from 0 to ≥3 (0 = low risk of social isolation, ≥3 = high risk of social isolation).

Covariates

Covariates were sex and age of the participants, self-rated health, presence of medical treatment for existing health conditions, basic activities of daily living (ADL), marital status and household equivalized income at the baseline survey in both studies. Age was categorized as 65–74, 75–84 and ≥85 years. Self-rated health was categorized into four categories from poor to excellent; ELSA items on self-rated health were combined into the same category. Information to derive the presence of medical treatment was gathered from responses to items on the presence of heart conditions, chronic lung disease or glaucoma in the ELSA, and from responses to items on medical conditions in the JAGES. All responses were then summed up and dichotomized into yes = 1 or no = 0. Basic ADL were dichotomized by whether respondents were able to bathe, walk and toilet independently or not. Marital status was categorized as married, widowed or divorced, and single or never married. We derived household equivalized income by the square root of the numbers and grouped them into quintiles in each study. Distributions of those variables are shown in Table S1.

Table 1 Distributions of social relationships in each cohort survey

	JAGES (Japan)	ELSA† (England)
Frequency of contact with others		
More than almost every day	39.0	31.4
4–6 times a week	15.2	26.0
3–4 times a week	7.0	16.6
Twice a week to <3 times a week	11.0	11.5
Once a week to less than twice a week	9.5	9.1
Once a month to less than once a week	9.6	4.2
Less than once a month	8.7	1.3
Isolation risk score		
0	47.9	50.3
1	31.0	33.9
2	15.7	13.1
≥3	5.5	2.7

†ELSA data were after sampling weight. Unit: person.

Statistical analysis

After calculating the descriptive statistics, we conducted three analyses. Concerning ELSA, we used sampling weight to minimize bias from differential non-responses among key subgroups, as recommended.[14] First, we adopted Cox regression analysis to examine the association between social isolation and mortality, controlling for baseline covariates. We analyzed and compared the two scales of social isolation, separately. Second, to describe the correlates of socially isolated older adults, we adopted a Poisson regression for low frequency of contact with others and linear regression models for isolation risk score. In addition, 25.7% of JAGES and 26.2% of ELSA respondent had missing values in some variables. Therefore, we performed a multiple imputation technique by chained equations under the missing at random assumption, which means there might be systematic differences between the missing and observed values. In addition to the above control variables, we included geographical location, household size and ethnicity (only ELSA) as auxiliary variables to strengthen the missing at random assumption. We created 20 imputed datasets. Using each dataset, we estimated with the robust variance estimator. Finally, we calculated population attributable risk percentages (PAR%) in Japan and England. PAR%, which considers not only relative risk ratio but also proportion of exposure, is an important indicator to clarify health impact. This estimation assumed that the adjusted HRs truly reflected causal impact and that our results represent the entire older population. As the denominator, data on annual mortality were obtained from governmental reports in both countries.[21,22] We performed analyses using Stata 15.1 (Stata Corp LP, College Station, TX, USA).

Results

The proportion of socially isolated older adults was higher in Japan than England (Table 1). For instance, the proportion of adults in the category of social contact frequency of less than once a month was remarkably higher in Japan (JAGES = 8.7%, ELSA = 1.3%). Likewise, there were more people in Japan with isolation scores of ≥3 (JAGES = 5.5%, ELSA = 2.7%).

In both cohorts, mortality during the follow-up period was higher for socially isolated people (Table 2). After adjusting for individual attributes, Japanese older adults with contact frequency of less than once a month had a mortality risk of 1.18 (95% confidence interval [CI]: 1.05–1.33) times higher than that of those with contact almost every day or more. In ELSA, it was similar and respondents who had social contact less than once a month had the highest mortality risk of all (HR = 1.27, 95% CI: 0.85–1.89); however, it was not statistically significant, most likely due to the small power. The estimates of isolation score also showed similar results. In comparison with 0, participants with a score of ≥3 had a 1.30 (95% CI: 1.12–1.50) times higher risk for premature death in JAGES, and a 2.05 (95% CI: 1.52–2.73) times higher risk in ELSA. When we analyzed complete cases with raw data without multiple imputation, the major results and trends were not largely different (Table S2).

Poisson regression models showed the correlates of socially isolated older adults were almost similar in England and Japan, although some of ELSA data were not significant due to the small statistical power (Table 3). In comparison with women, men had a 2.3–3.0 times higher risk for low frequency of contact as severe social isolation (JAGES: prevalence ratio = 2.33, ELSA: prevalence ratio = 2.99). Older age, single and never married, dependence in basic ADL, and poor self-rated health had a higher risk for social isolation. Linear regression model results for multidimensional score also showed similar associations.

The estimation of PAR% showed about 19 000 premature deaths (1.6% of all deaths) could be avoided annually if there were fewer cases of severe social isolation in Japan (Table 4). In England, PAR% was remarkably different between the two scales. Less frequent contact with others and high isolation risk score could be associated with about 1800 (0.4% of all deaths) and 13 000 (2.7% of all deaths) premature deaths annually, respectively.

Discussion

Severe social isolation among older adults was associated with higher mortality risk in Japan and England, and the attributable fraction for the population cannot be ignored. To the best of our knowledge, this is the first study to examine the differences in the mortality risk and the possibility of health impacts of social isolation on premature death among older adults in Japan and England based on comparable large-scale prospective cohort surveys.

Table 2 Association between social isolation and mortality: Cox regression analysis[†]

		JAGES 2003 (10 years follow-up)				ELSA 2002 (10 years follow-up)			
		Deceased %	Adjusted HR[‡]	(95% CI)	*P*	Deceased %	Adjusted HR[‡]	(95% CI)	*P*
Frequency of contact with others	More than every day	23.4	Ref.			38.6	Ref.		
	4–6 times a week	24.8	1.02	(0.92–1.14)	0.641	34.7	0.93	(0.81–1.06)	0.276
	3–4 times a week	22.1	0.91	(0.79–1.06)	0.218	39.6	1.03	(0.86–1.23)	0.777
	2 to <3 times a week	25.3	0.99	(0.88–1.12)	0.893	37.1	0.96	(0.82–1.12)	0.595
	Once a week to <2 times a week	25.9	1.02	(0.90–1.15)	0.776	39.1	1.01	(0.82–1.24)	0.940
	Once a month to less than once a week	29.1	1.06	(0.94–1.19)	0.341	47.7	1.06	(0.85–1.33)	0.593
	Less than once a month	33.5	1.18	(1.05–1.33)	0.005	64.4	1.27	(0.85–1.89)	0.235
Isolation risk score	0	22.1	Ref.			31.1	Ref.		
	1	26.2	1.11	(1.02–1.21)	0.015	42.3	1.24	(1.11–1.39)	0.000
	2	30.2	1.18	(1.06–1.30)	0.002	48.0	1.45	(1.22–1.72)	0.000
	≥3	33.1	1.30	(1.12–1.50)	0.001	63.7	2.05	(1.52–2.73)	0.000

CI, confidential interval; HR, hazard ratio.

[†]Multiple imputation by chained equations was performed using frequency of contact with others (less than once a week), isolation score, sex, age, self-rated health, presence of medical treatment, marital status, equivalent income (quintile) and basic activities of daily living (m = 20). In addition, geographical location, household size and ethnicity (only ELSA) have included in these models as auxiliary variables to strengthen the missing at random assumption.

[‡]Sex, age, self-rated health, presence of medical treatment, marital status, equivalent income and basic activities of daily living at baseline were controlled.

Similar to a previous report,[8] our results suggested that the prevalence of social isolation, that is, less frequent contact with others and high isolation risk score, among older adults in Japan was more than twice that in England. We confirmed the correlates of the isolated people did not largely differ between the two countries. This is also consistent with previous studies that mentioned several risk factors for social isolation in the older population: being male, advanced age, poor health and

Table 3 Correlates of social isolation among older adults: Poisson regression and multiple-linear regression analysis [†]

		Low frequency of contact with others: less than once a month						Isolation risk score (0 to ≥3)			
		JAGES 2003			ELSA 2002			JAGES 2003		ELSA 2002	
		PR	(95% CI)	P	PR	(95% CI)	P	β	P	β	P
Sex	Female	Ref.			Ref.			Ref.		Ref.	
	Male	2.33	(2.05–2.66)	0.000	2.99	(1.63–5.48)	0.000	0.121	0.000	0.066	0.000
Age, years	65–74	Ref.			Ref.			Ref.		Ref.	
	75–84	1.15	(1.02–1.30)	0.022	1.84	(1.05–3.23)	0.032	0.032	0.002	0.037	0.019
	≥85	1.71	(1.36–2.15)	0.000	2.47	(0.97–6.27)	0.057	0.068	0.000	0.054	0.003
Self-rated health	Poor, very poor	Ref.			Ref.			Ref.		Ref.	
	Fair	0.97	(0.77–1.22)	0.807	0.67	(0.28–1.56)	0.351	−0.051	0.008	−0.037	0.146
	Good	0.66	(0.53–0.83)	0.000	0.58	(0.25–1.32)	0.194	−0.138	0.000	−0.048	0.086
	Excellent, very good	0.48	(0.34–0.67)	0.000	0.78	(0.33–1.83)	0.566	−0.106	0.000	−0.025	0.293
Presence of medical treatment	No	Ref.			Ref.			Ref.		Ref.	
	Yes	0.88	(0.77–1.01)	0.076	0.81	(0.41–1.60)	0.543	−0.005	0.595	0.006	0.675
Marital status	Married	Ref.			Ref.			Ref.		Ref.	
	Widowed, divorced	1.17	(1.00–1.36)	0.048	0.73	(0.37–1.43)	0.359	0.034	0.002	0.061	0.000
	Single, never married	2.17	(1.54–3.07)	0.000	2.79	(1.24–6.26)	0.013	0.145	0.000	0.445	0.000
Equivalent income (quintile)	Lowest	1.20	(0.99–1.45)	0.071	1.37	(0.64–2.93)	0.419	0.039	0.003	0.004	0.825
	Low	1.08	(0.87–1.33)	0.487	0.91	(0.36–2.31)	0.846	0.010	0.472	0.012	0.532
	Middle	Ref.			Ref.			Ref.		Ref.	
	High	1.12	(0.91–1.38)	0.289	1.02	(0.46–2.26)	0.968	−0.012	0.341	−0.045	0.015
	Highest	0.97	(0.79–1.19)	0.746	0.67	(0.26–1.74)	0.412	−0.013	0.322	−0.105	0.000
Basic ADL	Independent	Ref.			Ref.			Ref.		Ref.	
	Dependent	1.38	(1.05–1.83)	0.022	1.35	(0.71–2.55)	0.361	0.036	0.001	0.062	0.000

β, standard partial regression coefficient; ADL, activities of daily living; CI, confidential interval; PR, prevalence ratio.

[†]Multiple imputation by chained equations was performed using frequency of contact with others (less than once a week), isolation score, sex, age, self-rated health, presence of medical treatment, marital status, equivalent income (quintile) and basic ADL (m = 20). Additionally, geographical location, household size, and ethnicity (only ELSA) have included in these models as auxiliary variables to strengthen the missing at random assumption.

Table 4 Population attributable risk fraction of social isolation

				PAR	
		Expose % (95% CI) †	HR	%‡ (95% CI)	*n*§
Japan	Low frequency of contact (less than once a month)	8.7 (8.2–9.2)	1.18	1.6 (1.5–1.6)	18 799 (17 788–19 809)
	Isolation risk score (≥3)	5.5 (5.1–5.9)	1.30	1.6 (1.5–1.7)	19 522 (18 179 –20 863)
England	Low frequency of contact (less than once a month)	1.4 (1.1–1.7)	1.27	0.4 (0.3–0.5)	1827 (1422–2232)
	Isolation risk score (≥3)	2.7 (2.3–3.1)	2.04	2.7 (2.3–3.2)	13 209 (11 154–15 247)

HR, hazard ratio; PAR, population attributable risk.

†% exposed is in our analyzed dataset.

‡PAR% $= \frac{Pe(HR-1)}{Pe(HR-1)+1}$ *Pe*, the proportion of exposure in the target population.

§Denominator is the annual number of mortalities among people ≥65 years, which was obtained from governmental reports.[21,22]

England: N = 422 159 (2017); Japan: N = 1 208 908 (2017).

[Correction added on 21 January 2020, after first online publication: The data for *n*§ in Table 4 has been corrected from "18 799 (15 836–17 638)" to "18 799 (17 788–19 809)".]

low socio-economic status.[4,10,11] It is important to note that we confirmed these prevalences and correlates using the present data, while previous research mentioned the key studies had been conducted well over 30 years ago.[4] These results suggest that the correlates of socially isolated older adults are almost unchanged over the long term, although the prevalence differs by nation.

There are several possible reasons why the point estimation (HRs) of social isolation for mortality was higher in England, although we did not estimate the significance of the difference between Japan and England. The concept of feelings of relative deprivation[23] might capture very severe conditions in a comparatively connected society. It was reported that social isolation might strongly enhance social stress for older Japanese women, as such isolation is rare in the community.[15] Another analysis reported that better friendship-based social relationships lengthened survival among men in England by 45.4 days compared with men in Japan.[24] In a connected society, most people receive the benefits of better social relationships. However, social isolation among people in a connected society might be more severe than that in a disconnected society.

According to our estimation of the population attributable risk percentages calculated using the proportion of exposure ratio and HR, about 1.6% of annual deaths in Japan are associated with social isolation. This is of concern because the aging population is huge in Japan. Social isolation among older adults is a risk factor that can be modified with diverse interventions.[25] Recently, evaluations and intervention studies on the promotion of social participation and social relationships are progressing in Japan.[26] Nationwide promotion of social participation and relationships is also necessary in Japan to combat social isolation among older adults.

Our study added new evidence about the cut-off point of severe social isolation. Tunstall mentioned that where the cut-off point is placed along the continuum of social contact is inevitably arbitrary.[11] Our results suggested that contact with others less than once a month becomes one criterion of severe social isolation in Japanese older adults, which is associated with risk of premature death. Although it was not statistically significant due to the small power, the result of ELSA showed a similar trend. Contact frequency of less than once a month might reflect qualitatively different conditions, including poor social support[27] and eating alone,[28] which contribute to health risks. In addition, the composite measurement score showed a stronger association and dose–response trend with mortality, although the cut-off point was unclear. As overlapping multidimensional disadvantage is more strongly associated with premature death,[29] it might capture not only social isolation in a narrow sense, but low socio-economic status and social vulnerability.

Our study has several limitations. First, we assessed social isolation and covariates only at baseline. Therefore, we cannot deny the possibility of reverse causation, although we adopted several statistical techniques. On the other hand, our findings may be underestimated because people living in serious social isolation may have been less likely to participate in these surveys. Second, we cannot discuss the mechanisms between social isolation and mortality. Control variables in our models were also limited because we considered comparability between the two surveys. For instance, although several studies suggested transport difficulties including driving cessation, or geographic location as possible risk factors for social isolation among older adults, we could not include these factors.[30] Third, JAGES data are not representative of the whole country. However, it is important to note that we did perform a large-scale survey concerning social isolation among older adults in more than one municipality in Japan. Fourth, our baseline survey data are dated because we focused on the association with mortality. We could not reflect diversification of social contact means across decades. Fifth, there might be cultural differences in the meanings of "friend" and "close relationship" between countries. However, we believe the bias would not explain all of the differences in our results. It would be meaningful to examine the association between social isolation and mortality in another cross-national comparison with the same framework in the future.

In conclusion, the results showed social isolation among older adults was associated with mortality in both Japan and England, and the socio-economic correlates of social isolation were similar. One important implication of our findings is that the health impacts of social isolation might differ by nation. Negative health impacts of social isolation were higher and should not be ignored among older Japanese.

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Disclosure statement

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

Table S1 Distributions of covariates in each cohort survey
Table S2. Association between social isolation and mortality in the raw data: complete case analysis

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