



Contents lists available at ScienceDirect

## Archives of Gerontology and Geriatrics

journal homepage: [www.elsevier.com/locate/archger](http://www.elsevier.com/locate/archger)

# Change in the prevalence of social isolation among the older population from 2010 to 2016: A repeated cross-sectional comparative study of Japan and England

Taishi Tsuji<sup>a,b,\*</sup>, Masashige Saito<sup>c</sup>, Takaaki Ikeda<sup>d,e</sup>, Jun Aida<sup>f,g</sup>, Noriko Cable<sup>h</sup>,  
Shihoko Koyama<sup>i</sup>, Taiji Noguchi<sup>j,k</sup>, Ken Osaka<sup>e</sup>, Katsunori Kondo<sup>b,k</sup>

<sup>a</sup> Faculty of Health and Sport Sciences, University of Tsukuba, 3-29-1 Otsuka, Bunkyo City, Tokyo 112-0012 Japan

<sup>b</sup> Center for Preventive Medical Sciences, Chiba University, 1-8-1 Inohana, Chuo Ward, Chiba City, Chiba 260-8670 Japan

<sup>c</sup> Department of Social Welfare, Nihon Fukushi University, Okuda, Mihama-cho, Chita-gun, Aichi 470-3295 Japan

<sup>d</sup> Graduate School of Medical Science, Yamagata University, 2-2-2 Iida-Nishi, Yamagata City, Yamagata 990-9585 Japan

<sup>e</sup> Department of International and Community Oral Health, Tohoku University Graduate School of Dentistry, 4-1 Seiryomachi, Aoba Ward, Sendai City, Miyagi 980-8574 Japan

<sup>f</sup> Graduate School of Medical and Dental Sciences, Tokyo Medical and Dental University, 1-5-45 Yushima, Bunkyo City, Tokyo 113-8549 Japan

<sup>g</sup> Liaison Center for Innovative Dentistry, Tohoku University Graduate School of Dentistry, 4-1 Seiryomachi, Aoba Ward, Sendai City, Miyagi 980-8574 Japan

<sup>h</sup> Department of Epidemiology and Public Health, University College London, 1-19 Torrington Place, London WC1E 6BT United Kingdom

<sup>i</sup> Cancer Control Center, Osaka International Cancer Institute, 3-1-69 Ohtemae, Chuo Ward, Osaka 541-8567 Japan

<sup>j</sup> Department of Public Health, Nagoya City University, 1 Kawasumi, Mizuho-cho, Mizuho Ward, Nagoya City, Aichi 467-8601 Japan

<sup>k</sup> Center for Gerontology and Social Science, National Center for Geriatrics and Gerontology, 7-430 Morioka-cho, Obu City, Aichi 474-8511 Japan

## ARTICLE INFO

## Keywords:

National comparison  
Social interaction  
Social participation  
Solitary death

## ABSTRACT

**Objective:** To compare the change in the prevalence of social isolation from 2010 to 2016 between older populations in Japan, the most aging and socially isolated country, and England, a country known for advanced social isolation measures.

**Methods:** Surveys from the Japan Gerontological Evaluation Study (JAGES) and the English Longitudinal Study of Aging (ELSA) included 70,751 and 4134 participants, respectively, aged 65 years or older in 2010 and 94,228 and 4295 participants in 2016. We assessed the social isolation of respondents on a scale from 0 to 5 points based on lack of social interactions with a spouse or partner, children, relatives, or friends and nonparticipation in any organization.

**Results:** Results of two-way analysis of variance confirmed significant interactions (nation × period) in men and women aged 65–74 years and women aged 75 years or older. In JAGES, all had higher scores in 2016 compared to 2010 (1.64–1.76, 1.28–1.36, and 1.55–1.60 points, respectively). Furthermore, the proportions of those with lack of interaction with relatives increased (52.7%–58.9%, 31.5%–41.1%, and 25.2%–39.2%, respectively). In ELSA, women aged 75 years or older demonstrated a significantly lower mean score in 2016 than in 2010 (1.40 vs. 1.21). No significant changes were observed in other groups.

**Conclusion:** Social isolation among older adults is more severe in Japan than in England. The difference has widened, especially for women and younger older adults. This is attributed to the weakening relationships with relatives in Japan.

## 1. Background

Social isolation is generally defined as a state in which objectively quantifiable social interactions, contacts, and networks are absent (de Jong Gierveld & Havens, 2004). Social relationships are composite of

structural aspects such as social networks/participations and functional aspects such as social support that is the resource social network brings (Antonucci & Akiyama, 1987). Enhancing structural aspects of social relationships could enrich social support, in turn bringing various health benefits (Cohen, 2004; Holt-Lunstad, Smith, Baker, Harris, &

\* Corresponding author at: Faculty of Health and Sport Sciences, University of Tsukuba 3-29-1 Otsuka, Bunkyo City, Tokyo 112-0012 Japan.

E-mail address: [tsuji.taishi.gn@u.tsukuba.ac.jp](mailto:tsuji.taishi.gn@u.tsukuba.ac.jp) (T. Tsuji).

<https://doi.org/10.1016/j.archger.2020.104237>

Received 11 May 2020; Received in revised form 4 August 2020; Accepted 18 August 2020

Available online 22 August 2020

0167-4943/© 2020 The Author(s).

Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Stephenson, 2015). In this sense, social isolation is broadly regarded as a state of poor social relationship that addresses both structural and functional aspects (Mehrabi & Beland, 2020).

Older adults are at a higher risk for social isolation (Iliffe et al., 2007); and globally, up to 50% of this population category are at risk of social isolation (Landeiro, Barrows, Nuttall Musson, Gray, & Leal, 2017). Recent empirical studies have reported that social isolation adversely affects various health outcomes (Mehrabi & Beland, 2020; Petersen, Konig, & Hajek, 2020), whereas the influence of adequate social relationships on risk for mortality is comparable with quitting smoking (Holt-Lunstad, Smith, & Layton, 2010). Studies examining relationships between social isolation and health among older adults are accumulated year by year, and the importance of prevention of social isolation and improvement of social relationships is being emphasized in each report (Fakoya, McCorry, & Donnelly, 2020; Mehrabi & Beland, 2020). However, most of those reports are based on localized analyses at the individual level, with few reports investigate how the prevalence of social isolation among the older adults has changed in recent years at the population level.

In Japan, where a super-aging society is advancing, social isolation among older adults is among the most important issues in public health. For instance, from 2000 to 2015, the never-married rate has rapidly increased 2 times for men (from 12.6% to 23.4%) and 2.5 times for women (from 5.8% to 14.1%) (National Institute of Population & Social Security Research, 2017). In the same period, the number of older adults living alone has almost doubled from 3 million to 6 million (Cabinet Office, Government of Japan, 2019). Older adults who are at higher risk of social isolation, such as the unmarried or those living alone, are more likely to experience solitary death (Gurley, Lum, Sande, Lo, & Katz, 1996; Kakiuchi, Nagao, Ochiai, Kakimoto, & Osawa, 2019). Actually, in the urban area of Tokyo, the number of solitary death among older adults has increased approximately 1.5 times during the past decade (Cabinet Office, Government of Japan, 2019). However, the detailed picture and trends of this multifaceted social isolation from structural/functional perspectives, including friendship and social participation among older adults nationwide in Japan, are not fully understood.

In contrast, the United Kingdom (UK) is one of the country's most enthusiastically working on countermeasures regarding this topic. The government of the UK published a policy paper, "A Connected Society: A Strategy for Tackling Loneliness," in 2018 examining the social issues caused by loneliness and social isolation (HM Government, 2018). In a scoping review that systematically searched for reviews on interventions for social isolation and loneliness in older adults, authors found three times more intervention studies from the UK than studies from Japan (Fakoya et al., 2020). However, in the UK, the trends of social isolation among older adults in recent years are also not well understood. For instance, the number of older adults living alone, which are classified as high-risk households for social isolation, is increasing (Office for National Statistics, 2019). Surprisingly, multiple-family households, which are low-risk households are regarded as the fastest growing household type in the UK (Office for National Statistics, 2019). Furthermore, we cannot find any reports that quantitatively evaluated changes in the prevalence of non-kin social relationships, such as social networks with friends and participation in local organizations. Both Japan and the UK are developed and advanced nations with considerable aging population where preventing social isolation among older people is an urgent need. However, their devotion to addressing the issue differs, and the change in recent years in the prevalence is unclear.

This study aims to compare the change in prevalence of social isolation from 2010 to 2016 between the older populations in Japan and England by age and sex groups and to verify which components contribute to this difference. We hypothesized that, in Japan, social isolation has been seen to worsen recently as family relationships have weakened, especially for younger older adults, compared with England.

## 2. Methods

### 2.1. Study design and participants

In our comparative repeated cross-sectional study, we obtained two ongoing prospective aging studies: the Japan Gerontological Evaluation Study (JAGES) and the English Longitudinal Study of Aging (ELSA). JAGES, which is panel study with more than 100,000 participants living in Japan as of 2016, is focused on investigating social and behavioral factors related to loss of independence with respect to functional decline, or cognitive impairment, among individuals 65 years or older. A detailed description of the study has been published elsewhere (Kondo, 2016; Kondo, Rosenberg, & World Health Organization, 2018). Meanwhile, ELSA is a panel study of a nationally representative sample of the English population living in private households and aged 50 years or older, which has also been described in detail elsewhere (Banks, Batty, Nazroo, Oskala, & Steptoe, 2018; Steptoe, Breeze, Banks, & Nazroo, 2013). We used the data from the JAGES (three waves: 2010/11, 2013, and 2016) and ELSA (four waves: 2010/11, 2012/13, 2014/15, and 2016/17). Hereinafter, the years that the survey started is indicated for identifying each survey wave for convenience. From each dataset, individuals with complete sex, age, and social isolation variables and those aged 65 years or older were selected for this analysis. They were stratified by sex and age (65–74 years and  $\geq 75$  years), and the numbers of analytic sample in each group were from 12,814 to 28,631 in JAGES and from 692 to 1403 in ELSA (Fig. 1). The JAGES protocols were approved by the Ethics Committee at Chiba University, Japan (Approval number: 2493) and the National Center for Geriatrics and Gerontology, Japan (Approval number: 992). Meanwhile, the ELSA received ethical approval for all waves of the study from the National Health Service Research Ethics Committees under the National Research and Ethics Service, UK.

### 2.2. Measurements

The ELSA proposed a 5-point social isolation index consisting of the following components: unmarried/not cohabiting; less than monthly contact with each of the following: children, other family members, friends, and nonparticipation in organizations (Shankar, McMunn, Banks, & Steptoe, 2011; Steptoe, Shankar, Demakakos, & Wardle, 2013). Older adults with higher index scores were more likely to be smokers and physically inactive, have higher blood pressure, and have a higher risk of all-cause mortality (Shankar et al., 2011; Steptoe, Shankar et al., 2013). In the present study, a modified version of the index was used in order to have comparability between JAGES and ELSA. Each participant gets 1 point if (1) not married or cohabitating with a partner; (2) did not live with their children or had no one to provide emotional or instrumental social support; (3) did not have immediate family members providing emotional or instrumental social support; (4) had face-to-face contact with friends less than once a month or did not have any friends who could provide emotional or instrumental social support; and (5) did not participate in any organizations, religious groups, or committees. While the original version of the index did not include providing social support, we used a modified version including social support that is a functional aspect of social relationships to make it comparable to JAGES. The total possible score could range from 0 to 5, with higher scores indicative of greater social isolation.

### 2.3. Statistical analysis

For each wave in each cohort, we described the mean and standard deviation of social isolation scores for each sex and age group. Furthermore, we performed a two-way analysis of variance (nation  $\times$  period) using two-wave data from each cohort collected in approximately the same period (first wave collected in 2010 and last wave collected in 2016) to determine the primary effects of nation and period

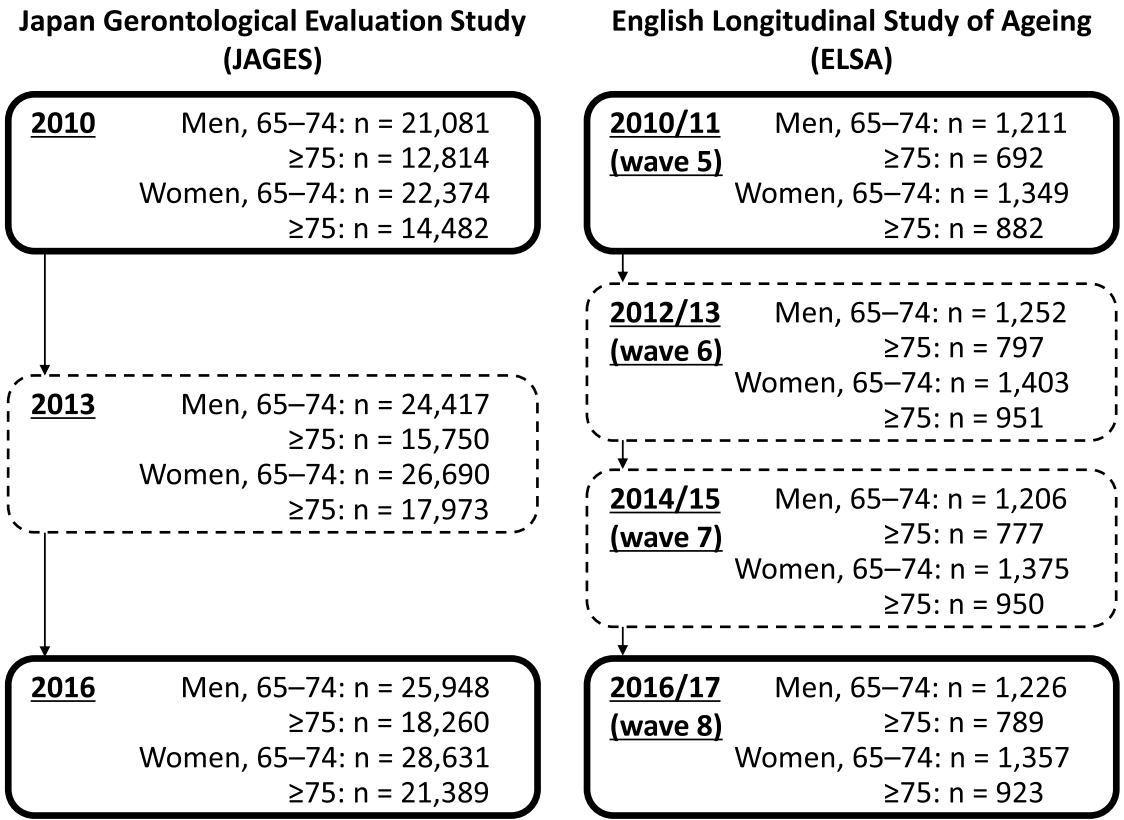


Fig. 1. Number of analytic participants in each cohort study for each survey wave.

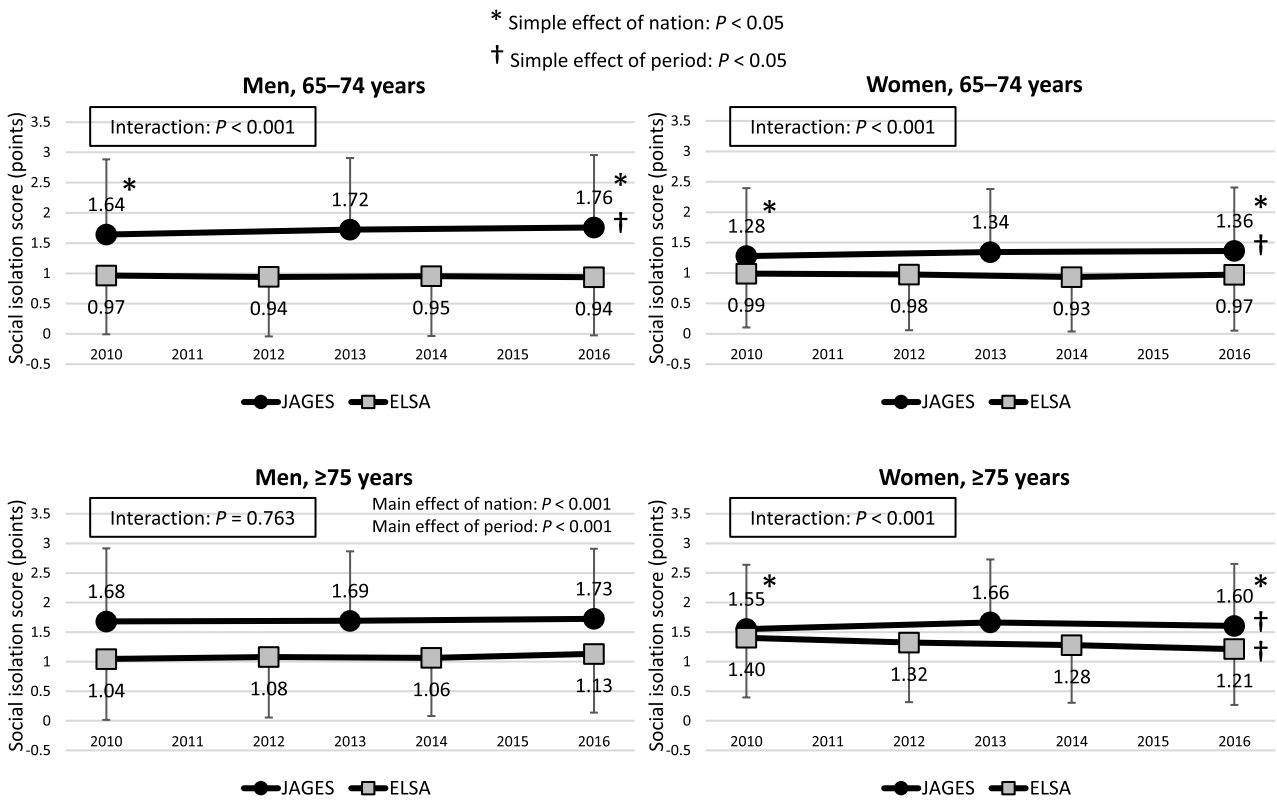


Fig. 2. The transition of the mean social isolation score in each sex and age group for each survey wave.

as well as their interaction. This statistical approach allowed us to estimate the cross-sectional difference in the prevalence of social isolation between Japan and England and how its transition differed in recent years. If significant interactions (nation × period) were confirmed, simple main effects were tested using the Bonferroni correction. In addition, to determine which component caused the difference, we described the proportions of the individuals assigned 1 point in each of the five items constituting the social isolation score in each wave of 2010 and 2016 in each cohort. All tests were two-tailed, with differences reported as significant if the *P*-value was less than 0.05.

To explore potential cohort period effects, we conducted the same analysis by tracing the birth cohort as a sensitivity analysis. For instance, we compared the group of participants aged 65–74 years in 2010 with the group aged 71–80 years in 2016. This comparison focuses on variations resulting from the unique experience and exposure of a cohort as they move across time. All analyses were performed using Stata/MP 14.2 (Stata Corp., College Station, TX).

### 3. Results

Fig. 2 shows the mean and standard deviation of each wave's social isolation score for each cohort for each sex and age group. In the main analyses, we found significant nation × period interactions in all groups except for men aged 75 years and older. In those three groups, JAGES had higher mean scores than ELSA in both 2010 and 2016, and the 2016 JAGES scores were significantly higher than the 2010 JAGES scores. On the other hand, women aged 75 years or older had a significantly lower ELSA score in 2016 than in 2010. Overall, men aged 75 years or older had a higher mean JAGES score than ELSA, and the 2016 score was higher than 2010. In sensitive analyses, we also found similar results, except that the significant interaction was abolished in the men aged 65–74 years (as of 2010) group (Fig. A1).

Fig. 3 shows the proportions of the individual assigned 1 point in each of the five items. As of 2010, the major components that induced

the difference between Japan and England were the lack of social interaction with children, relatives, and friends. Those were approximately twice or more frequent in JAGES compared to ELSA, except for women aged 75 years or older. Focusing on the changes from 2010 to 2016, a common feature seen only in JAGES was that the number of individuals who did not receive support from relatives except spouses and children increased (6.2%–14.0%). The only other item confirmed to increase by 5% or more was non-participation among men aged 65–74 years in JAGES (from 27.6%–34.2%). In contrast, ELSA did not have such an item. ELSA showed a flat or gradually declining trend for most components in all gender and age groups. If we dare mention the components that showed an increasing trend, it would be the lack of interaction with relatives (from 21.4% to 25.9%) and spouse/partner (from 26.5 to 29.3%) in men aged 75 years or older.

### 4. Discussion

The main findings of this study are as follows: (1) social isolation among older adults is more common in Japan than in England, regardless of sex and age; (2) the difference has widened further, especially for women and younger older adults in recent years; and (3) the main cause for this widening gap is the weakening relationships with relatives in Japan.

Japan is one of the most socially isolated countries in the world, with approximately three times more people than in the UK to rarely or never spend time with friends, colleagues, or others in social groups (OECD, 2005). In this study, which limited participants to older adults, JAGES participants were two to three times more likely to have less interaction with friends than ELSA participants in both 2010 and 2016, regardless of sex and age. This could be attributed to the introverted personality that is common among Japanese people and the context and culture that has been rooted in Japan over time.

The notable result of this study is that the relationship with relatives (excluding spouses and children) is weaker in Japan than in the UK, and

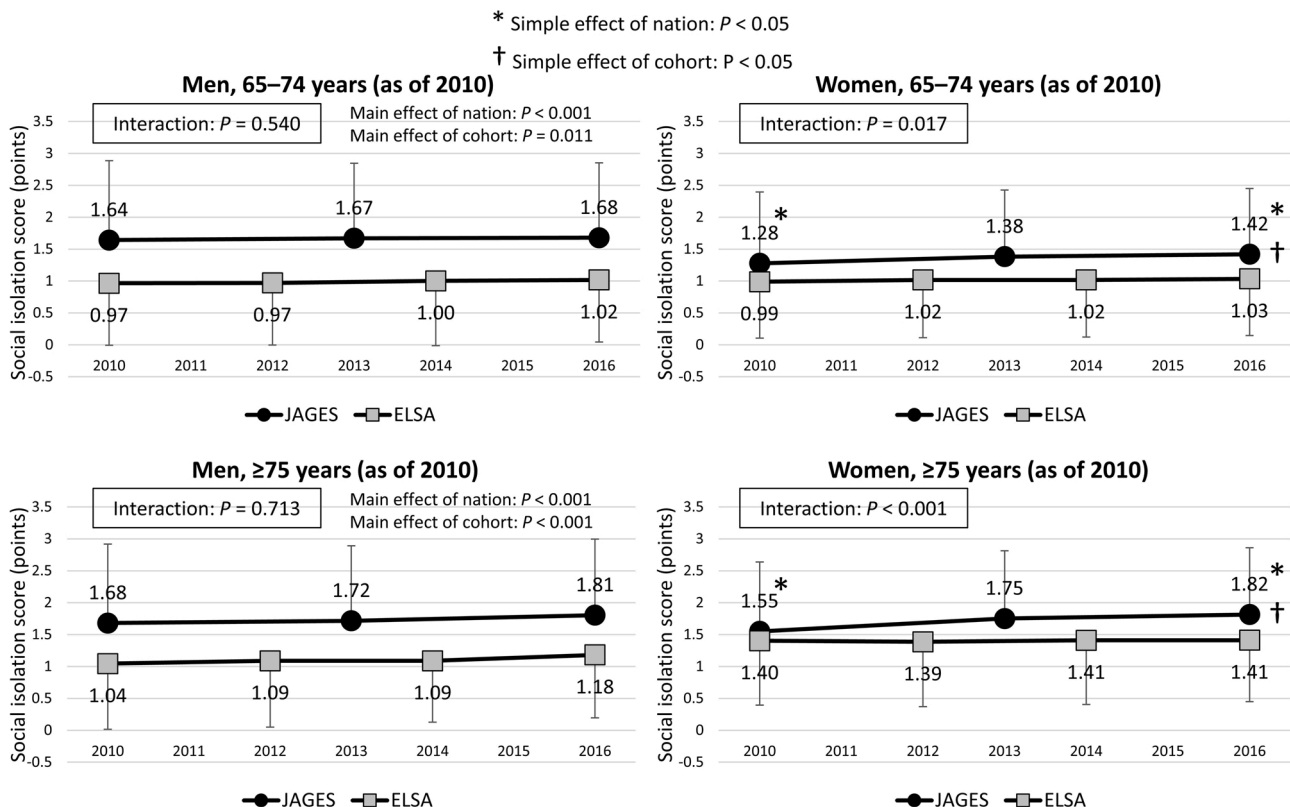


Fig. A1. The transition of the mean social isolation score in each sex and age group for each survey wave by tracing generations.

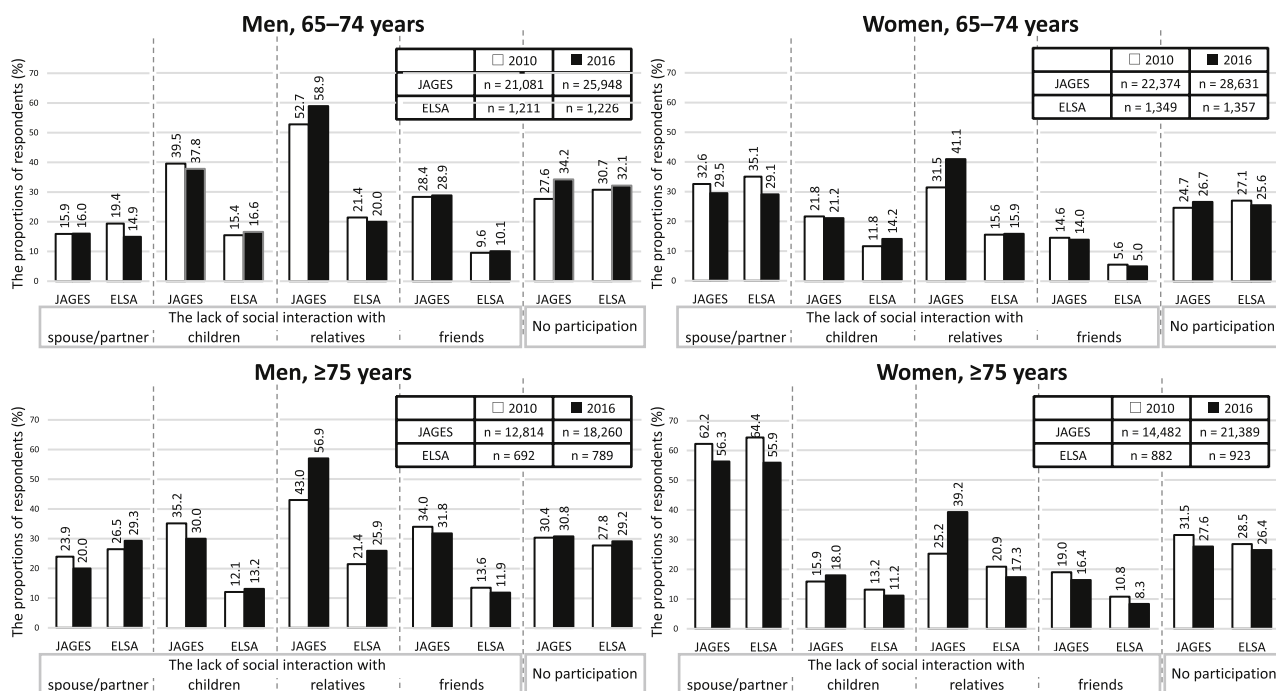


Fig. 3. The proportions of respondents assigned 1 point (i.e., lack of social interaction) for each of the five items in each sex and age group for the 2010 and 2016 surveys.

the difference is further widening. According to Japanese government statistics (Ministry of Health, Labour & Welfare, 2019), the number of three-generation households and those with siblings fell 6.4 percentage points from 27.4% in 2010 to 21.0% in 2016. Thirty years ago (1986), these households accounted for 57.5% of all households. This means that nuclear families (i.e., parents and children only) have now become the most common household composition, and the numbers of such households have grown rapidly (1% year) in Japan. On the other hand, a similar phenomenon was not reported in the UK. In this study, there was no noticeable change in ELSA as compared with JAGES for women and younger older adults. However, men aged 75 years or older were reported to have weakened their relationships with relatives in ELSA. This is one of the reasons that no significant interaction was observed between JAGES and ELSA in this sex and age group. Furthermore, ELSA shows an increasing trend in social isolation scores only in this group. We propose that this group might be a priority target population in the UK's social isolation measures.

Among women, significant interactions were observed in all analyses, including sensitivity analyses. Although social isolation has become more severe in JAGES regardless of the age group, the mean score has leveled off among those aged 65–74 years and has even decreased among those 75 years and older in ELSA. In this older population, all five items were reduced by a few percentage points. This group might be a population likely to benefit from the multicomponent, multilayered measures for social isolation, which have been implemented in the UK, for instance, suggested by the *Jo Cox Commission on Loneliness* (2017) and the previously mentioned policy paper (HM Government, 2018). Although the first annual report on tackling loneliness (HM Government, 2020) indicated 60 strategy commitments and a few case studies, it does not yet include a quantitative assessment. In spite of loneliness was emphasized in the titles of these documents (HM Government, 2020; *Jo Cox Commission on Loneliness*, 2017), they also described several measures against social isolation.

In considering measures to prevent social isolation, while improving the quality of social interaction with family and relatives is helpful, the size of such networks is likely to be exhaustive and increase of the

network size could be impractical at older age. On the other hand, it is expected that the approach of increasing social participation, which could be the best modifiable factor. According to a previous municipality-level ecological study (Watanabe et al., 2019), participation in sports groups and volunteer activities among older adults living in Japan has increased by approximately 2%–6% between 2010 and 2016. Furthermore, it was confirmed that the proportion of older adults with depressive symptoms decreased in municipalities in which participation in sports and hobby groups had increased (Watanabe et al., 2019). According to a report investigating the characteristics of older sports group participants (Yamakita, Kanamori, & Kondo, 2015), there were many people who participated in socially organized groups such as hobbies and volunteers, the number of friends and the frequency of meeting them became larger, and social support also became enriched. Therefore, further promotion of social participation could be a realistic measure for social isolation with high priority in Japan. As a result, the exchange with friends and acquaintances will also be accelerated, which may bring an advance effect on preventing social isolation among older adults. There is a movement to introduce the social prescribing framework, which is being institutionalized in the UK National Health Service, in Japan (Nishioka & Kondo, 2020). Social prescribing is a way for local agencies to refer people to a link worker who connects people to community groups and statutory services for practical and emotional support (NHS England, 2020).

The strength of this study was to compare the trends in social isolation among older adults using data from a large cohort in Japan and from a nationally representative sample in England. This might allow us to obtain results with highly internal validity. However, there were several limitations. First, we cannot discuss external validity or generalizability. Because social isolation is strongly influenced by the social background and context of each country, it is not clear whether the results of this study also apply to other Asian and European countries. In the future, collecting data from several countries will reveal common or different features in these regions. Second, there might be several biases resulting from differences in survey design. ELSA mainly conducted interviews on nationally representative samples, whereas JAGES



conducted mail surveys on non-nationally representative samples. Third, the questions and options in the JAGES and ELSA were not exactly the same, nor were they strictly authorized through procedures such as reverse translation and confirming reliability and validity. Furthermore, there is no denying that the meaning and definition of the term “friend” may differ depending on the culture of the country. However, we believe these biases and limitations would not explain all of the differences in our results. It is meaningful to describe the trend of social isolation among older adults with a cross-national comparison with the same framework.

## 5. Conclusion

Social isolation among the older population was originally more serious in Japan than England, and the gap has widened in recent years, especially for women and younger older adults. Its cause, although the trend of maintenance and improvement was confirmed in England, was mainly attributed to the weakening relationships with relatives in Japan. Therefore, England must continue with the strategy it started in 2018 for addressing loneliness and social isolation. Likewise, Japan should also proactively promote initiatives that foster social participation and friendship.

## Financial support

This study was supported by JSPS (Japan Society for the Promotion of Science) KAKENHI (Grant Number: JP15H01972, JP16K16595, JP18KK0057, JP20K19534), Health and Labour Sciences Research Grants (H28-choju-Ippan-002, 19FA1012, 19FA2001), Japan Agency for Medical Research and Development (AMED) (JP17dk0110017, JP18dk0110027, JP18ls0110002, JP18le0110009, JP19dk0110034, JP19dk0110037, JP20dk0110034), Open Innovation Platform with Enterprises, Research Institute and Academia (OPERA, JPMJOP1831) from the Japan Science and Technology (JST), and a grant from Innovative Research Program on Suicide Countermeasures (1–4). The funding sources had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

## Author contributions

Conception and design: TT and MS; data collection: TT and KK; analysis, interpretation of the data, and writing the article: TT; critical revision of the article: MS, TI, JA, NC, SK, TN, KO, and KK. All authors read and approved the final manuscript.

## Declaration of Competing Interest

The authors reported no declarations of interest.

## References

Antonucci, T. C., & Akiyama, H. (1987). Social networks in adult life and a preliminary examination of the convoy model. *Journal of Gerontology*, *42*, 519–527.

Banks, J., Batty, G. D., Nazroo, J., Oskala, A., & Steptoe, A. (2018). *The Dynamics of ageing: Evidence from the English Longitudinal Study of Ageing 2002-2016 (Wave 8)*. Institute for Fiscal Studies Accessed 1 May 2020 [https://www.ifs.org.uk/uploads/ELSA\\_Wave\\_8\\_report.pdf](https://www.ifs.org.uk/uploads/ELSA_Wave_8_report.pdf).

Cabinet Office, Government of Japan. (2019). *Annual report on the ageing society FY 2019* [in Japanese].

Cohen, S. (2004). Social relationships and health. *The American Psychologist*, *59*, 676–684.

de Jong Gierveld, J., & Havens, B. (2004). Cross-national comparisons of social isolation and loneliness: Introduction and overview. *Canadian Journal on Aging*, *23*, 109–113.

Fakoya, O. A., McCorry, N. K., & Donnelly, M. (2020). Loneliness and social isolation interventions for older adults: A scoping review of reviews. *BMC Public Health*, *20*, 129.

Gurley, R. J., Lum, N., Sande, M., Lo, B., & Katz, M. H. (1996). Persons found in their homes helpless or dead. *The New England Journal of Medicine*, *334*, 1710–1716.

HM Government. (2018). *A connected society: A strategy for tackling loneliness – Laying the foundations for change*. <https://www.gov.uk/government/publications/a-connected-society-a-strategy-for-tackling-loneliness>.

HM Government. (2020). *Loneliness annual report January 2020*. <https://www.gov.uk/government/publications/loneliness-annual-report-the-first-year>.

Holt-Lunstad, J., Smith, T. B., Baker, M., Harris, T., & Stephenson, D. (2015). Loneliness and social isolation as risk factors for mortality: A meta-analytic review. *Perspectives on Psychological Science: A Journal of the Association for Psychological Science*, *10*, 227–237.

Holt-Lunstad, J., Smith, T. B., & Layton, J. B. (2010). Social relationships and mortality risk: A meta-analytic review. *PLoS Medicine*, *7*, Article e1000316.

Ilfie, S., Kharicha, K., Harari, D., Swift, C., Gillmann, G., & Stuck, A. E. (2007). Health risk appraisal in older people 2: The implications for clinicians and commissioners of social isolation risk in older people. *The British Journal of General Practice: the Journal of the Royal College of General Practitioners*, *57*, 277–282.

Jo Cox Commission on Loneliness. (2017). *Combating loneliness one conversation at a time: A call to action* Accessed 1 May 2020 <https://www.redcross.org.uk/-/media/documents/about-us/combating-loneliness-one-conversation-at-a-time.pdf>.

Kakiuchi, Y., Nagao, R., Ochiai, E., Kakimoto, Y., & Osawa, M. (2019). A descriptive study of solitary death in Yokohama City. *Environmental Health and Preventive Medicine*, *24*, 12.

Kondo, K. (2016). Progress in aging epidemiology in Japan: The JAGES project. *Journal of Epidemiology*, *26*, 331–336.

Kondo, K., Rosenberg, M., & World Health Organization. (2018). *Advancing universal health coverage through knowledge translation for healthy ageing: Lessons learnt from the Japan gerontological evaluation study*. <https://apps.who.int/iris/handle/10665/279010>.

Landeiro, F., Barrows, P., Nuttall Musson, E., Gray, A. M., & Leal, J. (2017). Reducing social isolation and loneliness in older people: A systematic review protocol. *BMJ Open*, *7*, Article e013778.

Mehrabian, F., & Beland, F. (2020). Effects of social isolation, loneliness and frailty on health outcomes and their possible mediators and moderators in community-dwelling older adults: A scoping review. *Archives of Gerontology and Geriatrics*, *90*, Article 104119.

Ministry of Health, Labour and Welfare. (2019). *Comprehensive survey of living conditions 2018* [in Japanese].

National Institute of Population and Social Security Research. (2017). *6. nuptiality, population statistics of Japan 2017* [in Japanese].

NHS England. (2020). *Social prescribing* Accessed 1 Aug 2020 <https://www.england.nhs.uk/personalisedcare/social-prescribing/>.

Nishioka, D., & Kondo, N. (2020). A literature review of social prescribing: Implementation challenges and opportunities in Japan. *Iryo To Shakai*, *29*, 527–544 [in Japanese].

OECD. (2005). *Society at a glance 2005*. [https://doi.org/10.1787/soc\\_glance-2005-en](https://doi.org/10.1787/soc_glance-2005-en) Accessed 1 May 2020.

Office for National Statistics. (2019). *Families and households in the UK: 2019*.

Petersen, N., Konig, H. H., & Hajek, A. (2020). The link between falls, social isolation and loneliness: A systematic review. *Archives of Gerontology and Geriatrics*, *88*, Article 104020.

Shankar, A., McMunn, A., Banks, J., & Steptoe, A. (2011). Loneliness, social isolation, and behavioral and biological health indicators in older adults. *Health Psychology: Official Journal of the Division of Health Psychology, American Psychological Association*, *30*, 377–385.

Steptoe, A., Breeze, E., Banks, J., & Nazroo, J. (2013). Cohort profile: The English longitudinal study of ageing. *International Journal of Epidemiology*, *42*, 1640–1648.

Steptoe, A., Shankar, A., Demakakos, P., & Wardle, J. (2013). Social isolation, loneliness, and all-cause mortality in older men and women. *Proc. Natl. Acad. Sci. U. S. A.*, *110*, 5797–5801.

Watanabe, R., Kondo, K., Saito, T., Tsuji, T., Hayashi, T., Ikeda, T., et al. (2019). Change in municipality-level health-related social capital and depressive symptoms: Ecological and 5-year repeated cross-sectional study from the JAGES. *International Journal of Environmental Research and Public Health*, *16*, 2038.

Yamakita, M., Kanamori, S., Kondo, N., & Kondo, K. (2015). Correlates of regular participation in sports groups among Japanese older adults: JAGES cross-sectional study. *PLoS One*, *10*, Article e0141638.