



# Childhood socioeconomic status and social integration in later life: Results of the Japan Gerontological Evaluation Study

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## ARTICLE INFO

### Keywords:

social integration  
subjective socioeconomic status  
childhood circumstances  
life course  
Japan

## ABSTRACT

Older people's social integration is important for their health and well-being. However, few studies have investigated the determinants of older adults' social integration through childhood socioeconomic status (SES). This study investigated the association between childhood SES and each aspect of social integration among Japanese older people. We used data from the Japan Gerontological Evaluation Study 2010, a self-reported survey of 23,320 functionally independent people aged 65 or older across Japan (response rate: 66.3%). Childhood SES was assessed based on respondents' subjective assessment of their SES at the age of 15. Social integration was identified as participation in community groups, social networks, being homebound, and being married. We used Poisson regression analysis with robust variance to investigate the association between childhood SES and each social integration measurement, adjusted for potential mediators; namely, adult sociodemographic characteristics, health status, health behavior (smoking), living status, and personality. Lower childhood SES had long-lasting impact on the social integration of this older Japanese cohort. In the fully adjusted model, older people with lower childhood SES were less likely to participate in community groups (Non-membership sports group or club, adjusted prevalence ratio [APR]: 1.03, 95% confidence interval [CI]: 1.00–1.06; (Non-membership hobby group, APR: 1.04; 95% CI: 1.00–1.09), almost never met friends (APR: 1.17, 95% CI: 1.11–1.24), had a smaller social network (APR: 1.13; 95% CI: 1.08–1.19), and were more likely to be homebound (APR: 1.24; 95% CI: 1.05–1.45) than those with high childhood SES. Lower childhood SES negatively affected social integration in older age. Mitigating childhood poverty might be important to increase social integration in later life, thereby improving health outcomes.

## 1. Introduction

In the context of issues that involve inequality, social integration is part of the international agenda. Social integration has been reported as having a powerful impact on health (Berkman et al., 2000) via reinforcement of meaningful social roles and attachment and via facilitating access to resources and material goods through social networks (Berkman, 1995; Cohen, 2004). In this study, social integration was broadly defined as “the concrete involvement of individual with various aspects of a collectivity” (Michael et al., 2001; Moen et al., 1989).

Social integration has also been expressed using other terms such as “networks,” “social ties,” and “social inclusion” (Berkman et al., 2000; Seeman, 1996), although the basic concept is consistent. Having close

friends and relatives, being married, and affiliation with or membership in a voluntary association are measures of social integration (House et al., 1988). There is considerable evidence that a lack of social integration leads to poor health (Berkman & Syme, 1979; Holt-Lunstad et al., 2010; Reynolds & Kaplan, 1990). There is also accumulating research that childhood circumstances have long-term effects and influence old adults' health status (Landös et al., 2019; Tani et al., 2016). For example, a previous study conducted in the Netherlands reported that older adults who had low socioeconomic status (SES) in childhood are more likely to have experienced childhood maltreatment (Cuijpers et al., 2011). Further, another study, conducted in the US, showed that people who had experienced maltreatment developed an inability to trust others (Pepin & Banyard, 2006). This characteristic is associated

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with lower levels of social integration. Moreover, based on attachment theory (Bowlby, 1969, 1973, 1980), low childhood SES may be associated with poor social networking skills.

Furthermore, research conducted in the Netherlands in 1992 using face-to-face interviews with 2,285 married older adults found that participants who had lower SES in childhood had smaller networks than those who had higher SES in childhood (Van Groenou & Van Tilburg, 2003). Another longitudinal study, conducted in England, Wales, and Scotland, considered parental education levels or father's social class and found that childhood SES was a significant predictor of who would actively participate in sports activities in middle age (Kuh & Cooper, 1992). Further, persons who experienced childhood poverty have lower sports activity in old age, but greater education is associated with enhanced participation rates (Yamakita et al., 2020). Nevertheless, further research is needed to establish the relationship between childhood SES and initiatives for social integration. Older generations in particular are likely to be vulnerable to decreased social ties due to reduced activity (Li & Zhang, 2015). Thus, social relationships are useful as a component of intervention programs for social integration and for motivating residents to become more active. However, the independent contribution of each social relationship factor to social integration remains unexplored (Zunzunegui et al., 2003). To examine the independent pathways of social integration, it is important to compare childhood circumstantial factor with each social relationship factor in old age, in the same analytical model (Kuiper et al., 2015; VanderWeele, 2017).

Currently in Japan, the lifelong unmarried rate and the number of single-person households are increasing (Ministry of Health Labour and Welfare, 2020); social isolation is thus becoming an urgent issue. Moreover, in Japan's super-aging society, there are concerns that the demand for public nursing care services will not be sufficiently met in the future due to a shortage of workers. Therefore, to strengthen social security services, taxes and social security fees are being raised while promoting the development of mutual support by local residents' networks (Ministry of Health). Furthermore, the Japanese government, following that of the UK, appointed a Minister of Loneliness in 2021, which further increased interest in social integration. If factors related to the social integration of the older population in Japan can be identified, this could provide a launching ground for more direct measures to address this gap.

Additionally, the relationship between childhood circumstances and social relationships among the older population has been studied primarily in Western societies, such as those of the US or the Netherlands, and circumstances may differ in other cultures, such as Japan. For example, more than 80% of Japanese people claim that they do not adhere to any personal religion, thus signifying that the connotations of religious involvement differ between Japanese and many Western societies (Earhart, 1974). According to the World Values Survey (2017–2021), East Asia is relatively less likely than Western countries to say that religion is important in their lives. For example, Japan has 14.5%, China 13%, the U.S. 60.7%, the U.K. 37%, and the Netherlands 30.3% for the sum of "very important" and "somewhat important" affirmation of religious importance (Haerpfer et al., 2020). Additionally, using data from 53 countries, the study found that religion is a factor that promotes social activity (Ruiter & De Graaf, 2006), which suggests that religion enhances social integration. To the best of our knowledge, few studies have investigated the association between childhood SES and its long-term impact on each type of social tie, particularly on social bonding. Childhood disadvantage may underlie low social integration in old age, which may act as one of the mechanisms of social determinants of health. Accordingly, we assessed the impact of low childhood SES on social integration in older life, mediated by factors such as adulthood socio-economic status, health behavior (smoking), living status, and interpersonal trust, utilizing large-scale data from the Japan Gerontological Evaluation Survey (JAGES), which contains in-depth information about social relationships in old age.

## 2. Methods

### 2.1. Study population

We analyzed data from the JAGES project, a large-scale survey of Japanese adults aged 65 years and older, that aims to develop scientific evidence-based policy for long-term preventive care. People eligible to receive long-term public care insurance were excluded. The survey targets were cognitively and physically independent people aged 65 years or older who were residents of the community, without certified long-term care service needs. In the 2010 wave, questionnaires were distributed to community-dwelling older adults from 28 municipalities. The survey was conducted from August 2010 to January 2012. A total of 169,215 participants were enrolled from a list of 28 municipalities in 12 of Japan's 47 prefectures. In 15 municipalities with small population sizes (less than 5,000), the questionnaires were mailed to all the participants. In the other 13 municipalities, with large population sizes (more than 5,000), the participants were selected by random sampling method using population registers obtained from municipal authorities, and the questionnaires were mailed to those eligible.

The total number of questionnaires returned was 112,123 (66.3% response rate). The questionnaire included basic questions to be answered by all respondents, and five separate modules were randomly assigned to the participants, each module to about 20%. One of these modules, which included a topic assessing childhood SES, was used in this study ( $n = 23,320$ ).

After excluding those who answered that they were limited in engaging in daily life activities, which include walking, bathing themselves, or using a toilet without assistance and those who did not respond ( $n = 1,009$ ), and participants who did not provide a response to the question related to childhood SES ( $n = 1,307$ ), the analytic sample became 21,004 (men: 9,734, women: 11,270) (Supplement Fig. 1). The study protocol for the JAGES project was approved by the Nihon Fukushi University Ethics Committee (No. 10–05). The University of Tokyo Institutional Review Board (No. 10555) approved our use of the data. Written informed consent was obtained from all participants when they returned the questionnaire.

### 2.2. Assessment of social integration

We defined six types of social integration using frameworks such as the Berkman–Syme Social Network Index (Berkman & Syme, 1979), which is based on four dimensions of social relationships and affiliations: membership in a community association, church group membership, sociability, and marital status. The index has been used in leading research on the relationship between social engagement and mortality and is currently used in numerous studies in epidemiology and sociology. From among the index items, we excluded church members because of differences in religious beliefs in Japan and the US; we used the index of homeboundness, which is related to physical, psychological, and social factors and has become a serious public health issue (Nicholson, 2012).

Given the above, our measure of social integration consisted of six types: (1) sports group membership; (2) hobby group membership; (3) social network contact; (4) social network size; (5) homeboundness; and (6) ties with a spouse. To assess membership in a sports group/hobby group, the questionnaire asked, "Are you a member of the following organizations?" Sports group/hobby group membership was defined by the frequency of group engagement: membership (4 or more times a week, 2 or 3 times a week, once a week, and 1 to 3 times a month) versus non-membership (a few times a year, and never). Social network contact was assessed by frequency of contacts with friends and acquaintances, namely, "How often do you see your friends?" We defined frequency as follows: high network contact (4 or more times a week, 2 or 3 times a week, and once a week), versus low (1–3 times a month, a few times a year, and rarely). Social network size was measured by asking about the

number of friends and acquaintances met with in the past month (counting the same person once, no matter how many times the respondent had seen that person), categorized as follows: large network size (6–9, and 10 or more) versus small network size (none, 1 to 2, and 3 to 5). Being homebound was defined as leaving one's home less than once a week (Kawamura et al., 2005; Murayama et al., 2012); it often implies being socially isolated, with associated decreases in social support, declining health status (Pilisuk & Minkler, 1980), and lacking the necessary resources or knowledge of their condition to actively seek out assessments from primary care providers (Nicholson, 2012). Finally, ties with a spouse were assessed using a dichotomous variable: currently married versus currently not married (Berkman & Syme, 1979; Sarma et al., 2018). All variables were binary, set to "1" to define low social involvement and "0" to define high social involvement in the regression model.

### 2.3. Childhood socioeconomic status (SES)

To define SES in childhood, we used the retrospective subjective social status report. We asked participants: "What was your standard of living when you were 15 years old as seen by the general public?" Responses were quantified using a five-point Likert scale as follows: high, middle-high, middle, middle-low, and low. We then classified childhood SES into three categories: those who answered "high" and "middle-high" were considered to have had high SES in childhood; those who answered "middle class" were considered to have had middle-level SES in childhood, and those who answered "lower middle class" and "lower class" were considered to have had low SES in childhood (Fujiwara et al., 2013).

### 2.4. Covariates

As potential mediators of the association between childhood SES and social integration in old age, we included sex, age, educational attainment, equivalent annual household income, working status, health behavior, health status, living status, and tendency to trust other people. Age was grouped into 5 categories: 65–69 years, 70–74 years, 75–79 years, 80–84 years, and 85 years or over. Educational attainment was classified into three categories: less than 9 years, 10–12 years, and more than 13 years. Income was measured using 15 categories of pretax annual household income, including pensions. To calculate equivalent income; namely household income adjusted for family size, we divided the median of each category by the square root of the household members and categorized values into three groups: low (less than 2 million yen), middle (2–3.99 million yen), and high (4 million yen or higher). Working status was categorized into three groups: working, retired from job, or never had a job. Health behavior included smoking status (never, ex-smoker, current smoker) and health status included current medical treatment (receiving some treatment or not receiving any treatment). The respondents were also asked if they were currently living with their children, thereby creating a binary variable. Regarding living situation with children, the "no" response automatically includes those without children. Trust in others is an important concept in terms of having interactions with people or the community and plays an important role in our involvement in social relationships and systems (Jasielska et al., 2019; Putnam, 2000; Yamagishi & Yamagishi, 1994). The question related to trust was, "Generally speaking, would you say that people living in your area can be trusted?" We grouped responses into two groups: high degree of trust (very/moderately) and low degree of trust (neutral/slightly/not at all). Non-responses for sex and age were filled in from the municipal directory. All other missing responses were classified into the missing category for each item in the analysis.

### 2.5. Statistical analysis

We used Poisson regression analysis with robust variance to examine

relative risk without the use of an offset term for the association between subjective SES during childhood and each social integration measurement, adjusting for factors such as sex, age, education, equivalent income, working status, health behavior, health status, living status, and tendency to trust other people. Given the relatively high prevalence of social integration indicators (>10%), which would be overestimated by logistic regression analysis (McNutt et al., 2003; Barros & Hirakata, 2003; Zhang & Kai, 1998), Poisson regression analysis was employed as a robust variance estimator. To capture the individual effects of childhood SES, Model 1 comprised univariate analysis of SES in childhood. In Model 2, we adjusted the first model for the potential confounders of sex and age. In Model 3, we additionally adjusted for adult SES (equivalized household income, educational attainment, and employment status) as potential mediators. Model 4 was also adjusted for adulthood health behavior (smoking), health status, and living status with children as another mediator, because previous studies suggest that childhood socioeconomic conditions partially determine adult conditions and that adult socioeconomic conditions mediate the association between childhood socioeconomic conditions and health outcomes (Power et al., 2005). Model 5 (the full model) was additionally adjusted for trust in other people. Missing responses regarding socioeconomic covariates were included as dummy variables. Additionally, we examined, as a sensitivity analysis, whether the association between childhood SES and SI differed between the cases of pre-war and post-war births, that is, whether it differed by social circumstances. There were severe circumstances such as food shortages and poverty in Japan during and immediately after the Second Sino-Japanese War/World War II (1937–1945) (Yoshimura et al., 2005). In addition, we conducted a sensitivity analysis with the cutoff setting for social inclusion narrowed. In particular, non-membership in sports and hobbies was limited to "never," low network contact was defined as "a few times a year" and "rarely," and low network contact was defined as "a few times a year" and "rarely". Small social network size was set to "none" and "1 to 2 (Supplementary Tables 3-1 and 3-2). All analyses were conducted with STATA version 14.2 (Stata-Corp LP, College Station, Texas, USA).

## 3. Results

Of the study participants, 46.3% were male and 53.7% were female. The mean age was 73.8 years (standard deviation 6.132, ranging from 65 to 101 years). Table 1a and Table 1b summarize characteristics of outcomes measures and demographic characteristics of the study participants, respectively, by level of childhood SES. The distribution of respondents was as follows: low childhood-SES 9,230 (43.9%), middle childhood-SES 8,895 (42.4%), and high childhood-SES 2,879 (13.7%). For every outcome items except unmarried, the lower the SES in childhood, the larger the proportion of lower social integration. Individuals with low childhood SES tended to be less socially integrated (non-membership, low network contact, small network) than those with high childhood SES. Those with lower childhood SES had a lower socioeconomic background (years of schooling, equivalent household income) than individuals who were not, though there were no such differences in working status.

Table 2 shows the prevalence ratio (PR) of social integration according to childhood SES, using Poisson regression. Overall, older people with low childhood SES were less likely to participate in social activities than those with high childhood SES. For example, in the null model (Model1), those with low childhood SES were 1.259 times more likely to have low social network contact compared to older people with high childhood SES (Table 2, Model 1; 95% CI: 1.19–1.32), and 1.181 times more likely when further adjusted for sex and age (Table 2, Model 2; 95%CI:1.12–1.25). After mediation with adult SES (educational attainment, household income, employment status), the significant association remained. The PR for non-membership sports group, non-membership hobby group, low network contact, small network size, and the homebound were 1.035 (95% CI: 1.01–1.06), 1.053 (95% CI:

**Table 1a**  
Outcome Measure for this Study.

	Total		High		Middle		Low	
	(n = 21,004)		(n = 2,879)		(n = 8,895)		(n = 9,230)	
	n	%	n	%	n	%	n	%
Participation of sports group or club								
Non-membership	13,011	62.0	1,679	58.3	5,438	61.1	5,894	63.9
Membership	3,898	18.6	613	21.3	1,740	19.6	1,545	16.7
Missing	4,095	19.5	587	20.4	1,717	19.3	1,791	19.4
Participation of hobby group								
Non-membership	10,927	52.0	1,363	47.3	4,529	50.9	5,035	54.6
Membership	6,442	30.7	1,032	35.9	2,840	31.9	2,570	27.8
Missing	3,635	17.3	484	16.8	1,526	17.2	1,625	17.6
Social network contact								
Low	8,657	41.2	1,027	35.7	3,463	38.9	4,167	45.2
High	10,913	52.0	1,647	57.2	4,818	54.2	4,448	48.2
Missing	1,434	6.8	205	7.1	614	6.9	615	6.7
Social network size								
0-5	9,351	44.5	1,117	38.8	3,808	42.8	4,426	48.0
6 ≤	10,052	47.9	1,561	54.2	4,401	49.5	4,090	44.3
Missing	1,601	7.6	201	7.0	686	7.7	714	7.7
Homebound								
Homebound	1,543	7.4	189	6.6	642	7.2	712	7.7
Not homebound	18,346	87.4	2,537	88.1	7,759	87.2	8,050	87.2
Missing	1,115	5.3	153	5.3	494	5.6	468	5.1
Marital status								
Unmarried	5,800	27.6	938	32.6	2,472	27.8	2,390	25.9
Married	14,885	70.9	1,898	65.9	6,281	70.6	6,706	72.7
Missing	319	1.5	43	1.5	142	1.6	134	1.5

1.01–1.09), 1.189 (95% CI: 1.13–1.26), 1.144 (95% CI: 1.09–1.20), and 1.260 (95% CI: 1.07–1.48), respectively, among those with low SES in childhood (Table 2, Model 3). A further control for smoking, disease status, and living status with children in model 3 showed little shift in PR values for the childhood low SES group and remained statistically significant (Table 2, Model 4). Finally, the association between low childhood SES and low social network contact was significant after adjusting for age and sex, adult SES, health status, living status with children and trust (Model 5: PR: 1.171, 95% CI: 1.11–1.24). Regarding social integration in Model 5, the adjusted PRs were 1.030 (95% CI: 1.00–1.06) for non-membership sports group, 1.044 (95% CI: 1.00–1.09) for non-membership in a hobby group, and 1.13 (95% CI: 1.08–1.19) for small social network size. Being homebound increased the low social integration risk (Model 5: PR: 1.238, 95% CI: 1.05–1.45). Interestingly, the adjusted PR for middle-level childhood SES among unmarried participants was 0.93 compared with that for high childhood SES (95% CI: 0.89–0.99; Table 2, Model 5).

We also conducted an age-stratified analysis to examine differences by historical background (i.e., whether the childhood was spent during wartime). As a result, we found that childhood SES in the old-old group was no longer significantly related to each social integration indicator. Yet, the relationships persisted for the young-old group (Low Social network contact, small social network size, homebound) and the value of PR was larger compared with the old-old group or overall (Supplement Tables 1 and 2). For example, the PR of low childhood SES for homebound was 1.464 (95% CI: 1.07–2.00) in comparison with high childhood SES (Supplement Table 1, Model 5). PR for the analysis with stringent criteria for explanatory variables is shown in Supplement Table 3-2, and descriptive statistics are listed in Supplement Table 3-1.

#### 4. Discussion

Using a large population-based study, we found that low childhood SES was significantly associated with low social integration in later life among older adults in Japan. Our findings were consistent across all social integration types. Even when various confounding and mediating factors (sex, age, adult SES, health behavior (smoking), health status, living status, and trust) were removed, low childhood SES still had a

long-lasting effect in old age.

Several plausible pathways may explain this association. First, there may be a long-term negative effect of low childhood SES. For instance, education is an important determinant of the course of life, related to subsequent income, employment, and social networks (Byhoff et al., 2017). The circumstances that characterize low childhood SES may have limited participants' opportunities to gain education or employment (Luo & Waite, 2005) due to various types of childhood deprivation (in terms of opportunities, materials, or services). Additionally, limited income, time, and materials may have prevented them from participating in social relationships and activities. Alternatively, low childhood SES may have led to a lack of role models for social participation or networking. Van Groenou and Van Tilburg (2003) reported that people with low childhood SES and low adulthood SES had small social networks and received less support from non-family members, while people with low childhood SES but high adulthood SES had a large network of non-family members. This suggests that low lifetime SES decreases the benefit of social integration. That is, children from low SES families—who grew up in circumstances in which family members might have been involved in small social networks—emulated their parents' behavior when they reached old age.

Adjusting for all mediators and for general trust in others, the PR value decreased and the association between SES in childhood and social integration in old age persisted. This may be because loss of attachment in childhood, such as lack of interaction with one's parents during childhood, may be a contributing factor in one's ability to build and maintain interpersonal relationships (Bowlby, 1969, 1973, 1980). Such lack of attachment, in terms of reduced warmth, inconsistent supervision and discipline, and harsh punishment, may be more common in lower SES household as a result of poverty, income loss, and a parent's job loss (McLeod & Shanahan, 1993). A lack of financial resources may cause low SES children to face difficulties in developing non-cognitive skills such as social skills and literacy that are vital in building relationships (Heckman, 2006). Such early under-development in this regard therefore persists even long into the future.

A stratified analysis showed that the results for the younger and older age groups differed. The young-old people, that is, the 65–69 and 70–74 age groups, lived through the end of World War II when they were 0–4

**Table 1b**  
Characteristics of older Japanese participants by childhood SES (N = 21,004).

	Total (n = 21,044)		High (n = 2,879)		Middle (n = 8,895)		Low (n = 9,230)	
	n	%	n	%	n	%	n	%
Sex								
Men	9,734	46.3	937	32.6	3,740	42.1	5,057	54.8
Women	11,270	53.7	1,942	67.5	5,155	58.0	4,173	45.2
Age(years)								
65-69	6,287	29.9	727	25.3	2,631	29.6	2,929	31.7
70-74	6,108	29.1	827	28.7	2,495	28.1	2,786	30.2
75-79	4,605	21.9	633	22.0	2,012	22.6	1,960	21.2
80-84	2,701	12.9	467	16.2	1,171	13.2	1,063	11.5
85 $\leq$	1,303	6.2	225	7.8	586	6.6	492	5.3
Educational attainment (years)								
$\leq 9$	9,747	46.4	719	25.0	3,690	41.5	5,338	57.8
10-12	7,274	34.6	1,197	41.6	3,422	38.5	2,655	28.8
13 $\leq$	3,536	16.8	885	30.7	1,589	17.9	1,062	11.5
Other/Missing	447	2.1	78	2.7	194	2.2	175	1.9
Equalized household income(million yen)								
Low (<2.00)	8,580	40.9	972	33.8	3,389	38.1	4,219	45.7
Middle (2.00-3.99)	6,720	32.0	952	33.1	2,918	32.8	2,850	30.9
High ( $\geq 4.00$ )	1,988	9.5	439	15.3	903	10.2	646	7.0
Missing	3,716	17.7	516	17.9	1,685	18.9	1,515	16.4
Employment status								
Working	4,363	20.8	604	21.0	1,807	20.3	1,952	21.2
Retirement	11,662	55.5	1,412	49.0	4,851	54.5	5,399	58.5
Never had a job	2,439	11.6	503	17.5	1,084	12.2	852	9.2
Missing	2,540	12.1	360	12.5	1,153	13.0	1,027	11.1
Smoking status								
Never	11,335	54.0	1,770	61.5	5,101	57.4	4,464	48.4
Ex-smoker	5,516	26.3	573	19.9	2,075	23.3	2,868	31.1
Current smoker	2,102	10.0	241	8.4	790	8.9	1,071	11.6
Missing	2,051	9.8	295	10.3	929	10.4	827	9.0
Living status with children								
Yes	8,376	39.9	1,129	39.2	3,561	40.0	3,686	39.9
No	12,334	58.7	1,713	59.5	5,214	58.6	5,407	58.6
Missing	294	1.4	37	1.3	120	1.4	137	1.5
Disease status, currently in treatment								
Receiving some treatment	14,493	69.0	1,955	67.9	6,103	68.6	6,435	69.7
Not receiving any treatment	4,964	23.6	687	23.9	2,134	24.0	2,143	23.2
Missing	1,547	7.4	237	8.2	658	7.4	652	7.1
Trust in others								
Very or Moderately	14,344	68.3	2,037	70.8	6,271	70.5	6,036	65.4
Neutral, Slightly or Not at all	5,644	26.9	689	23.9	2,176	24.5	2,779	30.1
Missing	1,016	4.8	153	5.3	448	5.0	415	4.5

and 5–9 years old, respectively. They spent their childhood during and immediately after the war, in a period of severe food shortage. Therefore, they experienced more poverty and deprivation than the old-old generation, which may have been reflected in the results of this study. Studies have reported that those who experienced war and were undernourished during childhood had higher functional limitations (especially in intellectual activities and social roles) in old age (Fujiwara et al., 2013). This is consistent with our findings of childhood SES leading to future disadvantage.

Additionally, our findings are consistent with previous studies of childhood SES and social integration. Using data on the living arrangements and social networks of Dutch older adults, it was reported that older people with a low lifetime SES had smaller networks (Van Groenou & Van Tilburg, 2003). Furthermore, although limited to sports relations, in the Wisconsin Longitudinal Study, individuals from families with higher SES had higher levels of physical activity than those from a lower-SES family (Pudrovska & Anishkin, 2013). Our study contributes to this literature by showing that lower childhood SES circumstances lead to lower social integration in later life. To the best of our knowledge, this is the first study to show the long-term effects of low childhood SES not only on social networks and physical activities but also on multilateral social integration patterns in old age.

Middle-level childhood SES showed a protective effect among the unmarried. Further research would be needed to clarify why the results

for unmarried individuals differed from the other indicators. Perhaps, those with middle-level childhood SES may have benefited from the postwar modernization in a number of ways, such as 1) via the moderating effect on social inequality during a period of rapid economic growth (Katoh, 2011); 2) via the change in family structure from a feudalistic to a modern family system featuring small families and nuclear households; and 3) via changes to the institution of marriage (in particular the tendency to move from arranged marriages to autonomous marriages). It may be that Japanese people with middle-SES have found it easier to leave behind feudal structures than those with high-SES, and had wider choices with more freedom of choice than those with lower-SES, due to their economic structures.

Our study had several limitations. First, there may have been recall bias in the responses to questions about childhood SES because of the retrospective and cross-sectional study design. However, this design has been validated in previous studies (Krieger et al., 1998; Ward, 2011). Second, we used a subjective indicator of childhood SES rather than parental education and occupation as in previous studies (Pudrovska & Anishkin, 2013; Van Groenou & Van Tilburg, 2003). However, the conceptual validity of the subjective and objective indicators has been demonstrated (Demakakos et al., 2008; Sakurai et al., 2010). Third, related to the second point, we used only subjective socioeconomic status as a predictor of childhood SES, and did not account for other aspects of childhood adversity such as parental death or child abuse

**Table 2**  
Prevalence ratio of childhood SES and social integration using Poisson regression analysis.

		Model 1		Model 2		Model 3		Model 4		Model 5	
		PR	95%CI								
SES in childhood											
Non-membership sports group or club (N = 16,909)	Low	1.082***	1.05–1.11	1.085***	1.06–1.11	1.035*	1.01–1.06	1.030*	1.00–1.06	1.030*	1.00–1.06
	Middle	1.034*	1.01–1.06	1.036*	1.01–1.07	1.011	0.98–1.04	1.011	0.98–1.04	1.012	0.98–1.04
	High	ref									
Non-membership hobby group (N = 17,369)	Low	1.163***	1.12–1.21	1.134***	1.09–1.18	1.053*	1.01–1.09	1.051*	1.01–1.09	1.044*	1.00–1.09
	Middle	1.080***	1.03–1.12	1.069***	1.03–1.11	1.030	0.99–1.07	1.031	0.99–1.07	1.032	0.99–1.07
	High	ref									
Low Social network contact (N = 19,570)	Low	1.259***	1.19–1.32	1.181***	1.12–1.25	1.189***	1.13–1.26	1.187***	1.12–1.25	1.172***	1.11–1.24
	Middle	1.089**	1.03–1.15	1.060*	1.00–1.12	1.065*	1.01–1.12	1.065*	1.01–1.12	1.066*	1.01–1.12
	High	ref									
Small social network size (N = 19,403)	Low	1.246***	1.19–1.31	1.249***	1.19–1.31	1.144***	1.09–1.20	1.145***	1.09–1.20	1.130***	1.08–1.19
	Middle	1.112***	1.06–1.17	1.116***	1.06–1.17	1.066*	1.01–1.12	1.068**	1.02–1.12	1.069**	1.02–1.12
	High	ref									
Homebound (N = 19,889)	Low	1.172*	1.01–1.37	1.435***	1.23–1.67	1.260**	1.07–1.48	1.258**	1.07–1.48	1.238**	1.05–1.45
	Middle	1.102	0.94–1.29	1.215*	1.04–1.42	1.136	0.97–1.33	1.135	0.97–1.33	1.136	0.97–1.33
	High	ref									
Unmarried (N = 20,685)	Low	0.794***	0.75–0.85	1.066*	1.00–1.13	0.995	0.94–1.06	1.000	0.94–1.06	0.990	0.93–1.05
	Middle	0.854***	0.80–0.91	0.973	0.92–1.03	0.933*	0.89–0.99	0.938*	0.89–0.99	0.938*	0.89–0.99
	High	ref									

Note : SES = socioeconomic status, PR = prevalence ratio; 95% CI = 95% confidence interval; \*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001. Model 1: Univariate; Model 2: Model 1+age and sex; Model 3: Model 2+adult SES (education, normalized current household income, and working status); Model 4: Model 3+health behavior (smoking), disease status (currently in treatment), and living status with children; Model 5: Model 4+trust.

(Cuijpers et al., 2011). Fourth, our results may have been subject to self-selection bias, given the existence of non-respondents and a response rate of 66.3% (Fujiwara et al., 2013). Therefore, we may have either overestimated or underestimated the influence of childhood SES on social integration in older people. Fifth, this study focused on older people without activity limitations. People with activity limitations and those with low childhood SES background may have been less likely to answer the questionnaire. This suggests that our reported results may have underestimated the true underlying association.

In conclusion, our findings show that low childhood SES has long-term consequences for social integration in old age. Low childhood SES was associated with a significantly higher risk of social exclusion (isolation) in older age. This may indicate that fighting childhood poverty could improve social integration in later life. To address the social integration of older people, early childhood interventions are likely to be effective.

**Ethical approval**

The JAGES protocol was reviewed and approved by the Ethics Committee on Research of Human Subjects at Nihon Fukushi University (ApprovalNo 10-05).

**Funding**

This study used data from the Japan Gerontological Evaluation Study (JAGES), which was supported by JSPS(Japan Society for the Promotion of Science) KAKENHI Grant Numbers (JP15H01972), Health Labour Sciences Research Grants (H28-Choju-Ippan-002), Japan Agency for Medical Research and Development (AMED) (171s0110002, 181e0110009), the Research Funding for Longevity Sciences from National Center for Geriatrics and Gerontology (24-17, 24-23, 29-42, 30-30, 30-22, 20-19, 21-20); Open Innovation Platform with Enterprises, Research Institute and Academia (OPERA, JPMJOP1831) from the Japan Science and Technology (JST), World Health Organization Centre for Health Development (WHO Kobe Centre) (WHO APW 2017/713,981).

**Author contributions**

TA and TF conceived the design. KK, TF, and TA collected data. TA reviewed literature and performed all statistical analyses. TA wrote first draft of paper. KK, and TF edited the manuscript. All authors read, approved the final version of the manuscript. All co-authors have agreed to the submission the final version manuscript.

**Declaration of competing interest**

The authors have no competing interests to report.

**Acknowledgments**

The authors sincerely thank all JAGES project collaborators for practical comments and suggestions for this study. We are particularly grateful to the staff members in each study area, for conducting the survey. We would like to thank everyone who participated in the surveys.

**Appendix A. Supplementary data**

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ssmph.2022.101090>.

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