

Gender and age variations in the association between multigenerational cohabitation and self-rated health among middle-aged and older adults in Japan

Akane Nogimura^{1,2}, Takahiro Otani¹, Taiji Noguchi^{1,3},
Hiroko Nakagawa-Senda¹, Miki Watanabe⁴, Tamaki Yamada⁵
and Sadao Suzuki¹

¹Department of Public Health, Nagoya City University Graduate School of Medical Sciences, Nagoya, Japan

²Division of Psychiatry and Cognitive-Behavioral Medicine, Nagoya City University
Graduate School of Medical Sciences, Nagoya, Japan

³Department of Social Science, Research Institute, National Center for Geriatrics and Gerontology,
Obu, Japan

⁴Department of Educational Sciences, Lecture on Nursing Education, Faculty of Education,
Aichi University of Education, Kariya, Japan

⁵Okazaki Public Health Center, Okazaki Medical Association, Okazaki, Japan

ABSTRACT

Despite encouraging multi-generational cohabitation, the population of Japanese people living alone has increased. However, little is known about the association between health and multigenerational cohabitation. This study examined the relationship between self-rated health and living arrangements among Japanese adults using data from the Japan Multi-Institutional Collaborative Cohort Study (2013–2017). The analysis employed multivariate logistic regression to examine the associations. Our results showed no association between living arrangements and self-rated health when stratified by gender. Living alone was found to be associated with poor self-rated health among women aged 65 and above. A similar association may exist among men in the same age group. Among women aged < 65 years, two-generation cohabitation was associated with a good self-rated health, similar to those living alone. Among men aged < 65 years, neither living alone nor two-generation cohabitation was significantly associated with good self-rated health. We found no association between three- or plus-generation cohabitation and self-rated health. Therefore, our findings indicate associations between multigenerational cohabitation and self-rated health, but they vary by gender and age. Invested stakeholders in the public health field should consider the potential impact of living arrangements on health based on gender and age.

Keywords: health status, Japan, living arrangements, multi-generation cohabitation, self-rated health

Abbreviations:

CI: confidence interval

J-MICC: Japan Multi-Institutional Collaborative Cohort

OR: odds ratio

SRH: self-rated health

This is an Open Access article distributed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License. To view the details of this license, please visit (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Received: July 10, 2023; accepted: September 28, 2023

Corresponding Author: Sadao Suzuki, MD, PhD

Department of Public Health, Nagoya City University Graduate School of Medical Sciences, 1 Kawasumi,
Mizuho-cho, Mizuho-ku, Nagoya 467-8601, Japan

Tel: +81-52-853-8077, E-mail: sdsuzuki@med.nagoya-cu.ac.jp

INTRODUCTION

Living arrangements are defined by household composition or the number and identities of cohabitants. Households are key factors that determine individuals' social roles through social integration, social support, and interaction.¹ Generally, social support can improve health and buffer stress-related adverse effects.² However, social relationships in household living arrangements differ from other social setups. Although household members provide care, comfort, and intimacy, they also cause frustration and conflict.³ This may vary depending on the household composition, including multigenerational cohabitation, and the health effects could be complex, requiring a deeper understanding of the relationship between living arrangements and health.

Living arrangements differ based on culture and time. Studies have reported that individuals in East Asian countries are more inclined to live with others compared to their counterparts in European countries.⁴ However, the number of people living alone in Japan has increased in recent decades. In the 1980s, more than 40% of people in Japan lived with their spouses and children, but this had declined⁵ to 27.9% by 2020. In the traditional Japanese family system, three generations live together: older adult parents, their children and grandchildren.⁶ Nevertheless, the percentage of people living in this arrangement has decreased⁷ from 15.3% in 1986 to 5.9% in 2016, while the percentage of people living alone has increased^{5,8} from 19.6% in 1980 to 35.7% in 2020. In light of these changes, the Japanese government began encouraging three-generation cohabitations or close living in 2006 to promote cooperation regarding care provision between children and their older adult parents.⁹ Conversely, in Western countries, the prevalence of intergenerational cohabitation has always been low. Several studies have demonstrated the association between living arrangements and health and have reported that living with a spouse may reduce morbidity¹⁰ and improve mental health,^{11,12} whereas living alone is not beneficial for mental health.¹¹⁻¹⁴ Studies have also shown that people living with children are less likely to rate their health as poorly as those living alone.¹⁵ Although research has examined the health implications of living alone or with a spouse, few have focused on multigenerational cohabitation. Additionally, the association between living arrangements and health may vary by gender and age, but little is known. As living arrangements have changed rapidly across Japan, new evidence on the association between living arrangements, including multigenerational cohabitants, and health is needed.

Self-rated health (SRH), used in many epidemiological studies, has been suggested as a useful subjective measure of a person's overall health status. It is commonly used in epidemiological studies as a simple and cost-effective method to assess an individual's health status. Epidemiological studies have used SRH to predict mortality¹⁶⁻²¹ and morbidity.²²⁻²⁴ Previous studies have demonstrated SRH's validity and reliability.^{17,18,23,25} SRH has demonstrated a correlation with various physical conditions,²⁶⁻²⁸ and can be influenced socioeconomic status (SES), psychosocial factors, lifestyle, cultural background, age, and gender.^{21,29-31} Various researchers have suggested that the relationship between living arrangements and SRH reflects the culture and should not be ignored.^{15,32,33}

Accordingly, this study aimed to examine the association between living arrangements and SRH, focusing on multigenerational cohabitation and investigating differences by gender and age.

MATERIALS AND METHODS

Study population

This cross-sectional study was conducted as a part of the Japan Multi-Institutional Collabora-

tive Cohort (J-MICC) study which was initiated in 2005 with the aim of obtaining data for the prevention of lifestyle-related diseases.^{34,35} The present cross-sectional study enrolled 35–79 years Japanese adults who participated the study in the Okazaki area. The only exclusion criterion for this study was that the participants needed the cognitive and verbal abilities to answer the questionnaire without help. We collected data from 5,321 individuals (out of 7,580 invited to participate; response rate: 70.2%) who responded to the questionnaire between 2013 and 2017. We excluded participants who were under 45 years, those who provided an “other” response to the question about self-rated health, which was too small for data analysis, and those who did not answer items related to SRH, living arrangements, and all covariates. Our final sample comprised data from 4,347 respondents, including 2,362 respondents aged ≥ 65 years (valid response rate: 87.0%). All participants provided written informed consent, and the study protocol was approved by the Ethics Committee of Nagoya City University Graduate School of Medicine (approval no. 70-00-0058). This study was conducted in accordance with the guidelines of the Declaration of Helsinki.

Self-rated health

We assessed SRH by asking, “How do you rate your health in the last month?” and respondents could choose from the six options: “great,” “pretty good,” “rather good,” “not good,” “rather poor,” and “pretty poor.” For the analysis, we categorized those who answered “great,” “pretty good,” and “rather good” as having “good SRH,” and those who chose “not good,” “rather poor,” and “pretty poor” as having “poor SRH.”

Living arrangements

We categorized the participants’ living arrangements as follows: “living alone (living without family or roommates),” “living with spouse,” “two-generation household,” and “three or more generation household.” Two-generation cohabitation included (1) living with parents or in-laws and (2) living with children. Three-generation cohabitation included (1) living with a parent or parent-in-law and grandparent or grandparent-in-law, (2) living with a parent and child, or (3) living with a child and grandchild. We considered cohabitation of more than three generations similarly. In both cases, we did not distinguish between living with and without a spouse.

Covariates

We included these sociodemographic and health status data in the analyses as covariates: gender, age, marital status, employment status, educational attainment, need for home-based nursing care, and present illness(es) (ie, cancer, heart disease, and stroke). We used four age categories (45–54, 55–64, 65–74, and ≥ 75 years), three marital status categories (married, divorced or widowed, and never married), two employment status categories (employed and unemployed), and three educational attainment categories (<10, 10–12, or >12 years). We assessed the need for home-based nursing care and present illness (cancer, heart disease, or stroke). We selected these three diseases because they consistently rank among the top causes of death in Japan and have significant effects on health.⁸ Regarding the need for home-based nursing care and present illness, the respondents selected “yes” or “no” and “no illness” or “ill,” respectively. We assessed mental status³⁶ using the K6, and dichotomized the score³⁷ into ≥ 5 and < 5 .

Statistical analyses

All analyses were stratified by gender. First, we used descriptive statistics to summarize participants’ characteristics. Second, to examine the association between living arrangements and SRH, we used multivariate logistic regression analysis to calculate odds ratios (ORs) and 95%

confidence intervals (CIs) for poor SRH. We used two analytical models: crude and adjusted models, with covariates. For statistical analysis, we used the group living with a spouse as the reference group because many studies have shown that living with a spouse is associated with better health.^{15,16,38,39} Third, to examine differences by age group, we performed stratified analyses by age (< 65 and ≥ 65 years). The significance level for all analyses was set at $p < 0.05$. We used R, version 3.6.3 for Mac (<https://www.r-project.org>) for all statistical analyses.

RESULTS

Data from 2,472 males and 1,875 females were analyzed, and Table 1 presents the participants' characteristics. The mean age of participants was 65.7 years for males (standard deviation [SD], 9.1) and 61.8 years for females (SD, 9.0). Most participants lived with their spouses (38.9% for males and 31.8% for females) or in two-generation households (39.0% for males and 40.3% for females). In total, 16.7% of males and 19.1% of females lived in three-generation (or more) households. Living alone was the least common among participants (5.4% for males and 8.7% for females).

Table 1 Participants' characteristics (n = 4,347)

	Overall (n = 4,347)		Living arrangement								p-value
			Living alone (n = 297)		Living with spouse (n = 1,559)		Two-generation cohabitation (n = 1,721)		Three or more generation cohabitation (n = 770)		
	n	%	n	%	n	%	n	%	n	%	
Self-rated health											0.295
Good	3,506	80.7	238	80.1	1,275	81.8	1,365	79.3	628	81.6	
Poor	841	19.3	59	19.9	284	18.2	356	20.7	142	18.4	
Gender											<0.001
Men	2,472	56.9	133	44.8	962	61.7	965	56.1	412	53.5	
Women	1,875	43.1	164	55.2	597	38.3	756	43.9	358	46.5	
Age (years)											<0.001
45–54	855	19.7	42	14.1	118	7.6	518	30.1	177	23.0	
55–64	1,130	26.0	61	20.5	321	20.6	523	30.4	225	29.2	
65–74	1,869	43.0	137	46.1	891	57.2	557	32.4	284	36.9	
≥75	493	11.3	57	19.2	229	14.7	123	7.1	84	10.9	
Marital status											<0.001
Never married	146	3.4	75	25.2	4	0.3	61	3.5	6	0.8	
Married	3,731	85.8	32	10.8	1,547	99.2	1,467	85.2	685	89.0	
Widowed or divorced	470	10.8	190	64.0	8	0.5	193	11.2	79	10.3	

Employment status											<0.001
Unemployed	1,906	43.8	141	47.5	908	58.2	568	33.0	289	37.5	
Employed	2,441	56.2	156	52.5	651	41.8	1,153	67.0	481	62.5	
Educational attainment											<0.001
<10 years	529	12.2	52	17.5	193	12.4	176	10.2	108	14.0	
10–12 years	1,872	43.1	122	41.1	709	45.5	715	41.5	326	42.3	
>12 years	1,946	44.8	123	41.4	657	42.1	830	48.2	336	43.6	
Need home-based nursing care											<0.001
No	3,879	89.2	292	98.3	1,480	94.9	1,509	87.7	598	77.7	
Yes	468	10.8	5	1.7	79	5.1	212	12.3	172	22.3	
Illness											<0.001
No illness	3,520	81.0	239	80.5	1,191	76.4	1,468	85.3	622	80.8	
Ill	827	19.0	58	19.5	368	23.6	253	14.7	148	19.2	
K6											<0.001
<5	3,239	74.5	228	76.8	1,226	77.9	1,226	71.2	570	74.0	
≥5	1,108	25.5	69	23.2	344	22.1	495	28.8	200	26.0	

Table 2 shows the association between living arrangements and SRH based on multivariable logistic regression analysis by gender (all results are shown in Supplementary Tables 1a and 1b). In both men and women, neither living arrangement was significantly associated with poor SRH compared to living with a spouse (adjusted model, in men: living alone, OR [95% CI] = 1.23 [0.67, 2.24], $p = 0.496$; two-generation cohabitation, OR [95% CI] = 1.22 [0.94, 1.59], $p = 0.123$; three or more generation cohabitation: OR [95% CI] = 0.96 [0.69, 1.35], $p = 0.835$; in women: living alone, OR [95% CI] = 0.85 [0.49, 1.49], $p = 0.581$; two-generation cohabitation, OR [95% CI] = 0.88 [0.66, 1.18], $p = 0.409$; three or more generation cohabitation, OR [95% CI] = 0.85 [0.60, 1.20], $p = 0.357$).

Table 3 shows the results of the stratified analysis by age (all results are shown in Supplementary Tables 2a, 2b, 3a, and 3b). For men aged 65 years and older, neither living arrangement was significantly associated with poor SRH. However, for women, living alone was significantly associated with poor SRH (OR [95% CI] = 2.46 [1.03, 6.05], $p = 0.045$), whereas other living arrangements were not. For men aged < 65 years, living arrangements were not significantly associated with poor SRH. For women, compared with those living with a spouse, two-generation cohabitation was inversely associated with poor SRH (OR [95% CI] = 0.66 [0.45, 0.98], $p = 0.036$). Although not statistically significant, living alone was associated with good SRH (OR [95% CI] = 0.44 [0.18, 1.02], $p = 0.064$). Cohabitation of three or more generations was not significantly associated with good SRH.

Table 2 Odds ratios for poor self-rated health adjusted by living arrangements and covariates

Men									
	Crude				Adjusted				
	OR	95% CI		<i>p</i> -value	OR	95% CI		<i>p</i> -value	
Living arrangements									
Living with spouse	Reference				Reference				
Living alone	1.19	0.73	1.87	0.472	1.23	0.67	2.24	0.496	
Two-generation cohabitation	1.24	0.98	1.57	0.071 *	1.22	0.94	1.59	0.132	
Three or more generation cohabitation	0.98	0.71	1.33	0.890	0.96	0.69	1.35	0.834	
Women									
	Crude				Adjusted				
	OR	95% CI		<i>p</i> -value	OR	95% CI		<i>p</i> -value	
Living arrangements									
Living with spouse	Reference				Reference				
Living alone	0.97	0.63	1.47	0.881	0.85	0.49	1.49	0.581	
Two-generation cohabitation	1.06	0.82	1.37	0.675	0.88	0.66	1.18	0.409	
Three or more generation cohabitation	1.00	0.72	1.37	0.987	0.85	0.60	1.20	0.357	

OR: odds ratio

CI: confidence interval

Adjusted covariates: age, marital status, employment status, educational attainment, need for home-based nursing care, illness, and K6.

Table 3 Odds ratios of participants stratified by age for poor self-rated health adjusted by living arrangements and covariates

Over 65 years									
Men									
	Crude				Adjusted				
	OR	95% CI		<i>p</i> -value	OR	95% CI		<i>p</i> -value	
Living arrangements									
Living with spouse	Reference				Reference				
Living alone	1.68	0.962	2.83	0.061	1.83	0.82	4.04	0.136	
Two-generation cohabitation	1.15	0.85	1.56	0.367	1.19	0.85	1.65	0.303	
Three or more generation cohabitation	0.86	0.56	1.28	0.463	0.85	0.54	1.31	0.482	

Women								
	Crude				Adjusted			
	OR	95% CI		<i>p</i> -value	OR	95% CI		<i>p</i> -value
Living arrangements								
Living with spouse	Reference				Reference			
Living alone	1.21	0.70	2.04	0.486	2.46	1.03	6.05	0.045 *
Two-generation cohabitation	1.32	0.87	2.00	0.193	1.35	0.85	2.12	0.204
Three or more generation cohabitation	1.15	0.69	1.89	0.584	1.21	0.70	2.05	0.489
Under 65 years								
Men								
	Crude				Adjusted			
	OR	95% CI		<i>p</i> -value	OR	95% CI		<i>p</i> -value
Living arrangements								
Living with spouse	Reference				Reference			
Living alone	0.55	0.18	1.39	0.246	0.59	0.17	1.72	0.363
Two-generation cohabitation	1.34	0.87	2.11	0.206	1.31	0.83	2.12	0.264
Three or more generation cohabitation	1.15	0.67	1.99	0.610	1.15	0.65	2.04	0.639
Women								
	Crude				Adjusted			
	OR	95% CI		<i>p</i> -value	OR	95% CI		<i>p</i> -value
Living arrangements								
Living with spouse	Reference				Reference			
Living alone	0.76	0.36	1.53	0.465	0.44	0.18	1.02	0.064
Two-generation cohabitation	0.80	0.57	1.14	0.212	0.66	0.45	0.98	0.036 *
Three or more generation cohabitation	0.80	0.52	1.21	0.289	0.69	0.43	1.10	0.123

OR: odds ratio

CI: confidence interval

Adjusted covariates: age, marital status, employment status, educational attainment, need for home-based nursing care, illness, and K6.

DISCUSSION

This study examined the association between living arrangements and SRH. For men, no association was found between living arrangements and SRH in either the middle- or older-age groups. For women, living alone was associated with poor SRH among those aged 65 years and older, whereas it was inversely associated among those under 65 years of age. Additionally, among women aged < 65 years, two-generation cohabitation was inversely associated with poor SRH. Cohabitation among three or more generations was not associated with SRH in either age

group. Our findings indicate that the association between living arrangements and health may differ by gender and age, providing additional knowledge about the complexity of the roles of family and cohabitants in an individual's health.

The results of this study showed that, among those under 65 years of age, women living in two-generation cohabitation were likely to have a likelihood of better SRH. A previous study reported that middle-aged women in multigenerational cohabitation had less health anxiety, and among those women, cohabitation with parents was associated with healthy behaviors.⁴⁰ Our results were consistent with this idea. Although this study could not identify cohabitants of different generations because of the survey design, living with other people, such as parents or children other than spouses, might play a role in the household for women and improve their self-esteem. Additionally, emotional and social support from cohabitants has been suggested to contribute to health.⁴¹ This might be important in promoting health, especially for middle-aged women.

In this study, no significant association was found between three generation or more cohabitation and SRH among middle or older adults regardless of gender. This could be attributed to a lack of data, as detailed information about living arrangements, was not adequately surveyed. There are many forms of cohabitation involving three or more generations: living with parents or parents-in-law, grandparents or grandparents-in-law, living with parents and children, and living with children and grandchildren. The different compositions of cohabitants may have resulted in varying health effects. In a European cohort study, grandmothers caring for their grandchildren showed good SRH, whereas grandfathers did not.⁴² Studies have investigated the relationship between family structure and depression among older people and found that men had a lower risk of depression when living with their spouses but an increased risk of depression when living with their parents. Conversely, women had a lower risk of depression when living with their children or parents.¹¹ It is assumed that men are less likely to be cared for by their family members, which might be associated with poorer health. Previous studies have shown that the association between cohabitants and health is complex and may vary by gender. Additionally, each person's role in the family differs depending on culture, family situation, family structure, and individual characteristics, all of which may affect SRH.⁴³⁻⁴⁷ Therefore, further studies are needed with a detailed assessment of the type of cohabitants and family situations.

Our results indicated that older women living alone had higher odds of poor SRH, whereas middle-aged women living alone had a potentially positive association with SRH. Several studies on living arrangements have focused on the relationship between living alone and health; they have shown that living alone is a risk factor for poor health among older people,^{15,48} which is consistent with our results. The prevalence of older people living alone may be attributed to factors such as the family member loss through death or separation. In particular, the financial situation of older women living alone is often difficult and may lead to health loss. In contrast, among middle-aged women, living alone was inversely associated with poor SRH. These findings contradict prior evidence that living alone is associated with worse overall health⁴⁵ and lower psychological well-being.⁴⁹ Younger individuals may choose to live alone due to contemporary trends, including delayed or absence of marriage, divorce, and evolving attitudes toward traditional family structures.⁵⁰ For example, Japanese society once held a prevalent social prejudice against single adults and pressured people—especially women—to marry, but this prejudice has waned over time.⁵¹ Alternatively, who opt for living alone, either to assert their independence or due to favorable economic circumstances, may experience better health compared to those living under multigenerational cohabitation. This could be even more true for younger people, who have fewer health concerns than older generations.⁵² Furthermore, women who live alone tend to lead healthier lives and have a lower mortality rate than men,⁵³ even after adjusting for marital

status.⁵⁴ However, they might decide to live with others as they age or develop health issues.

For men, there was no significant association between living arrangements and health, although living alone was marginally associated with poor SRH. The association between living arrangements and SRH differed according to gender and age. Some studies have suggested that caring for a family and having social support might significantly affect women's health compared to men's.⁵⁵ The link between living arrangements and health might be more apparent financially unstable women with diverse household roles than for men. However, as with women, the association may vary depending on the type of cohabitant and family situation; therefore, further research based on detailed surveys is needed.

This study has some limitations. First, the data did not allow for the differentiation between the different types of three-generation cohabitation. We could not verify whether participants who reported living with their parents or children lived with them. Future research should focus on more detailed family structure when surveying. Second, our data does not examine the financial status of individuals. Considering that financial status can influence both health outcomes and decisions regarding living arrangements, unadjusted economic status could have served as a potential confounding factor in our study. Therefore, future studies should include SES data. Third, our cross-sectional design did not allow us to examine causality, which failed to indicate an association between living arrangements and long-term health. Therefore, further longitudinal studies are warranted. Fourth, the correlations related to multiple comparisons. As this is an exploratory study, it was assumed that corrections for multiple comparisons should not be applied. Therefore, caution should be exercised when interpreting the results. Finally, our participants are not representative of the entire Japanese population. Our sample recruited from the people who visited the public health center for annual health check-ups, which might potentially limit the generalizability of our findings.

Despite these limitations, our findings have practical implications for policymakers, public health specialists, and other scholars. Specifically, we highlight the need to pay more attention to living arrangements in health-related research and decision-making. Japanese culture is heavily influenced by Confucianism; therefore, the notions of filial duty to parents and multigenerational cohabitation are generally considered good and virtuous.³⁹ However, our findings raise questions about whether multigenerational cohabitation will positively affect the health of all Japanese people. As lifestyles, gender roles, and family structures change, living alone may not necessarily be associated with loneliness, social isolation, or lower socioeconomic status, especially among younger adults.³⁸ Thus, we recommend against prescribing a particular living arrangement in favor of considering the support appropriate to various living arrangements, which vary according to individual people, families, communities, and circumstances.

CONCLUSION

This cross-sectional study examined the association between living arrangements, including multigenerational cohabitation, and SRH as a function of gender and age among Japanese adults. The results showed that two-generation cohabitation was inversely associated with poor SRH among middle-aged women but not in older women. Additionally, living alone was associated with poor SRH among older women, it was associated with better SRH among middle-aged women. Among men, living arrangements were not associated with health in either age group. Our findings suggest that the association between living arrangements and health varies by gender and age.

CONFLICTS OF INTEREST

The authors declare that this study was conducted in the absence of any commercial or financial relationships that could be construed as potential conflicts of interest.

DATA AVAILABILITY STATEMENT

The data sets used in this study are available upon request. Details are available on the J-MICC study website (<http://www.jmicc.com/>).

ACKNOWLEDGMENTS

We express our sincere thanks to the medical staff of the Okazaki City Medical Association, Public Health Center, for their help with arranging the testing and their contributions to the study. We are also appreciative to all those who participated in the surveys.

FUNDING SOURCES

The J-MICC Study and the J-MICC Okazaki Study were supported by Grants-in-Aid for Scientific Research for Priority Areas of Cancer (no. 17015018) and Innovative Areas (no. 221S0001); by a Grant-in-Aid from the Japan Society for the Promotion of Science (JSPS) KAKENHI Grants (no. 16H06277); by the Japanese Ministry of Education, Culture, Sports, Science and Technology; and in part by a Grant-in-Aid from the JSPS KAKENHI Grants (Basic Research C: nos. 19590643 and 23590806; Research Activity Start-up: no. 19K24277). This study is supported by the JSPS KAKENHI Grants (21K17322 and 22KJ3208).

REFERENCES

- 1 Waite LJ, Hughes ME. At risk on the cusp of old age: living arrangements and functional status among black, white and Hispanic adults. *J Gerontol B Psychol Sci Soc Sci.* 1999;54(3):S136–S144. doi:10.1093/geronb/54b.3.s136.
- 2 Hupcey JE. Clarifying the social support theory-research linkage. *J Adv Nurs.* 1998;27(6):1231–1241. doi:10.1046/j.1365-2648.1998.01231.x.
- 3 Hughes ME, Waite LJ. Health in household context: living arrangements and health in late middle age. *J Health Soc Behav.* 2002;43(1):1–21. doi:10.2307/3090242.
- 4 Gender Equality Bureau Cabinet Office. International comparative study on gender-equal society (2002 survey) [in Japanese]. <https://www.gender.go.jp/research/kenkyu/intl-compare/mokuji.html>. Published June 2003. Accessed April 17, 2023.
- 5 National Institute of Population and Social Security Research. Future estimates of the number of households in Japan (national estimates)-Estimate for 2018 (Heisei 30) [in Japanese]. http://www.ipss.go.jp/pp-ajsetai/j/HPRJ2018/hprj2018_gaiyo_20180117.pdf. Published 2018. Accessed April 17, 2023.
- 6 Hashimoto A. Designing family values: cultural assumptions of an aging society. *Jpn Q.* 1997;44(4):59–66.
- 7 Household Statistics Office, Director-General for Statistics and Information Policy, Ministry of Health, Labour and Welfare. Summary Report of Comprehensive Survey of Living Conditions 2019. https://www.mhlw.go.jp/english/database/db-hss/dl/report_gaikyo_2019.pdf. Published July 17, 2020. Accessed February 9, 2024.
- 8 Ministry of Health, Labour and Welfare. Summary of vital statistics for 2020 [in Japanese]. <https://www.mhlw.go.jp/toukei/saikin/hw/jinkou/geppo/nengai20/index.html>. Published 2021. Accessed April 17, 2022.
- 9 Ministry of Land, Infrastructure, Transport and Tourism. Basic plan for housing life (national plan) [in

- Japanese]. <https://www.mlit.go.jp/common/001123473.pdf>. Published 2006. Accessed April 17, 2022.
- 10 Chappell NL. Living arrangements and sources of caregiving. *J Gerontol*. 1991;46(1):S1–S8. doi:10.1093/geronj/46.1.s1.
 - 11 Honjo K, Tani Y, Saito M, et al. Living alone or with others and depressive symptoms, and effect modification by residential social cohesion among older adults in Japan: the JAGES longitudinal study. *J Epidemiol*. 2018;28(7):315–322. doi:10.2188/jea.JE20170065.
 - 12 Kikuchi H, Takamiya T, Odagiri Y, et al. Gender differences in association between psychological distress and detailed living arrangements among Japanese older adults, aged 65–74 years. *Soc Psychiatry Psychiatr Epidemiol*. 2014;49(5):823–830. doi:10.1007/s00127-013-0778-8.
 - 13 Wilmoth JM, Chen PC. Immigrant status, living arrangements, and depressive symptoms among middle-aged and older adults. *J Gerontol B Psychol Sci Soc Sci*. 2003;58(5):S305–S313. doi:10.1093/geronb/58.5.s305.
 - 14 Xiu-Ying H, Qian C, Xiao-Dong P, Xue-Mei Z, Chang-Quan H. Living arrangements and risk for late life depression: a meta-analysis of published literature. *Int J Psychiatry Med*. 2012;43(1):19–34. doi:10.2190/PM.43.1.b.
 - 15 Li LW, Zhang J, Liang J. Health among the oldest-old in China: which living arrangements make a difference? *Soc Sci Med*. 2009;68(2):220–227. doi:10.1016/j.socscimed.2008.10.013.
 - 16 af Sillén U, Nilsson JA, Månsson NO, Nilsson PM. Self-rated health in relation to age and gender: influence on mortality risk in the Malmö Preventive Project. *Scand J Public Health*. 2005;33(3):183–189. doi:10.1080/14034940410019235.
 - 17 Miilunpalo S, Vuori I, Oja P, Pasanen M, Urponen H. Self-rated health status as a health measure: the predictive value of self-reported health status on the use of physician services and on mortality in the working-age population. *J Clin Epidemiol*. 1997;50(5):517–528. doi:10.1016/s0895-4356(97)00045-0.
 - 18 Pan Y, Pikhartova J, Bobak M, Pikhart H. Reliability and predictive validity of two scales of self-rated health in China: results from China Health and Retirement Longitudinal Study (CHARLS). *BMC Public Health*. 2022;22(1):1863. doi:10.1186/s12889-022-14218-1.
 - 19 Schnitker J, Bacak V. The increasing predictive validity of self-rated health. *PLoS One*. 2014;9(1):e84933. doi:10.1371/journal.pone.0084933.
 - 20 Strawbridge WJ, Wallhagen MI. Self-rated health and mortality over three decades. *Res Aging*. 1999;21(3):402–416. doi:10.1177/0164027599213003.
 - 21 Zajacova A, Woo H. Examination of age variations in the predictive validity of self-rated health. *J Gerontol B Psychol Sci Soc Sci*. 2016;71(3):551–557. doi:10.1093/geronb/gbv050.
 - 22 Chandola T, Jenkinson C. Validating self-rated health in different ethnic groups. *Ethn Health*. 2000;5(2):151–159. doi:10.1080/713667451.
 - 23 Lundberg O, Manderbacka K. Assessing reliability of a measure of self-rated health. *Scand J Soc Med*. 1996;24(3):218–224. doi:10.1177/140349489602400314.
 - 24 McFadden E, Luben R, Bingham S, Wareham N, Kinmonth AL, Khaw KT. Social inequalities in self-rated health by age: cross-sectional study of 22,457 middle-aged men and women. *BMC Public Health*. 2008;8:230. doi:10.1186/1471-2458-8-230.
 - 25 Pérez-Zepeda MU, Belanger E, Zunzunegui MV, Phillips S, Ylli A, Guralnik J. Assessing the validity of self-rated health with the short physical performance battery: A cross-sectional analysis of the international mobility in aging study. *PLoS One*. 2016;11(4):e0153855. doi:10.1371/journal.pone.0153855.
 - 26 Molarius A, Janson S. Self-rated health, chronic diseases, and symptoms among middle-aged and elderly men and women. *J Clin Epidemiol*. 2002;55(4):364–370. doi:10.1016/s0895-4356(01)00491-7.
 - 27 Tamura T, Naito M, Maruyama K, et al. The association between self-rated health and high-sensitivity C-reactive protein level: a cross-sectional and 5-year longitudinal study. *BMC Public Health*. 2018;18(1):1380. doi:10.1186/s12889-018-6251-6.
 - 28 van der Linde RM, Mavaddat N, Luben R, et al. Self-rated health and cardiovascular disease incidence: results from a longitudinal population-based cohort in Norfolk, UK. *PLoS One*. 2013;8(6):e65290. doi:10.1371/journal.pone.0065290.
 - 29 Andersen FK, Christensen K, Frederiksen H. Self-rated health and age: a cross-sectional and longitudinal study of 11,000 Danes aged 45–102. *Scand J Public Health*. 2007;35(2):164–171. doi:10.1080/14034940600975674.
 - 30 Jylhä M. What is self-rated health and why does it predict mortality? Towards a unified conceptual model. *Soc Sci Med*. 2009;69(3):307–316. doi:10.1016/j.socscimed.2009.05.013.
 - 31 Rohlfsen LS, Jacobs Kronenfeld J. Gender differences in trajectories of self-rated health in middle and old age: an examination of differential exposure and differential vulnerability. *J Aging Health*. 2014;26(4):637–662. doi:10.1177/0898264314527477.
 - 32 Henning-Smith C, Gonzales G. The relationship between living alone and self-rated health varies

- by age: evidence from the national health interview survey. *J Appl Gerontol.* 2020;39(9):971–980. doi:10.1177/0733464819835113.
- 33 Ku LJ, Stearns SC, Van Houtven CH, Lee SY, Dilworth-Anderson P, Konrad TR. Impact of caring for grandchildren on the health of grandparents in Taiwan. *J Gerontol B Psychol Sci Soc Sci.* 2013;68(6):1009–1021. doi:10.1093/geronb/gbt090.
 - 34 Wakai K, Hamajima N, Okada R, et al. Profile of participants and genotype distributions of 108 polymorphisms in a cross-sectional study of associations of genotypes with lifestyle and clinical factors: A project in the Japan Multi-Institutional Collaborative Cohort (J-MICC) study. *J Epidemiol.* 2011;21(3):223–235. doi:10.2188/jea.je20100139.
 - 35 Hamajima N; J-MICC Study Group. The Japan Multi-Institutional Collaborative Cohort Study (J-MICC Study) to detect gene-environment interactions for cancer. *Asian Pac J Cancer Prev.* 2007;8(2):317–323.
 - 36 Kessler RC, Andrews G, Colpe LJ, et al. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychol Med.* 2002;32(6):959–976. doi:10.1017/s0033291702006074.
 - 37 Prochaska JJ, Sung HY, Max W, Shi Y, Ong M. Validity study of the K6 scale as a measure of moderate mental distress based on mental health treatment need and utilization. *Int J Methods Psychiatr Res.* 2012;21(2):88–97. doi:10.1002/mpr.1349.
 - 38 Lamidi EO. Period trends in self-rated health at midlife: variations by race/ethnicity, union status, and education. *J Racial Ethn Health Disparities.* 2022;9(4):1243–1261. doi:10.1007/s40615-021-01066-9.
 - 39 Michael YL, Berkman LF, Colditz GA, Kawachi I. Living arrangements, social integration, and change in functional health status. *Am J Epidemiol.* 2001;153(2):123–131. doi:10.1093/aje/153.2.123.
 - 40 Takeda Y, Kawachi I, Yamagata Z, et al. Multigenerational family structure in Japanese society: impacts on stress and health behaviors among women and men. *Soc Sci Med.* 2004;59(1):69–81. doi:10.1016/j.socscimed.2003.10.003.
 - 41 Schaefer C, Coyne JC, Lazarus RS. The health-related functions of social support. *J Behav Med.* 1981;4(4):381–406. doi:10.1007/BF00846149.
 - 42 Di Gessa G, Glaser K, Tinker A. The impact of caring for grandchildren on the health of grandparents in Europe: A lifecourse approach. *Soc Sci Med.* 2016;152:166–175. doi:10.1016/j.socscimed.2016.01.041.
 - 43 Bianchi SM, Sayer LC, Milkie MA, Robinson JP. Housework: who did, does or will do it, and how much does it matter? *Soc Forces.* 2012;91(1):55–63. doi:10.1093/sf/sos120.
 - 44 Craig L, Mullan K. How Mothers and Fathers Share Childcare: A cross-national time-use comparison. *Am Sociol Rev.* 2011;76(6):834–861. doi:10.1177/0003122411427673.
 - 45 Kawachi I, Kennedy BP, Glass R. Social capital and self-rated health: a contextual analysis. *Am J Public Health.* 1999;89(8):1187–1193. doi:10.2105/ajph.89.8.1187.
 - 46 Marks NF, Lambert JD, Choi H. Transitions to caregiving, gender, and psychological well-being: A prospective U.S. national Study. *J Marriage Fam.* 2002;64(3):657–667. doi:10.1111/j.1741-3737.2002.00657.x.
 - 47 Markus HR, Kitayama S. Culture and the self: implications for cognition, emotion, and motivation. *Psychol Rev.* 1991;98(2):224–253. doi:10.1037/0033-295X.98.2.224.
 - 48 Alpass FM, Neville S. Loneliness, health and depression in older males. *Aging Ment Health.* 2003;7(3):212–216. doi:10.1080/1360786031000101193.
 - 49 Harrison J, Barrow S, Gask L, Creed F. Social determinants of GHQ score by postal survey. *J Public Health Med.* 1999;21(3):283–288. doi:10.1093/pubmed/21.3.283.
 - 50 Raymo JM. Living alone in Japan: relationships with happiness and health. *Demogr Res.* 2015;32:1267–1298. doi:10.4054/DemRes.2015.32.46.
 - 51 Brinton MC. *Women and the Economic Miracle: Gender and Work in Postwar Japan.* Berkeley: University of California Press; 1993.
 - 52 Glick PC. Living alone during middle adulthood. *Sociol Perspect.* 1994;37(3):445–457. doi:10.2307/1389506.
 - 53 Hanna KL, Collins PF. Relationship between living alone and food and nutrient intake. *Nutr Rev.* 2015;73(9):594–611. doi:10.1093/nutrit/nuv024.
 - 54 Staehelin K, Schindler C, Spoerri A, Zemp Stutz E; Swiss National Cohort Study Group. Marital status, living arrangement and mortality: does the association vary by gender? *J Epidemiol Community Health.* 2012;66(7):e22. doi:10.1136/jech.2010.128397.
 - 55 Denton M, Walters V. Gender differences in structural and behavioral determinants of health: an analysis of the social production of health. *Soc Sci Med.* 1999;48(9):1221–1235. doi:10.1016/s0277-9536(98)00421-3.

SUPPLEMENTAL INFORMATION

Supplementary Table 1a Odds ratio of male participants for poor self-rated health adjusted by living arrangements and covariates

	OR	95% CI		p-value	
Living arrangements					
Living with spouse	Reference				
Living alone	1.23	0.67	2.24	0.476	
Two generations	1.22	0.94	1.59	0.132	
Three or more generations	0.96	0.69	1.35	0.834	
Age					
45–54	Reference				
55–64	0.81	0.58	1.15	0.245	
65–74	0.70	0.48	1.02	0.061	
≥75	0.72	0.45	1.14	0.158	
Marital status					
Never married	Reference				
Married	1.12	0.58	2.26	0.745	
Widowed/divorced	0.95	0.46	1.99	0.885	
Employment status					
Unemployed	Reference				
Employed	0.78	0.59	1.03	0.084	
Educational attainment					
<10 years	Reference				
10–12 years	0.76	0.55	1.05	0.095	
>12 years	0.68	0.49	0.96	0.025	
Need home-based nursing care					
No	Reference				
Yes	0.92	0.63	1.31	0.643	
Illness					
No illness	Reference				
Ill	1.49	1.16	1.91	0.002	*
K6					
<5	Reference				
≥5	3.32	2.65	4.16	0.000	*

OR: odds ratio

CI: confidence interval

Supplementary Table 1b Odds ratio of female participants for poor self-rated health adjusted by living arrangements and covariates

	OR	95% CI		p-value	
Living arrangements					
Living with spouse	Reference				
Living alone	0.85	0.49	1.49	0.581	
Two generations	0.88	0.66	1.18	0.409	
Three or more generations	0.85	0.60	1.20	0.357	
Age					
45–54	Reference				
55–64	0.89	0.65	1.22	0.472	
65–74	0.84	0.58	1.22	0.361	
≥75	0.86	0.47	1.55	0.627	
Marital status					
Never married	Reference				
Married	0.58	0.32	1.07	0.074	
Widowed/divorced	0.60	0.33	1.12	0.101	
Employment status					
Unemployed	Reference				
Employed	0.99	0.75	1.32	0.964	
Educational attainment					
<10 years	Reference				
10–12 years	0.77	0.52	1.15	0.195	
>12 years	0.86	0.58	1.31	0.484	
Need home-based nursing care					
No	Reference				
Yes	1.35	0.95	1.90	0.093	
Illness					
No illness	Reference				
Ill	1.58	1.14	2.17	0.005	*
K6					
<5	Reference				
≥5	3.12	2.46	3.95	0.000	*

OR: odds ratio

CI: confidence interval

Supplementary Table 2a Odds ratio of male participants over 65 years for poor self-rated health adjusted by living arrangements and covariates

	OR	95% CI		p-value	
Living arrangements					
Living with spouse	Reference				
Living alone	1.83	0.82	4.04	0.136	
Two generations	1.19	0.85	1.65	0.303	
Three or more generations	0.85	0.54	1.31	0.482	
Age					
65–74	Reference				
≥75	1.02	0.74	1.40	0.893	
Marital status					
Never married	Reference				
Married	1.09	0.38	3.47	0.877	
Widowed/divorced	0.85	0.31	2.54	0.756	
Employment status					
Unemployed	Reference				
Employed	0.79	0.59	1.06	0.125	
Educational attainment					
<10 years	Reference				
10–12 years	0.68	0.47	0.97	0.033	*
>12 years	0.69	0.48	1.01	0.057	
Need home-based nursing care					
No	Reference				
Yes	0.84	0.50	1.37	0.507	
Illness					
No illness	Reference				
Ill	1.59	1.19	2.11	0.002	*
K6					
<5	Reference				
≥5	3.33	2.47	4.49	0.000	*

OR: odds ratio

CI: confidence interval

Supplementary Table 2b Odds ratio of female participants over 65 years for poor self-rated health adjusted by living arrangements and covariates

	OR	95% CI		p-value	
Living arrangements					
Living with spouse	Reference				
Living alone	2.46	1.03	6.05	0.045	*
Two generations	1.35	0.85	2.12	0.204	
Three or more generations	1.21	0.70	2.05	0.489	
Age					
65–74	Reference				
≥75	1.03	0.60	1.72	0.902	
Marital status					
Never married	Reference				
Married	2.32	0.65	9.96	0.218	
Widowed/divorced	1.13	0.37	4.31	0.839	
Employment status					
Unemployed	Reference				
Employed	0.68	0.42	1.07	0.104	
Educational attainment					
<10 years	Reference				
10–12 years	0.78	0.49	1.25	0.295	
>12 years	1.04	0.64	1.72	0.870	
Need home-based nursing care					
No	Reference				
Yes	1.28	0.72	2.22	0.389	
Illness					
No illness	Reference				
Ill	1.78	1.15	2.73	0.009	*
K6					
<5	Reference				
≥5	2.72	1.84	4.00	0.000	*

OR: odds ratio

CI: confidence interval

Supplementary Table 3a Odds ratio of male participants under 65 years for poor self-rated health adjusted by living arrangements and covariates

	OR	95% CI		p-value	
Living arrangements					
Living with spouse	Reference				
Living alone	0.59	0.17	1.72	0.363	
Two generations	1.31	0.83	2.12	0.264	
Three or more generations	1.15	0.65	2.04	0.639	
Age					
45–54	Reference				
55–64	0.82	0.57	1.18	0.278	
Marital status					
Never married	Reference				
Married	1.16	0.49	2.99	0.752	
Widowed/divorced	0.95	0.29	3.07	0.936	
Employment status					
Unemployed	Reference				
Employed	0.69	0.30	1.72	0.392	
Educational attainment					
<10 years	Reference				
10–12 years	1.17	0.52	2.91	0.724	
>12 years	0.88	0.40	2.16	0.760	
Need home-based nursing care					
No	Reference				
Yes	0.97	0.54	1.65	0.902	
Illness					
No illness	Reference				
Ill	1.17	0.66	2.00	0.577	
K6					
<5	Reference				
≥5	3.34	2.36	4.73	0.000	*

OR: odds ratio

CI: confidence interval

Supplementary Table 3b Odds ratio of female participants under 65 years for poor self-rated health adjusted by living arrangements and covariates

	OR	95% CI		p-value	
Living arrangements					
Living with spouse	Reference				
Living alone	0.44	0.18	1.02	0.064	
Two generations	0.66	0.45	0.98	0.036	*
Three or more generations	0.69	0.43	1.10	0.123	
Age					
45–54	Reference				
55–64	0.94	0.68	1.30	0.712	
Marital status					
Never married	Reference				
Married	0.38	0.19	0.77	0.007	*
Widowed/divorced	0.54	0.25	1.17	0.115	
Employment status					
Unemployed	Reference				
Employed	1.40	0.95	2.09	0.098	
Educational attainment					
<10 years	Reference				
10–12 years	0.56	0.23	1.40	0.198	
>12 years	0.55	0.23	1.36	0.181	
Need home-based nursing care					
No	Reference				
Yes	1.29	0.81	2.02	0.278	
Illness					
No illness	Reference				
Ill	1.33	0.80	2.16	0.256	
K6					
<5	Reference				
≥5	3.26	2.41	4.42	0.000	*

OR: odds ratio

CI: confidence interval