

Original article

Contribution of social relationships to self-rated health among Japanese community-dwelling elderly

Ryoko Kawasaki¹, Rieko Nakao², and Mayumi Ohnishi²

¹ Oita University of Nursing and Health Sciences, Japan

² Nagasaki University Graduate School of Biomedical Sciences, Japan

Abstract

Objective: Participation in social activities is associated with physical and psychological health in the community-dwelling elderly population. We examined the two factors of social relations and community health resources, associated with higher self-rated health levels in the community-dwelling elderly.

Methods: A total of 145 community-dwelling elderly people ≥ 65 years old from two neighborhood associations in Nagasaki City were recruited for this study, representing 85% of the officially registered ≥ 65 -year-old population in the target area. Face-to-face interviews using a structured questionnaire were conducted by trained interviewers in August 2009, with questions related to sociodemographic characteristics, social relationships, and self-rated health (SRH). Community health resources (type and walking distance from home) were evaluated by one of the authors as a community assessment.

Results: Seventy-eight community-dwelling elderly people (25 men and 53 women) participated in the study. Elderly people who reported going out every day were more likely to show higher SRH scores (excellent/good) than those going out less often (OR: 3.7; 95% confidence interval [CI]: 1.0, 14.2; $P = 0.056$). The numbers of interactions with friends in higher and lower SRH groups were 6.5 ± 8.4 (mean \pm standard deviation) and 2.4 ± 1.1 ($P = 0.01$, Mann-Whitney U test), respectively. The numbers of relatives talking on the phone in higher and lower SRH groups were 2.9 ± 1.3 and 2.2 ± 1.2 ($P = 0.031$, Mann-Whitney U test), respectively. Meeting scores with friends in higher and lower SRH groups were 7.8 ± 5.8 and 4.5 ± 3.6 ($P = 0.068$), respectively. The scores of community health resources among higher and lower SRH groups were 21.2 ± 1.5 and

20.9 ± 1.4 ($P = 0.547$), respectively. The scores of community association/activities in higher and lower SRH groups were 3.9 ± 1.0 and 3.6 ± 0.9 ($P = 0.227$), respectively.

Conclusion: This study indicated the importance of interaction with friends and relatives for maintaining higher SRH among community-dwelling elderly people.

Key words: community-dwelling elderly, self-rated health, social relation, community health resource

(J Rural Med 2018; 13(1): 18–25)

Introduction

According to the Cabinet Office, Government of Japan, the proportion of the elderly in Japan is expected to increase from 20.2% in 2005 to 33.3% in 2042, and then to 34.8% in 2065. Therefore, Japan is projected to become an extremely aged society, with approximately 1/2.6 of the population predicted to be aged ≥ 65 by 2065¹. The rapid increase of the elderly population not only increases the numbers of elderly couples and single elderly households, but also reduces the numbers and types of exchanges the elderly have within the community, because community-based social infrastructures and a mutual-aid were diminished in the community. Decreased participation in the community may lead to weakening of community efficacy. In an aging society, it is important to strengthen social relationships among the elderly to maintain and enhance community efficacy.

A number of studies performed in the USA and Europe since the 1970s indicated associations between social networks and mortality; social and community ties were shown to be associated with reduced mortality², while reduced levels of social interaction were associated with increased mortality³. In the elderly, reduced interactions with family and friends were shown to be related to decreases in physical and psychological functions⁴. Previous studies on Japanese elderly people also indicate that a rich social network makes

Received: September 12, 2017

Accepted: December 11, 2017

Correspondence: Mayumi Ohnishi, MPH, Ph.D., Nagasaki University Graduate School of Biomedical Sciences, 1-7-1 Sakamoto, Nagasaki-shi, Nagasaki-ken 852-8520, Japan

E-mail: mohnishi@nagasaki-u.ac.jp

This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial No Derivatives (by-nc-nd) License <<http://creativecommons.org/licenses/by-nc-nd/4.0/>>.

a positive contribution to health conditions. For example, lower levels of interaction with family members living separately and not providing social support to others, such as meetings with family members and/or friends, were shown to be associated with a higher risk of requiring care over a 2-year observation period⁵). In addition, having close friends was associated with receiving periodic health check-ups⁶). The contribution of social capital to health status in Japanese elderly people has been evaluated since the 2000s^{7, 8}). Ohno reported elevated risk of poor physical and psychological health among homebound elderly people regardless of marital status and/or cohabitation with a partner⁹). The level of physical activity was lower among homebound than non-homebound elderly people living in the community¹⁰). In addition, lack of instrumental support and current poor health conditions could be obstacles within the community-dwelling elderly population to preventing “housebound” status, defined as ordinarily going out no more than once a week¹¹).

The population and area of Nagasaki City, the capital of Nagasaki prefecture, Japan, increased following a municipal merger with seven small towns in 2005/2006. The city now has a population of approximately 432000 with 28.8% ≥ 65 years old (2015), which is higher than the Japanese average (26.7% in 2015). After the municipal merger, local town-based bus operations were abolished. Marginal areas became underserved by public transportation resulting in a reduction in accessibility, especially for elderly people and those with disabilities. In addition, the Nagasaki Hillside Association reported that 43% of the urban area of Nagasaki City consisted of sloped and hillside areas, most of which had no vehicle accessibility because of extremely narrow roads and/or stairs. Community A is a residential area consisting of approximately 60% sloped and hillside areas in Nagasaki City. It takes about 20 minutes to travel by bus from community A to the downtown area of Nagasaki City.

Participation in a variety of social activities has been shown to be associated with good physical and psychological health conditions among community-dwelling elderly. This study was performed to identify factors of social relations and community health resources associated with higher self-rated health among elderly people living in the community in an area with limited accessibility to social resources, including public transportation.

Methods

Study participants and data collection procedure

A total of 145 community-dwelling elderly people ≥ 65 years old belonging to two neighborhood associations (I and II) in community A were recruited for this study, which

represented 85% of the officially registered population ≥ 65 years old in this community. A residential address list was obtained from two neighborhood associations and an announcement letter was mailed to 145 target elderly people living in the community prior to data collection. The target community-dwelling elderly people were informed about data collection by visiting interviewer(s) through the neighborhood association. Face-to-face interviews using a structured questionnaire were conducted by trained interviewers, all of whom were licensed registered nurses or social-welfare workers, in August 2009.

Study variables

The structured questionnaire elicited responses regarding sociodemographic characteristics (including age, gender, years of education, marital status, family structure, use of long-term care insurance services, and going for medical consultation within the past year), social relationships (such as, frequency of going out, interaction with others, number of people with whom they interact, and counseling channels in the event of problems and emergencies), and self-rated health (SRH). The frequency of going out was scored as follows: every day, 3 points; more than once a week, 2 points; and 2–3 times a month, 1 point. Main measures of transportation and places visited also provided information regarding going out. An index of social interaction was evaluated using the following three items: 1) number of people with whom they interacted, including family living separately, relatives, neighbors, and friends; 2) frequency of interaction with these people through meetings or talking on the phone; and 3) average length of interactions with these people. The frequency of interaction was scored as follows: more than once a week, 3 points; more than once a month, 2 points; and 1–2 times a year, 1 point. Length of interaction was scored as follows: meeting more than 1 hour, 2 points; meeting less than one hour, 1 point; talking on the phone more than 30 minutes, 2 points; and talking on the phone less than 30 minutes, 1 point. The number of counseling channels available to the interviewees when faced with problems and/or emergencies was also evaluated.

In addition, community-based diagnosis was calculated based on scores of community health resources by one of the authors. The number of facilities and associations/activities related to health available to people in the community within the target areas of neighborhood associations were identified, regardless of formal and informal establishment/function. The temporal walking distances from each individual’s home to facilities and/or associations/activities were calculated and included in the community health resource score as follows: less than 10 minutes, 3 points; 10–20 minutes, 2 points; 20–30 minutes, 1 point; > 30 min-

Table 1 Sociodemographic characteristics and self-rated health ($n = 78$)

		Male ($n = 25$)		Female ($n = 53$)		<i>P</i> -value
		n	(%)	n	(%)	
Age	65 – 74 years old	10	(40)	22	(42)	0.899 ^a
	≥ 75 years old	15	(60)	31	(59)	
Number of years of education [‡]	> 9 years	6	(25)	16	(30)	0.641 ^a
	≤ 9 years	18	(75)	37	(70)	
Marital status	With spouse	20	(80)	21	(40)	0.001 ^a
	Without spouse	5	(20)	32	(60)	
Family structure	Living alone	3	(12)	20	(38)	0.032 ^b
	Living with others	22	(88)	33	(62)	
Use of long-term care insurance services	Yes	4	(16)	9	(17)	1.000 ^b
	No	21	(84)	44	(83)	
Medical consultation in the last 1 year [‡]	Yes	22	(88)	50	(96)	0.322 ^b
	No	3	(12)	2	(4)	
Self-rated health	Fair/poor	4	(16)	13	(25)	0.559 ^b
	Excellent/good	21	(84)	40	(76)	

[‡]: $n = 77$, ^a: chi-square test, ^b: Fisher's exact test.

utes, 0 points.

The interviewees rated their SRH (assessed with a single question, “In general, how do you rate your overall health?” as follows: excellent, 4; good, 3; fair, 2; or poor, 1. SRH) was given a score of 2 for excellent/good or 1 for fair/poor.

Analysis

Chi-square test and/or Fisher's exact test were used for analysis of gender differences regarding sociodemographic characteristics and SRH. Spearman's rank-order correlation was used to analyze the relationship between age and SRH (4 ranks). Odds ratios were calculated to analyze associations between frequency, measures of transportation and places visited, and SRH. The Mann-Whitney U test was used to analyze associations between social relationships and/or community health resources and SRH. Statistical analyses were performed using IBM SPSS Statistics 22, and $P < 0.05$ was taken to indicate statistical significance.

Ethical considerations

This study was performed after obtaining ethical clearance from the Ethical Review Board of Nagasaki University Graduate School of Biomedical Sciences (approval number: 09070947).

Results

Seventy-eight community-dwelling elderly people (25 men and 53 women) participated in this study, and the participation rate was 54%. The sociodemographic characteristics and SRH of the study participants according to

gender are shown in Table 1. Sixty-one (78%) participants rated their health as excellent/good, and there was no significant difference (Fisher's exact test, $P = 0.559$) between men (85%) and women (76%). There was also no significant relation between age and SRH ($r_s = -0.2$, $P = 0.093$).

Table 2 shows the associations between social activities, including measures of transportation and places went out, and SRH. Elderly people who went out every day showed higher SRH compared to those that went out less than every day, but the relation was not statistically significant (OR: 3.7; 95% confidence interval [CI]: 1.0, 14.2; $P = 0.056$).

The associations between social relationships and SRH are shown in Table 3. Interaction with a greater number of friends ($P = 0.010$) and a greater score of talking to relatives on the phone ($P = 0.031$) were significantly associated with higher SRH (Mann-Whitney U test). A greater score for meeting friends ($P = 0.068$) also tended to be related to higher SRH, although the association was not statistically significant. Scores for community resources ($P = 0.547$) and community association/activities ($P = 0.227$) were not significantly associated with SRH.

Table 4 shows a comparison of community characteristics for two different areas, that is, neighborhood associations I and II. There were no significant differences between the two neighborhood association areas. However, elderly people in neighborhood association II showed higher SRH (chi-square test, $P = 0.008$). This difference remained after adjusting for sex, age, number of years of education, marital status, use of long-term care insurance services, and medical consultation in the past year (AOR: 5.1; 95% CI: 1.3, 20.2; $P = 0.019$). Among people from neighborhood association I,

Table 2 Self-rated health depend on social activities ($n = 78$)

	Fair/poor ($n = 17$)		Excellent/good ($n = 61$)		Odds ratio	(95% confidence interval)	P-value
	<i>n</i>	(%)	<i>n</i>	(%)			
Going out							
Less than every day	3	(18)	27	(44)	1		
Every day	14	(82)	34	(56)	3.7	(1.0, 14.2)	0.056
Main measures of going out							
Walking	5	(25)	21	(35)	1		
Driving by family	3	(18)	14	(23)	1.1	(0.2, 5.4)	0.896
Public transportation/taxi	9	(53)	25	(42)	0.7	(0.2, 2.3)	0.513
Place of going out							
Social activities	9	(53)	30	(43)	1		
Only shopping	6	(35)	19	(32)	1.0	(0.3, 3.1)	0.932
Only hospital/clinic	2	(12)	12	(20)	1.8	(0.3, 9.6)	0.491
Going to election							
No	2	(12)	4	(7)	1		
Yes	15	(88)	57	(94)	1.9	(0.3, 11.4)	0.482

Table 3 Self-rated health according to social relationships ($n = 78$)

	Fair/poor ($n = 17$)		Excellent/good ($n = 61$)		P-value ^c
	Mean	SD	Mean	SD	
Number of persons with whom I can consult	1.4 [†]	1.0	1.4	0.8	0.850
Number of persons with whom I can consult in the case of an emergency	1.1	0.6	1.2	0.5	0.878
Number of persons with whom I interact					
With children/parents	1.8	1.5	2.1	1.3	0.221
With relatives	3.8	3.5	4.5 [‡]	3.3	0.310
With neighbors	5.1	2.5	5.9	4.0	0.665
With friends	2.4	1.1	6.5	8.4	0.010
Index score of persons to meet					
With children/parents	7.0	4.8	6.5	4.0	0.628
With relatives	4.6	2.4	6.2	4.2	0.209
With neighbors	8.2	4.3	8.3	4.7	0.781
With friends	4.5	3.6	7.8	5.8	0.068
Index score of persons to talk by phone					
With children/parents	3.5	2.9	4.6	3.2	0.184
With relatives	2.2	1.2	2.9	1.3	0.031
With neighbors	1.7	1.7	1.7	1.7	0.896
With friends	3.5	4.0	4.5	4.9	0.343
Number of counseling channels in the event of problems	1.4 [†]	1.0	1.4 [‡]	0.8	0.850
Number of counseling channels in the event of an emergency	1.1 [‡]	0.6	1.2 [‡]	0.5	0.878
Score of community resources (facilities) (0–33)	20.9	1.4	21.2	1.5	0.547
Score of community association/activities (0–15)	3.6	0.9	3.9	1.0	0.227

[†]: $n = 16$, [‡]: $n = 15$, [‡]: $n = 60$, ^c: Mann-Whitney U test.

64% participated in community-based activities more than once a month, such as neighborhood association activities, while the rate in neighborhood association II was 33% (chi-square test, $P = 0.008$). The target area of this study had both flat and sloped (approximately 60%) geographic areas. Both areas included residents who had to walk more than 20 minutes to get to the nearest supermarket on flat roads, and residents who had to walk 20–30 m from the closest bus

stop on sloping terrain and/or stairs. In the flat areas, houses were adjacent to each other, most people had lived in the area a long time, and some neighbors had meals together. However, in the sloped areas, there were time consuming and/or physical obstacles to going out for elderly people, such as narrow sloped roads and/or stairs such that vehicles could not access the fronts of houses. In both areas, the most frequent destinations when going out were their home doc-

Table 4 Community characteristics of study areas and self-rated health according to neighborhood association ($n = 78$)

		Association I ($n = 33$)		Association II ($n = 45$)		<i>P</i> -value
		<i>n</i>	(%)	<i>n</i>	(%)	
Self-rated health	Fair/poor	12	(36)	5	(11)	0.008 ^a
	Excellent/good	21	(64)	40	(89)	
Distance to primary school by walking	< 10 min	15	(46)	18	(40)	0.630 ^a
	≥ 10 min	18	(55)	27	(60)	
Distance to junior high school by walking	< 10 min	18	(55)	29	(64)	0.377 ^a
	≥ 10 min	15	(46)	16	(36)	
Distance to police office by walking	< 30 min	19	(42)	26	(42)	0.986 ^a
	≥ 30 min	14	(58)	19	(58)	
Distance to municipal branch office by walking	< 10 min	20	(61)	20	(56)	0.656 ^a
	≥ 10 min	13	(39)	25	(44)	
Distance to closest bus stop by walking	< 10 min	30	(91)	39	(87)	0.726 ^b
	≥ 10 min	3	(9)	6	(13)	
Distance to post office by walking	< 10 min	10	(30)	11	(24)	0.564 ^a
	≥ 10 min	23	(70)	34	(76)	
Distance to supermarket by walking	< 20 min	11	(33)	17	(38)	0.686 ^a
	≥ 20 min	22	(67)	28	(62)	
Distance to convenience store by walking	< 30 min	10	(30)	17	(38)	0.493 ^a
	≥ 30 min	23	(70)	28	(62)	
Distance to temple/church by walking	< 10 min	15	(46)	17	(38)	0.496 ^a
	≥ 10 min	18	(55)	28	(62)	
Distance to clinic by walking	< 10 min	11	(33)	11	(24)	0.389 ^a
	≥ 10 min	22	(67)	34	(76)	
Distance to hospital by walking	< 20 min	13	(39)	16	(36)	0.729 ^a
	≥ 20 min	20	(61)	29	(64)	

^a: chi-square test, ^b: Fisher's exact test.

tor (51%) and the supermarket to shop for food and daily necessities (35%). On average, home doctors were within 10 minutes and supermarkets were within 30 minutes of walking distance, and 33% of interviewees usually walked to these places. In neighborhood association area I, there were two areas where neighbors gathered and chatted every afternoon: park benches on a sloping area and the house of a single female resident. In neighborhood association area II also, there were two areas where neighbors gathered and chatted every afternoon: both were houses with gardens in flat areas. However, there were no notable geographic differences between neighborhood association areas I and II.

Discussion

Approximately 80% of study participants rated their health as excellent/good, which was similar to or greater than that of previous studies in Japanese community-dwelling elderly populations^{12, 13}. Although the sample size was small and study participants lived in geographically inconvenient areas, their general health according to SRH was

determined to be average for Japanese community-dwelling elderly.

Among the individual factors related to social relationships examined in this study, only greater frequency of going out, interacting with a greater number of friends, and greater frequency and/or duration of talking with relatives on the phone were associated with higher SRH. However, the numbers of people with whom they generally interacted and in the case of emergency showed no association with higher SRH. In general, greater amounts of social relationships contributed to higher SRH, especially good relationships with friends. This is consistent with previous studies that demonstrated better social relationships had protective effects against early death and physical disability¹⁴, and occasionally meeting with friends was associated with better glycemic control in older Japanese subjects¹⁵. Social support, not only from family members but also from neighbors and friends, was reported to be related to a low prevalence rate of depression in older Japanese people¹⁶. However, relationships with people, including in the case of an emergency, may have a positive effect, but sometimes it may raise

negative feelings because of the excessive closeness of the relationships. Previous studies indicated that greater network size and social interaction were negatively associated with disability risk¹⁷⁾, greater frequency of instrumental support was associated with increased risk of activities of daily living disability¹⁸⁾, and improper instrumental support adversely affected the mental and physical independence of elderly people¹⁴⁾. In addition, interfering, excessive helping, and excessive requests within relationships can cause problems and conflict; such relationships are generally less socially supportive and are associated with an increased rate of depressive conditions¹⁹⁾. Feeling upset due to social relationships also contributed to depressive conditions and reduced happiness²⁰⁾. Thus, not only abundant social relationship networks and opportunities, but also moderate closeness, such as relationships with friends, may be important for supporting better health conditions. Relationships with friends provide appropriate gentle tension for elderly people, which is different from relationships with family that sometimes have a negative influence.

On the other hand, social health among the elderly may be determined directly by psychological health and indirectly by physical health over long-term follow-up²¹⁾. SRH was significantly poorer among homebound individuals who went out less than once a week compared to non-homebound elderly people²²⁾. It was reported that older people who had quit full-time jobs showed deterioration of both mental health and higher-level functional capacity²³⁾. A higher frequency of using community-based facilities, such as community centers, may mitigate feelings of loneliness²⁴⁾ and improve SRH among elderly Japanese individuals²⁵⁾. However, encouraging voluntary social participation rather than frequent social participation may have a positive effect on SRH²⁶⁾. Both bonding and bridging social capital were reported to have beneficial effects on health among elderly Japanese people²⁷⁾. Thus, SRH may be associated with social network and/or support in a complex manner depending on physical and psychological conditions, community values, and social norms. The results of the present study indicated no significant relationships between SRH in the elderly and the number of people with whom they met in general or in the case of emergency. However, it may be important to evaluate not only the quantity, but also the quality of social interactions, including positive and negative impacts, which contribute to health status among community-dwelling elderly people.

Although there was a difference regarding SRH in the two neighborhood associations, factors contributing to higher SRH could not be identified, because these were not considered in this study. Neighborhood characteristics, such as quantity of community resources and community asso-

ciation/activities, including accessibility to these resources, were not associated with SRH among community-dwelling elderly people in this study. Previous studies indicated increased suicide risk in sloping and mountainous areas of Japan^{28, 29)}. Community interventions to increase social interactions were reported to be effective in improving health status among elderly people^{30, 31)}. Neighborhood characteristics may also contribute to health among elderly people in Japan³²⁾. Conditions that were not evaluated in this study may contribute to SRH, such as values and the nature of decision making in a community. Thus, geographical conditions and neighborhood characteristics should be taken into consideration when implementing community health promotion programs for community-dwelling elderly populations.

This study had several limitations. First, the sample size was small and was not appropriate to conduct multivariate analysis. Therefore, we did not calculate the influences of interactions among variables on the results. Second, elderly people who were absent from the neighborhood association lists despite being registered as residents in community A were not interviewed and not included in the analysis. The characteristics of such individuals regarding social relationships and community participation may be different from those who were included in the analysis. Third, the study participants may not have clearly differentiated between “friend” and “neighbor” in the interview. We initially hypothesized that interaction with neighbors may be one factor contributing to SRH. However, only relationships with friends showed a contribution to higher SRH in this study. Fourth, economic conditions were not evaluated in this study. The frequency and amount of time spent meeting with friends and talking on the phone may be affected by the economic conditions of the study participants. Fifth, community profiles regarding community resources and community association/activities were evaluated based only on the researcher’s observation. Objective geographical conditions, including accessibility and availability of transportation, were not included in the analysis. Further studies involving comprehensive analysis with increased sample size and objective geographical information obtained using a geographical information system are required.

Conclusion

The results of the present study indicated the importance of interaction with friends and relatives for maintaining higher SRH among community-dwelling elderly people; however, both positive and negative influences of human relationships should be taken into consideration. Although being alone may be associated with lower health conditions

and happiness, relationships that are excessively tense are not beneficial for health. Maintaining loose connections and ties that prevent both personal and social isolation may have a positive effect on health status among elderly people in Japan.

Acknowledgments

The authors are grateful to all of the neighborhood associations and community-dwelling elderly people for their participation in this study.

References

1. Cabinet Office, Government of Japan. Heisei 29 Nendo-ban Kourei Shakai Hakusyo (Aged Society White paper 2017) Cabinet Office, Government of Japan, Tokyo, 2017. http://www8.cao.go.jp/kourei/whitepaper/w-2017/zenbun/29pdf_index.html (accessed 12 November 2017) (in Japanese, not available abstract in English).
2. Berkman LF, Syme SL. Social networks, host resistance, and mortality: a nine-year follow-up study of Alameda County residents. *Am J Epidemiol* 1979; 109: 186–204. [[Medline](#)] [[CrossRef](#)]
3. Morgan DL, Schuster TL, Butler EW. Role reversals in the exchange of social support. *J Gerontol* 1991; 46: S278–S287. [[Medline](#)] [[CrossRef](#)]
4. Unger JB, McAvay G, Bruce ML, *et al.* Variation in the impact of social network characteristics on physical functioning in elderly persons: MacArthur Studies of Successful Aging. *J Gerontol B Psychol Sci Soc Sci* 1999; 54: S245–S251. [[Medline](#)] [[CrossRef](#)]
5. Yoshii K, Kondo K, Kuze J, *et al.* Social relationship factors and risk of care requirement in Japanese elderly. *Nippon Koshu Eisei Zasshi* 2005; 52: 456–467 (in Japanese, Abstract in English). [[Medline](#)]
6. Mitsuhashi Y, Kishi R, Ecuchi T, *et al.* Study of influences of social support and social networks on participation in periodic health examination of the elderly at home comparison of three regions with different social backgrounds. *Nippon Koshu Eisei Zasshi* 2006; 53: 92–104 (in Japanese, Abstract in English). [[Medline](#)]
7. Kondo N, Minai J, Imai H, *et al.* Engagement in a cohesive group and higher-level functional capacity in older adults in Japan: a case of the Mujin. *Soc Sci Med* 2007; 64: 2311–2323. [[Medline](#)] [[CrossRef](#)]
8. Yamaoka K. Social capital and health and well-being in East Asia: a population-based study. *Soc Sci Med* 2008; 66: 885–899. [[Medline](#)] [[CrossRef](#)]
9. Ohno M. Prevention of homebound states evaluated in terms of life-style of home-kiving elderly people with or without spouse. *J Jpn Soc Nurs Health Care* 2002; 4: 1–10 (in Japanese, Abstract in English).
10. Tsuneyoshi A, Nagayama H, Wakui S, *et al.* Physical activity patterns and physical fitness levels of homebound elderly people living in the community. *Jpn J. Fitness Sports Med* 2008; 57: 433–442 (in Japanese, Abstract in English). [[CrossRef](#)]
11. Furuta K, Itoh K, Sasuga Y. Study of psychological factors related to community-dwelling elderly persons' becoming housebound. *Journal of Japan Academy of Gerontological Nursing* 2005; 10: 5–16 (in Japanese, Abstract in English).
12. Kasai K, Kajita E. Association between the self-assessment of health status and pain in elderly people at home. *The Journal of the Nursing Society of the Toyama Medical and Pharmaceutical University* 2001; 4: 13–22 (in Japanese, Abstract in English).
13. Liu X, Gao Y, Nakayama N, *et al.* Chronological three-year trend in subjective health for elderly urban dwellers. *Bulletin of Social Medicine* 2008; 26: 9–14 (in Japanese, Abstract in English).
14. Kishi R, Horikawa N. Role of the social support network which influences age of death and physical function of elderly people: study of trends in and outside of Japan and future problems. *Nippon Koshu Eisei Zasshi* 2004; 51: 79–93 (in Japanese, Abstract in English). [[Medline](#)]
15. Yokobayashi K, Kawachi I, Kondo K, *et al.* JAGES group. Association between social relationship and glycemic control among older Japanese: JAGES cross-sectional study. *PLoS ONE* 2017; 12: e0169904. [[Medline](#)] [[CrossRef](#)]
16. Sasaki Y, Miyaguni Y, Tani Y, *et al.* Possibility of social supports as indicators for the community diagnosis of a community preventive approach for depression among older people: Japan Gerontological evaluation Study (JAGES) 2013. *Japanese Journal of Geriatric Psychiatry* 2015; 26: 1019–1027.
17. Mendes de Leon CF, Gold DT, Glass TA, *et al.* Disability as a function of social networks and support in elderly African Americans and Whites: the Duke EPESE 1986–1992. *J Gerontol B Psychol Sci Soc Sci* 2001; 56: S179–S190. [[Medline](#)] [[CrossRef](#)]
18. Seeman TE, Bruce ML, McAvay GJ. Social network characteristics and onset of ADL disability: MacArthur studies of successful aging. *J Gerontol B Psychol Sci Soc Sci* 1996; 51: S191–S200. [[Medline](#)] [[CrossRef](#)]
19. Schuster TL, Kessler RC, Aseltine Jr RH. Supportive interactions, negative interactions, and depressed mood. *Am J Community Psychol* 1990; 18: 423–438. [[Medline](#)] [[CrossRef](#)]
20. Pagel MD, Erdly WW, Becker J. Social networks: we get by with (and in spite of) a little help from our friends. *J Pers Soc Psychol* 1987; 53: 793–804. [[Medline](#)] [[CrossRef](#)]
21. Hoshi T, Takagi C, Bosako Y, *et al.* Chronological evaluation of physical, psychological and social health of urban elderly dwellers over 6 years and assessment of causal inter-relationships. *Nippon Koshu Eisei Zasshi* 2011; 58: 491–500 (in Japanese, Abstract in English). [[Medline](#)]
22. Umegaki H, Yanagawa M, Nakashima H, *et al.* The prevalence of homebound individuals in the elderly population: a survey in a city area in Japan. *Nagoya J Med Sci* 2015; 77: 439–446. [[Medline](#)]
23. Minami U, Nishi M, Fukaya T, *et al.* Effects of the change in

- working status on the health of older people in Japan. *PLoS ONE* 2015; 10: e0144069. [[Medline](#)] [[CrossRef](#)]
24. Hoshino A, Usui K, Katsura T. The development of a town of safety, security and health project in an area with a very high population aging rate: -the activities of a community salon on a shopping street and their assessment-. *J Rural Med* 2011; 6: 65–70. [[Medline](#)] [[CrossRef](#)]
 25. Ichida Y, Hirai H, Kondo K, *et al.* Does social participation improve self-rated health in the older population? A quasi-experimental intervention study. *Soc Sci Med* 2013; 94: 83–90. [[Medline](#)] [[CrossRef](#)]
 26. Tomioka K, Kurumatani N, Hosoi H. Association between the frequency and autonomy of social participation and self-rated health. *Geriatr Gerontol Int* 2017; 17: 2537–2544 [[CrossRef](#)]. [[Medline](#)]
 27. Murayama H, Nishi M, Matsuo E, *et al.* Do bonding and bridging social capital affect self-rated health, depressive mood and cognitive decline in older Japanese? A prospective cohort study. *Soc Sci Med* 2013; 98: 247–252. [[Medline](#)] [[CrossRef](#)]
 28. Oka M, Kubota T, Tsubaki H, *et al.* Analysis of impact of geographic characteristics on suicide rate and visualization of result with Geographic Information System. *Psychiatry Clin Neurosci* 2015; 69: 375–382. [[Medline](#)] [[CrossRef](#)]
 29. Oka M, Kubota T, Tsubaki H, *et al.* Relationship between geographical characteristics and suicide rate in Wakayama Prefecture: Its visualization using geographic information system and consideration on the index of regional disparities. *Nippon Koshu Eisei Zasshi* 2017; 64: 36–41 (in Japanese, not available abstract in English). [[Medline](#)]
 30. Hikichi H, Kondo N, Kondo K, *et al.* Effect of a community intervention programme promoting social interactions on functional disability prevention for older adults: propensity score matching and instrumental variable analyses, JAGES Taketoyo study. *J Epidemiol Community Health* 2015; 69: 905–910. [[Medline](#)] [[CrossRef](#)]
 31. Yazawa A, Inoue Y, Fujiwara T, *et al.* Association between social participation and hypertension among older people in Japan: the JAGES Study. *Hypertens Res* 2016; 39: 818–824. [[Medline](#)] [[CrossRef](#)]
 32. Inoue Y, Stickley A, Yazawa A, *et al.* Neighborhood characteristics and cardiovascular risk among older people in Japan: findings from the JAGES project. *PLoS ONE* 2016; 11: e0164525. [[Medline](#)] [[CrossRef](#)]