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Do bonding and bridging social capital affect self-rated health, depressive mood and cognitive decline in older Japanese? A prospective cohort study

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ABSTRACT

Little is known regarding the longitudinal effects of bonding and bridging social capital on health. This study examined the longitudinal associations of bonding and bridging social capital with self-rated health, depressive mood, and cognitive decline in community-dwelling older Japanese. Data analyzed in this study were from the 2010 (baseline) and 2012 (follow-up) Hatoyama Cohort Study. Bonding social capital was assessed by individual perception of homogeneity of the neighborhood (the level of homogeneity among neighbors) and of networks (the amount of homogeneous personal networks) in relation to age, gender, and socioeconomic status. Bridging social capital was assessed by individual perception of heterogeneity of networks (the amount of heterogeneous personal networks) in relation to age, gender, and socioeconomic status. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to evaluate the effects of baseline social capital on poor health outcome at follow-up by logistic regression analysis. In total, 681 people completed baseline and follow-up surveys. The mean age of participants was 71.8 ± 5.1 years, and 57.9% were male. After adjusting for sociodemographics, lifestyle factors, comorbidity, functional capacity, baseline score of each outcome, and other bonding/bridging social capital, stronger perceived neighborhood homogeneity was inversely associated with poor self-rated health (OR = 0.55, 95% CI = 0.30–1.00) and depressive mood assessed by the Geriatric Depression Scale (OR = 0.58, 95% CI = 0.34–0.99). When participants who reported a depressive mood at baseline were excluded, stronger perceived heterogeneous network was inversely associated with depressive mood (OR = 0.40, 95% CI = 0.19–0.87). Neither bonding nor bridging social capital was significantly associated with cognitive decline assessed by the Mini-Mental State Examination. In conclusion, bonding and bridging social capital affect health in different ways, but they both have beneficial effects on the health of older Japanese. Our findings suggest that intervention focusing on bonding and bridging social capital may improve various health outcomes in old age.

Introduction

Social capital is used to explain health disparities and promote health (Baum & Ziersch, 2003; Kawachi & Berkman, 2000; Lindström, 2008). According to Putnam (1993), social capital refers to "features of social organization, such as trust, norms and networks that can improve the efficacy of society by facilitating coordinated actions (p. 167)". Because social capital is an umbrella concept, subclassification of social capital into some aspects and dimensions is useful for clarifying its effect on health (e.g., Murayama, Wakui, Arami, Sugawara, & Yoshie, 2012). This could be helpful for developing an intervention program to foster social capital. To date, several classification systems for social capital have been suggested (Harpham, Grant, & Thomas, 2002; Putnam, 1993; Szreter & Woolcock, 2004) of which the concept of bonding and bridging social capital has credence. According to Szreter and

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Woolcock (2004), bonding social capital refers to aspects of "inward-looking" social networks that reinforce exclusive identities and homogeneous groups. Therefore, there are strong ties between members of a network who are similar in terms of sociodemographic or social characteristics (e.g., age, ethnicity, and social class). Bridging social capital refers to "outward-looking" social networks across different social and ethnic groups that do not necessarily share similar identities. Although the importance of distinguishing between these types of social capital is understood, few empirical studies have investigated their individual effects on health.

The first empirical study to examine the association of bonding and bridging social capital with health was reported by Mitchell and LaGory (2002). They showed that higher bridging social capital on an individual level (strength of trust and ties with others of different race and education from the respondent) was associated with less mental distress, whereas bonding social capital had the opposite association in an impoverished community. Following this study, further reports on the association of bonding and bridging social capital with health emerged. Kim, Subramanian, and Kawachi (2006) reported that bonding social capital at the individual (definition based on race/ethnicity, gender, and education) and community (aggregated based on individual responses) levels was associated with better self-rated health, but there was no such association with bridging social capital at both levels among U.S. adults. Beaudoin (2009) studied the two health outcomes of self-rated health and stress, and defined bonding and bridging social capital based on the relationships of an individual with people of (dis)similar race/ethnicity. He found that bonding and bridging social capital on an individual level were associated with better self-rated health, and that bonding social capital was associated with less stress among U.S. adults. Iwase et al. (2012) reported that in Japan, individual-level bridging social capital, which was defined by the number of heterogeneous groups that each respondent participated in, was associated with better self-rated health, particularly among women.

Despite the growing literature on evidence for an association between bonding/bridging social capital and health, this association remains inconclusive, and some issues need to be addressed. First, almost all of the previous studies used cross-sectional designs that failed to identify causality. Longitudinal studies are required to understand the effect of social capital on health. Poulsen et al. (2012) reported the only longitudinal study to date examining the effects of bonding and bridging social capital on mortality; however, they failed to find any significant link between these factors. Second, the health outcomes included by previous studies were limited. Most previous studies used either self-rated or mental health (e.g., stress) as their outcome. Exploring the effects of bonding and bridging social capital on various types of health outcomes could lead to a broader understanding of their importance, possibly leading to interventions and health policies. Third, most studies considering bonding and bridging social capital and health were conducted in Western countries. Only three studies based in Asia have been reported, including two Japanese studies (Iwase et al., 2012; Norstrand & Xu, 2012; Ueshima et al., 2010). In Japan, which has a relatively collectivist society with intense group ties, people feel comfortable under systems of mutual assurance and monitoring among residents within a community (Nakane, 1970; Yamagishi, Cook, & Watabe, 1998; Yamagishi & Yamagishi, 1994). Therefore, considering the difference in cultural and historical backgrounds between Japan and Western countries, it is important to explore the association between bonding and bridging social capital and health in Japan.

In this study, data were analyzed from a cohort study of community-dwelling older Japanese. Three types of health outcomes were used: self-rated health (as an indicator of general health), depressive mood (as a measure of psychological health), and cognitive decline (as a measure of cognitive health). These three factors are known to effect functional decline in old age (Stuck et al., 1999). In Japan, measures of depression and cognitive decline are considered good indicators for developing policies for long-term care prevention (Ministry of Health, Labour and Welfare, 2012). The purpose of this study was to examine the longitudinal association of bonding and bridging social capital with self-rated health, depressive mood, and cognitive decline in older Japanese.

Methods

Study population

The Hatoyama Cohort Study consisted of randomly sampled community-dwelling individuals aged 65 years or older, living in the town of Hatoyama in Saitama, Japan. Hatoyama is a suburban area located 50 km northwest of central Tokyo. To recruit the study participants, we used stratified random sampling of four groups classified by age (65–74 and 75–84 years) and residential area of the town (traditional areas and newly developed areas). People with long-term care certification (levels 1–5) and those admitted to hospitals or residing in nursing homes were excluded. In addition to the random sampling recruitment, we recruited study participants using the Hatoyama town bulletin, to permit broader recruitment. Further information on sampling and the participants is described by Murayama, Nishi, et al. (2012).

After using these two methods, 751 people agreed to participate in the Hatoyama Cohort Study. Immediately before the baseline survey, we directly informed participants of the study purpose, method, survey items, and merits of participation, after which nine declined to participate in the study. As a result, a total of 742 people participated in the baseline survey in 2010. Comprehensive information was collected at face-to-face interviews. In 2012, a follow-up survey of the participants in the baseline survey was conducted. Of 742 participants, eight had died, 27 had dropped out between baseline and follow-up surveys (e.g., moved away and health-related exclusion), and 26 were unable to attend the follow-up survey (e.g., health-related reasons and schedule conflicts). In the follow-up survey, a mailed questionnaire option was offered to participants unable to attend the face-to-face interviews. As a result, 681 (91.8%) participants completed both baseline and follow-up surveys (571 attended a face-to-face interview and 110 self-completed the questionnaire at the follow-up survey).

The study protocol was reviewed and approved by the Ethical Committee of the Tokyo Metropolitan Institute of Gerontology, Japan. All subjects gave written consent to participate in this study.

Measurements

Bonding and bridging social capital

There is no standard measure of bonding and bridging social capital. Based on previous studies (Harpham et al., 2002; Kawachi, Subramanian, & Kim, 2008; Poortinga, 2012; Szreter & Woolcock, 2004), a system of assessing bonding social capital using two factors and bridging social capital by a single factor was developed in the baseline study. Previous studies from Western countries have defined bonding and bridging social capital based on relationships with racially or ethnically (dis)similar people (Beaudoin, 2009; Kim et al., 2006; Poortinga, 2012). However, because Japan has little racial and ethnic diversity, we considered that this definition was inappropriate for this study. Therefore, we focused on the (dis) similarity of relationships with regard to age, gender, and socioeconomic status (SES).

For bonding social capital, the perception of homogeneity of neighborhood and personal networks (network homogeneity) was examined. Perceived neighborhood homogeneity was regarded as the level of homogeneity among local residents in their neighborhood in terms of social characteristics. This concept was investigated by asking the participants: "Do you agree that many residents in your neighborhood have similar social characteristics (age, gender, and SES) to yourself?" (1 = agree, 2 = slightly agree, 3 = slightly disagree, and 4 = disagree). The response of "agree" meant that participants thought that there were many residents with similar social characteristics to them, and "disagree" meant that they thought that there were not many residents with such social characteristics. Perceived network homogeneity was regarded as the amount of personal networks with others who have similar social characteristics. This concept was examined with the statement: "Do you agree that you have some networks with people who have similar social characteristics to yourself in your daily life?" (1 = agree, 2 = slightly agree, 3 = slightly disagree, and 4 = disagree). The response of "agree" meant that participants thought that they have some networks with people who have similar social characteristics to them, and "disagree" meant that they thought that they have few such networks.

Bridging social capital was assessed by perception of the heterogeneity of participants' networks (network heterogeneity). Network heterogeneity was regarded as the amount of personal networks with others who have dissimilar social characteristics, and this was addressed with the statement: "Do you agree that you have some networks with people who have dissimilar social characteristics to yourself in your daily life?" (1 = agree, 2 = slightly agree, 3 = slightly disagree, and 4 = disagree). The response of "agree" meant that participants agreed that they have some networks with people who have dissimilar social characteristics to themselves, and "disagree" meant that they thought that they have few such networks. Responses for the three questions were classified into two categories: stronger (responses 1 and 2) and weaker (responses 3 and 4).

We assumed that homogeneous and heterogeneous networks were not opposite concepts to each other because these were defined as the amount of networks that the respondents had. Therefore, some people would have homogeneous and heterogeneous networks, while some would have neither of these networks.

Individual-level social capital was the focus of this study. Although the precise definition and measurement of social capital are controversial (Baum & Ziersch, 2003; Kawachi et al., 2008), it remains important to determine the association between individual social capital and health. This is because individual social capital indices are components of aggregated measurements of community social capital (Harpham, 2008). Moreover, individuals are one of the essential units of health intervention. Therefore, investigating the effect of individual-level social capital on health could contribute to developing interventions that target individual perceptions and behavior.

Health outcomes

Self-rated health, depressive mood, and cognitive decline were measured in baseline and follow-up surveys. Self-rated health was assessed by the question "How would you rate your current overall health?" Respondents answered on a four-point Likert scale (1 = good, 2 = slightly good, 3 = slightly poor, and 4 = poor). Responses were dichotomized into "good" (1 and 2) and "poor" (3 and 4). Depressive mood was assessed using the Geriatric Depression Scale (GDS) short-form (Burke, Roccaforte, & Wengel, 1991; Schreiner, Hayakawa, Morimoto, & Kakuma, 2003). Respondents answered dichotomized questions, and the answers were summed (range of scores: 0–15). Cronbach's alpha at baseline was 0.77. A cutoff point of 5/6 was adopted, and a score of ≥6 indicated depressive mood (Schreiner et al., 2003).

Cognitive decline was assessed with the Mini-Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975; Tombaugh & McIntyre, 1992), which was administered by trained personnel. The MMSE is widely used as a brief screening test for dementia and is a measure of global cognitive ability. The MMSE consists of 11 questions, and the score ranges from 0 to 30, with a lower score indicating poorer global cognitive ability. In this study, a cutoff point of 26/27 was adopted, and a score of ≤26 indicated cognitive decline (Kukull et al., 1994). At the follow-up survey, the MMSE was only administered to participants who were interviewed face-to-face.

Covariates

Baseline data on age, gender, marital status, SES, lifestyle factors, comorbidity, and functional capacity were used as covariates in the analysis of this study. Marital status was categorized as "married" or "not married" (unmarried, divorced, and widowed). SES included educational attainment and long-term occupation. Lifestyle factors included smoking status and body mass index (BMI). BMI was calculated from measured height and weight (kg/m^2). Information on comorbidity was assessed in a medical interview by a doctor or registered nurse and included the following five diseases: hypertension, cardiovascular disease, cerebrovascular diseases, hyperlipidemia, and diabetes mellitus.

Functional capacity included basic activities of daily living (BADL) and instrumental activities of daily living (IADL). BADL was measured using five actions: walking, eating, bathing, dressing, and toileting. IADL was measured by five actions: the ability of the participant to use public transport (bus or train), shop for daily necessities, prepare meals, pay bills, and handle banking. The ability of an individual to perform each action was assessed by 1 = yes or 0 = no. The actions were summed to give a score between 0 and 5. A higher score indicated greater independence, with a score of 5 indicating complete independence.

Statistical analysis

First, intercorrelation between bonding and bridging social capital was assessed by Cramér's V. Logistic regression analyses were then used to examine the associations of bonding and bridging social capital with health outcomes. In Model 1, we regressed each outcome variable at follow-up into each social capital indicator at baseline, adjusting for age, gender, marital status, SES, and each baseline outcome variable (i.e., when self-rated health was used as the outcome, self-rated health at baseline was adjusted for). In Model 2, we also controlled for lifestyle factors and comorbidity, and functional capacity in Model 3. In Model 4a, we added two other bonding/bridging social capital indicators simultaneously. Finally, to check the robustness of the effects of bonding and bridging social capital on health outcomes, additional analysis was performed excluding the participants who reported poor health for each health outcome at baseline in Model 4b. Odds ratios (ORs) and 95% confidence intervals (CIs) for poor health were calculated. A p-value of <0.05 was considered statistically significant (two-sided test). All analyses were conducted with IBM SPSS Statistics 20.

Results

Table 1 shows the characteristics of the participants. All participants scored full points on the BADL, indicating that all had BADL independency. Therefore, BADL was not used as a variable in the logistic regression models. Responses to questions on social

Table 1
Characteristics of participants ($n = 681$).

		No. of respondents	Mean ± SD or n (%)[a]
Baseline (2010)			
Age		681	71.8 ± 5.1
Gender	Male	681	394 (57.9)
Marital status	Not married	679	111 (16.3)
Socioeconomic status			
Education attainment	12 years or less	681	444 (65.2)
Long-term occupation		680	
	White-collar job		361 (53.1)
	Blue-collar job		168 (24.7)
	Unemployed/ housewife		151 (22.2)
Lifestyle factors			
Smoking status	Current smoker	680	75 (11.0)
Body mass index (kg/m^2)		679	23.5 ± 3.0
Comorbidity		681	
	0		171 (25.1)
	1		249 (36.6)
	≥2		261 (38.3)
Functional capacity			
Basic activities of daily living	Dependent (score of 0–4)	680	0 (0.0)
Instrumental activities of daily living	Dependent (score of 0–4)	680	26 (3.8)
Bonding social capital			
Perceived neighborhood homogeneity	Stronger	679	506 (74.5)
Perceived homogeneous network	Stronger	680	449 (66.0)
Bridging social capital			
Perceived heterogeneous network	Stronger	677	207 (30.6)
Self-rated health	Poor	681	94 (13.8)
GDS	≥6	680	81 (11.9)
MMSE	≤26	675	64 (9.5)
Follow-up (2012)			
Self-rated health	Poor	673	106 (15.8)
GDS	≥6	656	104 (15.9)
MMSE	≤26	569	59 (10.4)

GDS: Geriatric Depression Scale; MMSE: Mini-Mental State Examination.
[a] Mean, SD, and percentage were calculated based on the number of respondents for each variable.

capital showed that 75% of respondents felt that their neighborhood was homogeneous. A total of 66% of respondents felt that they had a stronger homogeneous network, while 31% felt that they had a stronger heterogeneous network. The interrelationships between bonding and bridging social capital were 0.13 ($p = 0.001$) between perceived neighborhood homogeneity and perceived homogeneous network, 0.02 ($p = 0.589$) between perceived neighborhood homogeneity and perceived heterogeneous network, and 0.10 ($p = 0.007$) between perceived homogeneous network and perceived heterogeneous network.

Table 2 shows the adjusted ORs and 95% CIs for outcomes according to levels of bonding and bridging social capital assessed at baseline. For self-rated health, stronger perceived neighborhood homogeneity was negatively associated with poor self-rated health (OR = 0.55, 95% CI = 0.30–1.00) and a score of ≥6 on the GDS (OR = 0.58, 95% CI = 0.34–0.99) in Model 4a. Neither bonding nor bridging social capital was associated with cognitive decline, as measured on the MMSE. However, when we used the original four response categories of bonding and bridging social capital in the analysis, although not significant, we found a possible association of perceived heterogeneous networks with cognitive decline (OR = 0.43, 95% CI = 0.12–1.56 in the category of "strong" [1 = agree] compared with that of "weak" [4 = disagree] in Model 4a) (see Supplementary data).

To further check the robustness of our analyses, they were repeated after excluding participants who reported poor health outcomes at baseline. In Model 4b, the association between perceived neighborhood homogeneity and self-rated health was attenuated (OR = 0.66, 95% CI = 0.32–1.38). However, the association between perceived neighborhood homogeneity and the GDS remained significant and strengthened (OR = 0.39, 95% CI = 0.21–0.73), and that between perceived heterogeneous networks and the GDS became significant (OR = 0.40, 95% CI = 0.19–0.87).

Discussion

The present study attempted to distinguish between bonding and bridging social capital. We examined their different effects on three health outcomes after 2 years using cohort data of older Japanese. Overall, bonding social capital was associated with self-rated health and depressive mood, and bridging social capital was associated with depressive mood after adjusting for sociodemographics, lifestyle factors, comorbidity, functional capacity, baseline score of each outcome, and other bonding/bridging social capital. This study is the first attempt to examine the longitudinal association of bonding and bridging social capital with various health outcomes. Our results should stimulate further research and discussion on the link between bonding/bridging social capital and health, and also provide guidelines for health promotion policies for both current and future aging societies.

In our study, perceived neighborhood homogeneity, measured as an aspect of bonding social capital, was negatively associated with poor self-rated health and depressive mood. This result is consistent with previous studies, which found that individual bonding social capital is inversely associated with poor self-rated health (Beaudoin, 2009; Kim et al., 2006; Poortinga, 2012) and mental health (Beaudoin, 2009). Similarity among local residents is of greater benefit than dissimilarity. This is because shared personal characteristics elicit perceptions of trust and social resemblance, which may foster the development of a social support system and enhance the flow of information and knowledge in a community (Kawachi & Berkman, 2000). Moreover, residents of cohesive neighborhoods are more likely to form social organizations (Coleman, 1990). Greater need for a service or amenity would develop by gathering people with similar sociodemographics in one community. In such a community, healthcare services or amenities to meet this need are likely to be allocated and maintained (Kawachi & Berkman, 2000). Such services or amenities would in turn have a positive influence on the perception of the health and psychological health of the residents.

Perceived homogeneous networks were not associated with health outcomes in our study, even though this was considered as another aspect of bonding social capital. Hatoyama was developed as a typical commuter town for Tokyo at the end of a period of high economic growth from the mid-1950s through to the mid-1970s. Many young adults and middle-aged people who worked in Tokyo at that time moved to live in Hatoyama with their families, and many stayed as they aged. In Hatoyama in 2010, the proportion of people aged 65 years and older was 26.1% and that of people aged 55 years and older was 48.0%. This proportion substantially exceeds the national average and suggests that Hatoyama has demographic homogeneity. At baseline, three-quarters of participants answered that perceived neighborhood homogeneity was strong where they lived (Table 1). In such a homogeneous society, people could easily find others nearby with a similar background to themselves. Therefore, accessibility to homogeneous networks may be relatively less valuable than access to heterogeneous networks. Moreover, people tend to receive less novel information and ideas or tend to receive these less easily through strong ties (e.g., networks with similar persons, such as family members and close friends) than weak ties (e.g., networks with acquaintances), because strong

Table 2
Individual effects of bonding and bridging social capital on self-rated health, depressive mood, and cognitive decline in older Japanese.

		All participants					Excluding participants who reported poor health for each outcome at baseline	
		% poor health at follow-up	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4a OR (95% CI)	% poor health at follow-up	Model 4b OR (95% CI)
Poor self-rated health								
Bonding social capital								
Perceived neighborhood homogeneity	Weaker	24.6	1	1	1	1	11.5	1
	Stronger	12.8	0.50 (0.29–0.87)	0.50 (0.28–0.91)	0.55 (0.30–1.00)	0.55 (0.30–1.00)	6.6	0.66 (0.32–1.38)
Perceived homogeneous network	Weaker	17.0	1	1	1	1	7.8	1
	Stronger	14.9	1.00 (0.58–1.71)	0.79 (0.44–1.41)	0.79 (0.44–1.42)	0.85 (0.46–1.54)	7.7	0.83 (0.40–1.73)
Bridging social capital								
Perceived heterogeneous network	Weaker	16.2	1	1	1	1	7.6	1
	Stronger	15.1	1.14 (0.66–1.98)	1.02 (0.55–1.89)	1.04 (0.56–1.93)	1.01 (0.54–1.88)	8.3	1.07 (0.51–2.26)
GDS ≥6								
Bonding social capital								
Perceived neighborhood homogeneity	Weaker	24.0	1	1	1	1	18.1	1
	Stronger	13.0	0.61 (0.37–0.99)	0.58 (0.34–0.97)	0.61 (0.36–1.02)	0.58 (0.34–0.99)	7.8	0.39 (0.21–0.73)
Perceived homogeneous network	Weaker	21.1	1	1	1	1	10.4	1
	Stronger	13.0	0.74 (0.45–1.20)	0.80 (0.48–1.33)	0.79 (0.47–1.32)	0.82 (0.48–1.39)	10.0	1.10 (0.58–2.09)
Bridging social capital								
Perceived heterogeneous network	Weaker	17.7	1	1	1	1	12.3	1
	Stronger	12.1	0.59 (0.34–1.02)	0.60 (0.34–1.02)	0.61 (0.34–1.09)	0.59 (0.33–1.06)	5.7	0.40 (0.19–0.87)
MMSE ≤26								
Bonding social capital								
Perceived neighborhood homogeneity	Weaker	14.4	1	1	1	1	6.6	1
	Stronger	9.1	0.82 (0.42–1.60)	1.08 (0.55–2.12)	1.06 (0.52–2.18)	1.06 (0.51–2.18)	7.0	1.64 (0.67–4.01)
Perceived homogeneous network	Weaker	12.0	1	1	1	1	7.2	1
	Stronger	9.6	0.93 (0.49–1.77)	0.99 (0.50–1.93)	0.96 (0.49–1.91)	0.96 (0.48–1.91)	6.7	0.83 (0.38–1.82)
Bridging social capital								
Perceived heterogeneous network	Weaker	9.9	1	1	1	1	7.2	1
	Stronger	11.6	1.04 (0.54–1.99)	1.08 (0.55–2.12)	1.11 (0.56–2.20)	1.10 (0.55–2.19)	6.1	0.95 (0.43–2.10)

CI: confidence interval; GDS: Geriatric Depression Scale; MMSE: Mini-Mental State Examination; OR: odds ratio.
Model 1: age, gender, marital status, educational attainment, long-term occupation, each outcome variable at baseline, and neighborhood homogeneity/homogeneous network/heterogeneous network.
Model 2: Model 1 + smoking status, body mass index and comorbidity.
Model 3: Model 2 + instrumental activities of daily living.
Model 4a: Model 3 + other two social capital variables.
Model 4b: each outcome variable at baseline was excluded from Model 4a.

ties have some redundancy (Granovetter, 1973). Therefore, the possession of homogeneous networks might not have affected health outcomes in this study.

We found that people with stronger perceived heterogeneous networks, which were measured as an indicator of bridging social capital, were unlikely to be depressed. This result supports findings from previous studies (Erickson, 2003; Mitchell & LaGory, 2002). Our study was based on a prospective longitudinal design. Therefore, our study provides dynamic evidence for the relationship between bridging social capital and depression. Bridging ties involving dissimilar persons is important for obtaining outside information and assistance from diverse resources to address challenges (Putnam, 2000; Wellman & Wortley, 1990). Particularly later in life, people experience changes in various factors, such as social function (e.g., retirement), social relations (e.g., death of a spouse and friends), and physical condition (e.g., chronic disease and disability) (Müller-Spahn & Hock, 1994; Rowe & Kahn, 1997). In fact, symptom scale-based studies of depression show an increasing rate of depression with age (Luppa et al., 2012; Stordal et al., 2001). In such a period of change, people with richer perceived heterogeneous networks are able to access a wider variety of resources than those with weaker ones, which is beneficial for their mental condition.

The present study also found that a strong perceived heterogeneous network was possibly associated with less cognitive decline compared with a weak heterogeneous network. Previous studies have reported that rich social networks help to prevent cognitive decline in old age (Crooks, Lubben, Petitti, Little, & Chiu, 2008; Holtzman et al., 2004; Zunzunegui, Alvarado, Del Ser, & Otero, 2003). This study confirms the importance of heterogeneous social networks as in these previous studies. Granovetter (1973) argued that weak ties with acquaintances who sometimes have different values, styles, and social standing can provide novel information and inspiring ideas. The association between a heterogeneous network and cognitive decline did not reach statistical significance in the present study. However, our results suggest that such information and ideas obtained through heterogeneous networks might stimulate cognitive function and protect against cognitive decline. Further examination of this issue using a larger sample size and longer follow-up period is necessary.

Excluding participants who reported a depressive mood at baseline strengthened the effects of bonding and bridging social capital on lessening depression (Model 4b). We conclude that both types of social capital may prevent the onset of depressive mood. In contrast, excluding those with poor self-rated health possibly reduced our ability to detect a statistically significant association between perceived neighborhood homogeneity and self-rated health, resulting in an imprecise risk estimate. An alternative interpretation is that neighborhood homogeneity helps people with poor self-rated health at baseline to recognize their own health better during the follow-up period.

The current study has several limitations. First, measurements for bonding and bridging social capital were developed in this study. Further examination of the validity and reliability of these

measurements would be useful. We cannot rule out the possibility that these items are double-barreled. In the example of perceived homogeneous network, we intended to ask the respondents about the amount of networks with people who have similar social characteristics to themselves in their daily life. However, some respondents might misunderstand the phrase "the amount of networks with people who have similar social characteristics", where the emphasis is on the similarity of social characteristics. Therefore, the response of "disagree" might indicate that participants have some networks with people who have dissimilar social characteristics to them. We thought that the respondents correctly understood our intention because the correlation between homogeneous network and heterogeneous network was weak (Cramér's V was 0.10). However, the findings of this study should be carefully interpreted, and more robust items about bonding and bridging social capital should be developed. Second, data for this study came from a single suburban area of Tokyo. Therefore, the generality of these findings should be examined by conducting further studies in various settings. Third, the possibility of an effect of healthy volunteers must be considered. Our study participants tended to be healthy and wealthy compared with the Japanese average (Murayama, Nishi, et al., 2012), and perhaps people with depression or cognitive impairment tended not to participate. In particular, in the analysis using the MMSE as outcome, we used the data of participants who performed a face-to-face MMSE at baseline and follow-up surveys. This might have caused selection bias. In fact, for participants who had a questionnaire mailed for the follow-up survey, there was a higher proportion of people with an MMSE $\leq$26 at baseline than that among participants who had a face-to-face interview at the follow-up survey ($p < 0.001$, data not shown). This suggests that the association between social capital and health outcomes was underestimated.

In conclusion, the present longitudinal study provides evidence that bonding and bridging social capital have different effects on health outcomes, but all of these effects are beneficial to the health of older Japanese. Therefore, intervention focusing on bonding and bridging social capital may improve various health outcomes in old age.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.socscimed.2013.09.026.

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ORIGINAL PAPER

Social support and suicidal ideation in Japan: are home visits by commissioned welfare volunteers associated with a lower risk of suicidal ideation among elderly people in the community?

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Abstract
Aims Social support has consistently been reported to be effective in reducing suicidal ideation. This cross-sectional study was performed to determine whether home visits by commissioned welfare volunteers (i.e., organizations of community residents appointed by national or prefectural governments) are associated with a lower risk of suicidal ideation among the elderly.
Methods In August 2010, questionnaires were sent to all residents aged ≥65 years in three municipalities ($n = 21,232$) in Okayama prefecture, Japan, and 13,929 returned the questionnaire (response rate: 65.6 %). We finally analyzed 11,218 subjects. Both home visits by commissioned welfare volunteers and suicidal ideation within the last 30 days were assessed in the questionnaire. Odds ratios (ORs) and 95 % confidence intervals (CIs) for suicidal ideation were calculated adjusting for age, sex, educational attainment, and marital status. We then additionally adjusted for instrumental and emotional support, separately.
Results The prevalence of suicidal ideation was 10.0 % and higher in women than in men (11.4 % vs. 8.0 %). Home visits were significantly associated with a lower risk of suicidal ideation after adjusting for instrumental and emotional support, respectively (OR: 0.60, 95 % CI: 0.53–0.69; OR: 0.67, 95 % CI: 0.59–0.78). In sex-stratified analysis, the association was clearer for women than for men: the corresponding ORs among women were 0.55 (95 % CI: 0.46–0.65) and 0.61 (95 % CI: 0.52–0.73), whereas they were 0.71 (95 % CI: 0.56–0.90) and 0.78 (95 % CI: 0.61–0.99) among men.
Conclusion Our findings suggest that home visits by commissioned welfare volunteers are significantly associated with lower suicidal ideation among the elderly, particularly in women.

Keywords Commissioned welfare volunteers · Community · Elderly people · Social support · Suicidal ideation

Introduction

The number of suicide victims had exceeded 30,000 per year for the 13 years from 1998 to 2011 in Japan [1]. The suicide rate of the elderly aged 60 years or over was about 26.9 per 100,000 annually in 2011, which was higher than the national average (24.0 per 100,000) [2]. Indeed, the elderly account for about one-third of all suicide victims [2]. Thus, how to prevent suicide among the elderly is an urgent problem for the Japanese society, where the suicide rate has been continuously ranked within the top ten countries internationally [3].

Training general physicians for early detection and treatment of depressive patients with antidepressants has

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been proven to be effective [4, 5]. In Japan, research on suicide prevention yielded a two-step depression screening method, which consists of a brief self-reporting questionnaire to detect those who are at risk for suicide in the first step and assessment performed by public health nurses or psychiatrists in the second step [6]. The two-step method has effectively utilized community resources to detect high-risk individuals to provide medical interventions. In addition to these studies, recent investigations have focused on a comprehensive approach to employ multiple community resources. For example, Ono et al. [7] proposed a comprehensive community suicide prevention program, named NOCOMIT-J. This program endeavors to integrate a wide range of community resources, including education, group activities, and gatekeeper training. Community resources are expected not only to detect high-risk individuals, but also to enhance the community's support system to protect residents from suicide intentions. Hegerl et al. [8] also reported a similar comprehensive suicide prevention program, named OSPI Europe (Optimizing Suicide Prevention Programs and Their Implementation in Europe). This study was performed to determine the community resources that are effective ingredients for suicide prevention in the elderly.

Social support is one of the most extensively investigated community resources for suicide prevention [9–12]. Previous studies on social support have focused mainly on social support from family, friends, relatives, and neighbors. There are many other community resources that have not been studied, such as volunteer groups. In Japan, we have unique voluntary organizations, "commissioned welfare volunteers," which are familiar to the elderly. Commissioned welfare volunteers are half private and half public. That is, they are officially assigned to their work by the local government, but are not employed by the government. Commissioned welfare volunteers started their activities before the 1950s, when Japan still suffered from poor hygiene, malnutrition, life-threatening infection, including tuberculosis, and high infant mortality. Due to financial restrictions, the Japanese government decided to utilize the private sector to organize public health activities to improve people's hygiene and well-being [13].

In this study, we focused on the following three types of commissioned welfare volunteers: *Minsei-iin*, *Aiiku-iin*, and *Eiyo-iin*. The numbers of each type of volunteers were 2,349, 12,963, and 7,457, respectively, as of 2010 [14, 15]. The activities of the three types of volunteers overlap considerably with each other [13, 16, 17]. The shared features among all organizations include being attentive to local residents' well-being and health, providing advice or support on financial, interpersonal, and health affairs, and giving information on those with difficult problems to health professionals and the local government [18]. The commissioned volunteers have often been recruited from influential individuals in their local neighborhood and are proud of their activities. The local government provides organizational support, including management and holding regular meetings and training courses to the volunteers' activities with no salary paid. Home visits are not strictly predetermined duties, but the volunteers can judge whom to visit on the basis of the needs of the residents [16, 18]. The numbers of total home visits by *Minsei-iin,Aiiku-iin*, and *Eiyo-iin* for the whole population in Okayama prefecture were 200,147, 1,013,501, and 128,216, respectively, as of 2010 [14, 15]. The detailed information on their visits is not officially reported. In summary, the arrangement of their activities including home visits relies on their self-active judgment to some extent, but the quality of their activities is maintained by backup systems by the local government. Commissioned welfare volunteers play an important role in the lives of community residents, but to date their effectiveness has not been studied.

Accordingly, we decided to examine the association between commissioned welfare volunteer activities, particularly home visits, and suicidal ideation. To our knowledge, this is the first study of this relationship. We hypothesized that home visits by commissioned welfare volunteers may be associated with a lower risk of suicidal ideation adjusting for other types of social support. Here, we focus on the present activities of commissioned welfare volunteers for innovative and effective design of suicide prevention programs.

Methods

Participants

Data were obtained from the Okayama Mental Health Survey of Elderly People, a cross-sectional complete community survey conducted in three municipalities in Okayama prefecture, Japan. This survey was designed to investigate the associations of social support with subjective health perception and mental health problems, including suicidal ideation, in community-dwelling elderly people. The surveyed municipalities were located in the northern and rural areas of the prefecture. The size of the total population in the three municipalities was 61,388 in 2010. The average population aging rates (the number of people 65 years or over in the population) of the three municipalities were 34.6, 35.4, and 37.0 % (in total, 35.5 %), which were higher than those of Okayama prefecture (25.3 %) and Japan as a whole (23.4 %) as of 2011 [19]. This indicates that the surveyed areas were all highly aging districts. They are all rural areas in the prefecture and are close to each other geographically, which we expected

a priori to control the demographical features of the population among them.

From August 2010 to October 2010, the prefectural government conducted a postal survey of all residents aged 65 years or over (n = 21,232) in the three municipalities and 13,929 questionnaires were returned (response rate: 65.6 %). We excluded 2,711 subjects with missing values related to home visits by commissioned welfare volunteers, suicidal ideation, or sex. Thus, we finally analyzed 11,218 subjects.

A thorough explanation about the aim of the survey was provided on the cover of the questionnaire. When residents did not agree to participate in this survey, they could freely choose not to respond without any disadvantages. It was therefore considered that return of the questionnaire indicated informed consent. The investigators obtained data from the Okayama Prefectural Government and removed personal identifiers. The study protocol was reviewed and approved by the Ethics Committee on the Research of Epidemiology at Graduate School of Medicine, Dentistry and Pharmaceutical Sciences, Okayama University.

Measures

Exposure

We conceptualized social support as consisting of the following three sub-scales: instrumental support, emotional support, and providing support, which means opportunities to provide support to others, derived from the Measurement of Social Support-Elderly (MOSS-E) [20]. We focused on instrumental and emotional support, receiving aspects of social support, in the present paper because our primary interest was the effect of home visits by commissioned welfare volunteers from whom the elderly people were expected to receive social support. We utilized three items regarding instrumental support [shopping (SS1), cleaning and cooking (SS2), offering to run errands (SS3)], three of the four items regarding emotional support [reassure (SS4), be on the side of (SS5), take care of (SS6)]. We did not use the question, "Do you have someone who attentively listens to your worries or anxieties?" because in a Japanese cultural context this question overlaps with item SS4 ("Do you have someone who is on your side when you are in a worrisome or difficult situation?"). We asked another question regarding our hypothesis, "Do commissioned welfare volunteers, either *Aiiku-iin*, *Minsei-iin*, and/or *Eiyo-iin*, visit your home?" (SS7), which was used as the exposure of primary interest. We did not put special emphasis on or exclude any volunteer organizations. The answers to all of the above questions were either "yes" or "no," and responses were summed (Yes = 1, No = 0) to obtain scores for instrumental support (SS1–3) and emotional support (SS4–6). These two sub-categories have sufficiently high internal consistency (Cronbach's alpha = 0.81 for both sub-categories). We also summed the seven responses as total social support (SS1–7) (Cronbach's alpha = 0.82).

Outcome

Suicidal ideation at the time of the survey was evaluated by a single item as follows: "Do you feel so depressed that you have thought about committing suicide at some point in the last 30 days?" The answer to the questions was either "yes" or "no." Awata et al. [21] adopted a similar question without specifying the period to detect the elderly with suicidal ideation in a previous community survey.

Covariates

To comprehensively and briefly assess psychosocial characteristics of the elderly, the questionnaire included items pertaining to socio-demographic variables (age, gender, educational attainment, and marital status) and instrumental activities of daily living (IADL). We used educational attainment (junior high school or lower; high school; college or higher) as an indicator of socioeconomic status, which has been used frequently for mental health problems, including depression [22, 23] and suicide [24]. Socioeconomic status has been reported to be an important determinant of risk for suicide in many countries [25], including Japan [26]. Although previous studies have also employed other indicators of socioeconomic status, such as employment and income, we did not use employment status in this study because most of the study subjects were expected to have retired. The information about income was not available as the local government did not permit its disclosure due to the private information protection. We included marital status as a covariate, because previous literature demonstrated that marital status exerted influence on the suicidal ideation in community-dwelling elderly residents [27, 28]. Subjects were divided into two categories according to marital status: "living together" or "not living together." The latter included "divorced," "widowed," "single," and "separated or institutionalized."

IADL was assessed with the Instrumental Activities of Daily Living Scale devised by Lawton and Brody [29]. We included these questions in the questionnaire because previous reports indicated that ADL limitations were an important correlate of suicidal ideation in the elderly [30]. This scale is composed of eight questions designed to assess independent living skills, including ability to use the telephone (IADL1), shopping (IADL2), food preparation (IADL3), home making (IADL4), laundry (IADL5), mode of transportation (IADL6), responsibility for own medication (IADL7), and ability to handle finances (IADL8). The

Table 1 Characteristics of the study subjects, Okayama, Japan, 2010

Characteristics	Total (N = 11,218)	Men (N = 4,525)	Women (N = 6,693)
Mean age, year (SD)	76.7 (7.3)	76.0 (6.9)	77.1 (7.5)
Suicidal ideation, *n* (%)			
Yes	1,124 (10.0)	360 (8.0)	764 (11.4)
No	10,094 (90.0)	4,165 (92.0)	5,929 (88.6)
Social support (SS1-7)			
Shopping (SS1), *n* (%)			
Yes	1,320 (11.8)	538 (11.9)	782 (11.7)
No	9,898 (88.2)	3,987 (88.1)	5,911 (88.3)
Cleaning and cooking (SS2), *n* (%)			
Yes	2,011 (17.9)	603 (13.3)	1,408 (21.0)
No	9,207 (82.1)	3,922 (86.7)	5,285 (79.0)
Offer to run errands (SS3), *n* (%)			
Yes	1,697 (15.1)	636 (14.1)	1,061 (15.9)
No	9,521 (84.9)	3,889 (85.9)	5,632 (84.2)
Reassure (SS4), *n* (%)			
Yes	1,647 (14.7)	709 (15.7)	938 (14.0)
No	9,571 (85.3)	3,816 (84.3)	5,755 (86.0)
Be on the side of (SS5), *n* (%)			
Yes	1,986 (17.7)	672 (14.9)	1,314 (19.6)
No	9,232 (82.3)	3,853 (85.2)	5,379 (80.4)
Take care of (SS6), *n* (%)			
Yes	1,397 (12.5)	533 (11.8)	864 (12.9)
No	9,821 (87.6)	3,992 (88.2)	5,829 (87.1)
Home visits by commissioned welfare volunteers (SS7), *n* (%)			
No	4,061 (36.2)	1,757 (38.8)	2,304 (34.4)
Yes	7,157 (63.8)	2,768 (61.2)	4,389 (65.6)
Educational attainment, *n* (%)			
Junior high school or lower	4,992 (47.1)	2,108 (48.4)	2,884 (46.1)
High school	4,615 (43.5)	1,782 (40.1)	2,833 (45.3)
College or higher	996 (9.4)	463 (10.6)	533 (8.5)
Missing	615	172	443
Marital status, *n* (%)			
Living together	4,324 (38.6)	888 (19.6)	3,436 (51.3)
Not living together	6,894 (61.5)	3,637 (80.4)	3,257 (48.7)
Instrumental Activities of Daily Living[a], *n* (%)			
Mean scores (SD)		4.33 (1.26)	6.72 (2.19)
Missing		748	2,427

SD standard deviation

[a] Assessed with the Instrumental Activities of Daily Living Scale by Lawton and Brody. Summary scores were obtained by adding IADLs 1, 2, 6, 7, and 8 for men, and IADLs 1–8 for women

areas of food preparation (IADL3), home making (IADL4), and laundry (IADL5) are excluded for men in the original scale scoring system, according to their traditional gender role. The responses were coded as 0 (low function) or 1 (high function) according to the original protocol and were summed to obtain scores, with higher values being indicative of higher function. The summary score ranged from 0 to 5 for men and from 0 to 8 for women. We treated the summary score as a continuous variable. Due to the large number of missing values for IADL (748 for men, 2,368 for women), we decided to adjust for IADL only in a supplementary analysis.

Statistical analysis

We conducted logistic regression analysis to examine the relationships between home visits by commissioned welfare volunteers and suicidal ideation. After examining the crude association, we adjusted for age, sex, educational attainment, and marital status in Model 1. We subsequently adjusted for instrumental support in Model 2 and emotional support in Model 3. We did not simultaneously adjust for the two sub-categories of social support because of their strong correlation (Pearson's correlation coefficient = 0.66). In contrast, home visits by commissioned

Table 2 Mean and median sores of social support and its two sub-categories, Okayama, Japan, 2010

	Total (n = 11,218)		Men (n = 4,525)		Women (n = 6,693)		
	Mean (SD)	Median	Mean (SD)	Median	Mean (SD)	Median	P value
Social support (SS1-7)	5.74 (1.83)	6	5.79 (1.82)	7	5.70 (1.84)	6	0.005
Instrumental support (SS1-3)	2.55 (0.91)	3	2.61 (0.88)	3	2.51 (0.92)	3	<0.001
Emotional support (SS4-6)	2.55 (0.91)	3	2.58 (0.91)	3	2.53 (0.91)	3	<0.001

SD standard deviation

P values were obtained by examining differences between sexes by using Wilcoxon's ranked sum test

welfare volunteers correlated less with instrumental and emotional support (Pearson's correlation coefficient = 0.20 for instrumental support; 0.24 for emotional support). Subsequently, we repeated the logistic regression analysis by stratifying according to sex. Furthermore, as a supplementary analysis, we additionally adjusted for IADL as a covariate because IADL was scored differently between sexes.

Odds ratios (ORs) and 95 % confidence intervals (CIs) for suicidal ideation were calculated. P values were considered statistically significant at 0.05 (two-sided test). All statistical analyses were performed using Stata/SE version 12.1 (Stata Corp LP, College Station, TX, USA).

Results

Table 1 shows the demographic characteristics of the study subjects (men/women = 4,525/6,693). The number of subjects with suicidal ideation was 1,124, corresponding to 10.0 % of the subjects. The proportion of women with suicidal ideation (11.4 %) was significantly higher than that of men (8.0 %) ($P < 0.001$ Chi-squared test). Home visits were significantly more common for women (65.6 %) than for men (61.2 %) ($P < 0.001$ Chi-square test).

Table 2 shows the mean and median scores of social support (SS1-7), instrumental support (SS1-3), and emotional support (SS4-6). All were significantly different between sexes ($P < 0.01$, Wilcoxon's ranked sum test).

Table 3 shows ORs for suicidal ideation according to home visits by commissioned welfare volunteers. Home visits by commissioned welfare volunteers were significantly associated with lower suicidal ideation in the crude model. When we adjusted for all covariates in Model 1, the association remained statistically significant (OR: 0.55, 95 % CI: 0.48–0.63, $P \leq 0.001$). In Models 2 and 3, we additionally adjusted for instrumental and emotional support. Home visits remained significantly associated with lower suicidal ideation in both models. We also noted that both types of social support were significantly associated with lower suicidal ideation. When we conducted analysis including an interaction term between sex and home visits, we found that the interaction effect was statistically significant (OR: 0.80, 95 % CI: 0.65–0.98, $P = 0.031$).

Accordingly, we conducted logistic regression analysis by stratifying according to sex (Table 4). Overall, we found significant associations between home visits and lower suicidal ideation in both sexes, although the point estimates of ORs among men were closer to 1, compared to those in women. We also noted that both types of social support were significantly associated with lower suicidal ideation for both sexes, except for instrumental support among men (Model 2). When we additionally adjusted for IADL as a supplementary analysis, the results did not substantially change in the sex-stratified analysis (data available from the authors on request).

Discussion

The findings of this study indicate that home visits by commissioned welfare volunteers are significantly associated with lower suicidal ideation for Japanese elderly men and women even after adjusting for socio-demographic variables and other types of social support. Overall, the association was more prominent among women than men. Previous studies have consistently demonstrated that social support improves depression [9, 10] and reduces suicidal ideation [11] and suicide [12]. The present findings are consistent with those reported in the literature. Our findings also show that home visits by commissioned welfare volunteers are associated with a lower risk of suicidal ideation, no less than other forms of social support. Commissioned welfare volunteers thus constitute a unique form of social support in the community as well as instrumental and emotional support.

With respect to social support, both higher instrumental and emotional support were associated with lower suicidal ideation for men and women, although we found a

Table 3 Odds ratios for suicidal ideation associated with home visits by commissioned welfare volunteers, Okayama, Japan, 2010

	Crude model		Model 1[a]		Model 2[b]		Model 3[c]	
	OR	(95 % CI)	OR	(95 % CI)	OR	(95 % CI)	OR	(95 % CI)
Home visits by commissioned welfare volunteers (SS7)								
Yes vs. No	0.56***	(0.49–0.63)	0.55***	(0.48–0.63)	0.60***	(0.53–0.69)	0.67***	(0.59–0.78)
Instrumental support (SS1-3)								
Per 1 increase					0.82***	(0.77–0.88)		
Emotional support (SS4-6)								
Per 1 increase							0.70***	(0.66–0.75)

CI confidence interval, *OR* odds ratio

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

[a] Adjusted for age, sex, educational attainment, and marital status

[b] Adjusted for age, sex, educational attainment, marital status, and instrumental support

[c] Adjusted for age, sex, educational attainment, marital status, and emotional support

marginally significant association for instrumental support among men. The association was particularly notable for emotional support. Previous studies have suggested that emotional support is probably the most important form of social support for mental health [31, 32]. Our results are in accordance with the previous literature on the protective impact of social support, particularly emotional support, on depression [33] and suicide [12, 34]. Home visits were significantly associated with lower suicidal ideation even after adjusting for instrumental or emotional support, particularly for women. In addition, it is notable that they were only mildly correlated with instrumental support (Pearson's correlation coefficient = 0.20) and emotional support (Pearson's correlation coefficient = 0.24). These results suggest that the commissioned welfare volunteers' activities are not totally limited to instrumental and emotional support. Thus, we consider that home visits by the commissioned volunteers are interrelated with, but distinct from, instrumental and emotional support from family, friends, relatives, and neighbors. Our results suggest that home visits are also an important component of social support, no less than instrumental and emotional support.

With regard to gender differences, the association between commissioned welfare volunteers and lower suicidal ideation was more pronounced among women. Kendler et al. [35] reported that the relationship between social support and risk for depression is stronger in women than in men. Oyama et al. [36, 37] reported that suicide prevention through psychoeducation and group activities had limited value in elderly men. It is likely that home visits by commissioned welfare volunteers were not welcomed by men as much as women. Meanwhile, a previous study in Japan examined the association between work-based social networks and self-rated health among workers, and no substantial differences were observed between men and women [38]. The gender differences observed in the present study should be examined in future studies.

Home visits by commissioned welfare volunteers would be relevant for devising effective measures to promote beneficial social relationships including social support. Family support is amenable to educational approaches, while neighborhood social support is not an easy target for intervention. In this regard, commissioned welfare volunteers are unique in three ways. First, the volunteers themselves dwell and are respected within the local community. They are therefore expected to be influential in their residential community. Second, they are well organized and have a close connection with the public sector, including municipal government, prefectural government, and the public health center. Third, they numbered about 28,000 altogether. This is more than 30 times the number of public health nurses who are primarily responsible for community mental health (914 in total as of 2009) [39]. Taking these

Table 4 Odds ratios for suicidal ideation associated with home visits by commissioned welfare volunteers, stratified by sex, Okayama, Japan, 2010

	Crude model OR (95 % CI)	Model 1[a] OR (95 % CI)	Model 2[b] OR (95 % CI)	Model 3[c] OR (95 % CI)
Men				
Home visits by commissioned welfare volunteers (SS7)				
Yes vs. No	0.67*** (0.54–0.83)	0.68** (0.54–0.86)	0.71** (0.56–0.90)	0.78* (0.61–0.99)
Instrumental support (SS1-3)				
Per 1 increase			0.89 (0.78–1.01)	
Emotional support (SS4-6)				
Per 1 increase				0.77*** (0.69–0.87)
Women				
Home visits by commissioned welfare volunteers (SS7)				
Yes vs. No	0.49 *** (0.42–0.57)	0.50*** (0.43–0.60)	0.55*** (0.46–0.65)	0.61*** (0.52–0.73)
Instrumental support (SS1-3)				
Per 1 increase			0.80*** (0.74–0.87)	
Emotional support (SS4-6)				
Per 1 increase				0.67*** (0.62–0.72)

CI confidence interval, *OR* odds ratio

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

[a] Adjusted for age, educational attainment, and marital status

[b] Adjusted for age, educational attainment, marital status, and instrumental support

[c] Adjusted for age, educational attainment, marital status, and emotional support

characteristics into consideration, commissioned welfare volunteers would be valuable resources to promote social support in the community-dwelling elderly, which may become a candidate for lowering suicide risk in this population. The possible methods to be taken would include: increasing the frequency of visits by commissioned welfare volunteers to decrease the loneliness and isolation of the elderly, that is, to enhance the community support system based on population strategy. This should be investigated in future prospective intervention studies.

The present study had the limitation that it was a cross-sectional survey. Therefore, we cannot determine the direction of the cause–effect relationship between commissioned welfare volunteers and lower risk of suicidal ideation. Future prospective studies should focus on interventions to clarify the effects of commissioned welfare volunteers on suicidal ideation. Another limitation is that the final number of samples ($n = 11,218$) included in the analysis was about half of the original population ($n = 21,232$). As the likelihood of responding to the questionnaire may be influenced by the recipient's level of social support as well as the recipient's suicidal ideation, there was a possibility of selection bias. Even under this constraint, however, the ORs were not biased when social support and suicidal ideation were non-interacting (i.e., the effect of social support on responding to the questionnaire is independent of the effect of suicidal ideation on responding to the questionnaire) [40]. The higher proportion of the elderly population in the surveyed municipalities is the third limitation of the present study. Therefore, we cannot generalize the findings of the present report to the population in urban districts where the demographic structure consists of a higher proportion of younger generations than in the surveyed areas. However, the local context of these municipalities, i.e., depopulated areas where the aging rate is extremely high, is similar to other areas in Japan, with aging populations.

Financial constraints will force the country to control specialized medical spending and to find means of utilizing and nurturing social resources of informal and quasi-informal support. It should be emphasized, however, that the present findings do not necessarily mean that informal support and voluntary organizations can substitute for the public sector. As Muramatsu et al. [41] demonstrated, public expenditure is significantly associated with decreased suicidal ideation among those with less informal support. It is therefore important to identify those who cannot receive social support from informal relationships from those who can, to provide support to the former and, if necessary, to help those at high risk to receive specialized services from public health nurses and mental health professionals. In this regard, commissioned welfare