琉球大学学術リポジトリ

[原著]Gender difference in the mediating effect of health-related behaviors on the relationship between neighborhood social capital and self-rated health among community dwelling people in a town of Okinawa

Gender difference in the mediating effect of health-related behaviors on the relationship between neighborhood social capital and self-rated health among community dwelling people in a town of Okinawa

Takehiko Toyosato[1] and Minoru Takakura[1]

[1] *Department of Health Sciences, Faculty of Medicine, University of the Ryukyus, Okinawa, Japan*

ABSTRACT

The aim of the present study was to investigate the mediating effects of health-related behaviors on the relationship between neighborhood trust and self-rated health by gender. We conducted a cross-sectional study in A Town, Okinawa in 2011. A questionnaire survey was sent to 7,425 residents (aged 20-79 years) who were selected random sampling from the Basic Resident Register. The number of responses and response rate were 1,271 (583 men, 688 women) and 17.3%, respectively. The questionnaire consisted of self-rated health as dependent variable, neighborhood trust as independent variable, health-related behaviors (breakfast intake, smoking, alcohol intake, sleeping habits and physical activity) as mediating variables, and socioeconomic and demographic variables as control variables. We applied logistic regression analysis to clarify the mediating effect using the traditional mediational model of Baron and Kenny, and Sobel test. As results, neighborhood trust was significantly associated with self-rated health in both men (adjusted odds ratio [*AOR*] = 3.2, 95% confidence interval [*CI*] = 1.6-5.9) and women (*AOR* = 2.1, 95%*CI* = 1.1-3.9), that the magnitude of the association was higher in men than in women, and that the associations were mediated by health-related behaviors such as alcohol intake in men (Sobel test statistics = 2.07, *p* = 0.038) and sleep duration in women (Sobel test statistics = 2.06, *p* = 0.039). This study suggests the importance of neighborhood social capital for health, especially in men's health, and show that the association was mediated by health-related behaviors; alcohol intake in men and sleep duration in women. Furthermore, the measures to promoting neighborhood social capital might improve drinking behaviors in men and sleep duration in women, and its effect on health behaviors could lead to improved self-rated health. *Ryukyu Med. J., 33 (1, 3) 17~28, 2014*

Key words: neighborhood social capital, self-rated health, health-related behavior, mediating effect, gender difference

INTRODUCTION

As disparities in health status that accompany the economic disparities of recent years have become more evident in Japan, a society must be realized in which community-dwelling people can have equal access to health care and welfare services by encouraging them to trust their neighbors and support each other. Within this context, Healthy Japan 21 (second issue) pointed out the importance of promoting social capital as a means toward this end and focused on "the maintenance and improvement of the social environment," such as correcting disparities in health status and improving health-related lifestyles and social environments[1]. Putnam's definition of social capital commonly adopted in public health research is that features of social organization, such as trust, norms, and networks, can improve the efficacy of society by facilitating coordinated actions[2].

Many studies have examined the association between social capital and health outcomes: mortality[3] , heart disease[4] , depression[5, 6] , well-being[3, 7] , dentate status[8] , and the incidence of functional disability[9] . In addition, many previous studies[3] have examined the relationship between social capital and self-rated health, which is used in many epidemiological studies for its utility in predicting mortality and morbidity[10] . In a meta-analysis of eligible studies conducted in 2013 that assessed the bivariate association of social capital with self-reported health and all-cause mortality, social capital (i.e., trust) increased the odds of good health by 32% (95% CI = 19%, 46%) [11] , indicating that social capital can be considered one of the most important determinants of individual health.

The hypothesized mechanism linking social capital to individual health is that social capital might affect individual health by promoting and controlling an individual's health-related behaviors through facilitation of more rapid access to health information and by exerting norms and social control over deviant health-related behaviors[13] . Although little has been reported on the mechanisms underlying the link between social capital and health outcomes, the Dutch National Survey of General Practice found a positive association between neighborhood social capital and self-rated health, mediated by health-related behaviors such

as physical activity, and concluded that promoting both neighborhood social capital and physical activity might be the most successful approach to improving health[12] . On the other hand, Poortinga's study in Britain revealed no mediated effects on the relationship between neighborhood social capital and self-rated health by health-related behaviors such as smoking, alcohol intake, and fruit and vegetable consumption[14] . A consistent conclusion has yet to be reached on the hypothesis that health behaviors mediate the correlation between social capital and self-rated health. Furthermore, a major cited criticism of previous studies involves the correlation between social capital and self-rated health. Previous studies have not examined the correlation by gender[15] , although some studies have reported gender differences in the relationship between social capital and health[16-18] . For example, Eriksson et al.[17] showed a positive association between social capital and self-rated health in women but not in men [18] . In contrast, Ota H. reported that lower levels of social capital were associated with poorer self-rated health in men but not in women. As mentioned above, both the association between social capital and self-rated health and its mechanism need to be examined by gender.

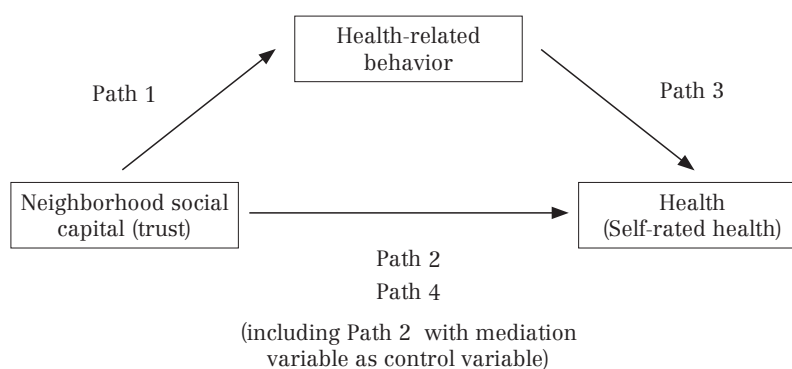The aims of this study are to investigate (1) whether social capital is associated with self-rated

(including Path 2 with mediation
variable as control variable)

Fig. 1   **Illustrates a possible of the mediational model of Baron and Kenny**
Path 1; Association between independent variable (neighborhood trust) and
mediation variable (health-related behaviors).
Path 2 (direct effect); Association between independent variable and dependent
variable (self-rated health).
Path 3; Association between mediation variable and dependent variable.
Path 4; Association between mediation variable and dependent with mediation
variable as control variable.

health; (2) whether the association and magnitude of the association differ by gender; (3) whether the association between social capital and self-rated health is mediated by health behaviors such as breakfast intake, smoking, alcohol intake, sleep duration, and physical activity; and (4) whether the mediating effects differ by gender.

METHOD

In 2011, we conducted a cross-sectional study in A Town, Okinawa Prefecture, Japan. A questionnaire survey was sent to 7,425 residents (aged 20-79 years) who were selected using 30% random sampling by ward, sex, and age from the Basic Resident Register. The number of responses and response rate were 1,271 (583 men, 688 women) and 17.3%, respectively. The study protocol was approved by the Ethics Committee of the University of the Ryukyus.

The main outcome variable was self-rated health, a commonly used indicator of overall health in social epidemiology. Self-rated health was assessed with a single question: "In general, would you say your health is excellent, very good, good, fair or poor?" The response was dichotomized with (1) representing excellent to good health and (0) representing fair or poor health. We measured neighborhood trust as neighborhood social capital with reference to previous studies[19-21]. Neighborhood trust was measured by the single question "People around my neighborhood trust each other." We classified responses into two categories: "trust (1)" representing "totally agree," "agree," and "do not trust (0)" representing "neutral," "don't agree," and "totally don't agree." Five measurements of health-related behaviors, namely, breakfast intake, smoking, alcohol intake, sleeping habits and physical activity served as mediating variables in this study. We measured breakfast intake by asking one question "How often do you eat breakfast?" We collapsed responses into two categories, everyday (1) and sometimes and never (0)[25]. The previous study has been confirmed that the regular intake of breakfast has wide ranging implications for lower body mass index[26], improved appetite control[27], and lack of breakfast was a factor of increasing the risk of deviation of nutrient intake[28]. The smoking question ("Do you smoke?")

contained four alternatives. We collapsed the four-category variable of smoking status into two categories: quitters and non-smokers (1) and non-daily and daily smokers (0)[22]. Alcohol intake was assessed by calculating the amount of total ethanol intake from the number of *gou*（1 *gou* = 180 ml）, drinking frequency, and type of alcohol. The result was converted to amount of ethanol per day. We collapsed the quantity of ethanol consumed in a day into moderate alcohol intake < 23 g/day (1) and binge alcohol intake > 23 g/day (0)[24]. Sleep duration was measured by one question: "How many hours do you sleep in a typical night?" Responses were categorized into four groups: 5 h or less, 6 h, 7 h, and 8 h or more of sleep. Participants' sleep duration was classified into two categories with reference to a previous study. Healthy sleep duration was defined as >7 h (1), and unhealthy sleep duration was defined as <7 h (0)[23]. We used the short version of the International Physical Activity Questionnaire (IPAQ), recommended for the national prevalence studies[29], to assess participants' physical activity. We assigned three categories of physical activity (low, moderate, and high) based on the IPAQ scoring manual[30], which were then classified into two groups, moderate and high PA (1) and low PA (0). Participants were asked about the following socioeconomic and demographic variables: sex, age (20s, 30s, 40s, 50s, 60-64 and 65-79), education level (below high school, high school, vocational school and junior college, and university or higher) and marital status (married, unmarried・divorce, and unmarried). According to age, we collapsed six categories into three categories: 20-39, 40-59 and 60-79, because deflection occurred in the frequency when we put it as a control variable by 10 years old age division. These socioeconomic and demographic variables, which could be potential confounders, served as control variables.

ANALYTIC STRATEGY

We applied logistic regression analysis to estimate the mediating effect of health behaviors on the association between neighborhood trust and self-rated health by gender using SPSS version 20.0J (SPSS, Tokyo, Japan). Sample size required for logistic regression analysis that was used in

Table 1   **Distributions of Sociodemographic,social capital, self-rated health and Health related behaivors**

	Total		Men		Women	
Variables	n	(%)	n	(%)	n	(%)
Age						
20-39	328	(25.8)	129	(23.6)	199	(30.4)
40-59	426	(33.5)	191	(34.9)	235	(35.9)
60-79	443	(34.9)	226	(41.3)	217	(33.2)
Missing	74	(5.8)	37	(0.2)	37	(0.5)
Education level						
Below high school	130	(10.2)	51	(8.7)	79	(11.5)
High school	408	(32.1)	196	(33.6)	212	(30.8)
Junior college / Vocational high school	291	(22.9)	68	(11.7)	223	(32.4)
University	365	(28.7)	230	(39.5)	135	(19.6)
Missing	77	(6.1)	38	(6.5)	39	(5.7)
Marital status						
Married	843	(66.3)	400	(73.1)	443	(67.7)
Bereaved・Divorced	117	(9.2)	37	(6.8)	80	(12.2)
Unmarried	222	(17.5)	104	(19.0)	118	(18.0)
Missing	89	(7.0)	42	(1.1)	47	(2.0)
Neighborhood trust						
Trust	1039	(81.7)	470	(80.6)	569	(82.7)
Mistrust	172	(13.5)	83	(14.2)	89	(12.9)
Missing	60	(4.7)	30	(5.1)	30	(4.4)
Self-rated health						
Good / Very good	1006	(79.2)	449	(77.0)	557	(81.0)
Poor / Very poor	184	(14.5)	93	(16.0)	91	(13.2)
Missing	81	(6.4)	41	(6.0)	40	(5.8)
Breakfast intake						
Everyday eat	974	(76.6)	436	(74.8)	538	(78.2)
Don't or sometime eat	252	(19.8)	128	(22.0)	124	(18.0)
Missing	45	(3.5)	19	(3.3)	26	(3.8)
Smoking						
Non-smoking	1059	(83.3)	449	(77.0)	610	(88.7)
Smoking	166	(13.1)	111	(19.0)	55	(8.0)
Missing	46	(3.6)	23	(3.9)	23	(3.3)
Alcohol intak						
Appropriate drinking	873	(68.7)	296	(50.8)	577	(83.9)
Binge drinking	326	(25.6)	252	(43.2)	74	(10.8)
Missing	72	(5.7)	35	(6.0)	37	(5.4)
Sleep duration						
> 7 h	1118	(88.0)	512	(87.8)	606	(88.1)
< 7 h	121	(9.5)	54	(9.3)	67	(9.7)
Missing	32	(2.5)	17	(2.9)	15	(2.2)
Physical activity						
Moderate-High	477	(37.5)	247	(42.4)	230	(33.4)
Low	727	(57.2)	310	(53.2)	417	(60.6)
Missing	67	(5.3)	26	(4.5)	41	(6.0)

$n = 1,271$

present study, was calculated by Peduzzi P. et al.[32], method; number of explanation variables × 10 = the number of events per predictive variable. In the case of the present study, the computational expression was 5 (number of explanation variables) × 10 = 50 (the minimum number of people with poor self-rated health). The percentages of poor self-rated health which have revealed on the previous study[17, 18] were about 20 % to 25%. The minimum number of participants required in present study was estimated to be from 200 to 400 people on men and women, respectively. As described above, the number of men and women in present study was 583 and 688, respectively, so this study has sufficient sample size. The mediation analysis in this study was broadly adapted from the traditional mediational model of Baron and Kenny[31], which has been used in many studies[19,33] and proved that mediated effect[31], is

appropriate if the following conditions are satisfied (Fig. 1): (a) the association between independent variable (neighborhood trust) and mediating variable (health-related behaviors) (Path 1) is significant; (b) the association between the independent variable and dependent variable (self-rated health) (Path 2) is significant (direct effect); and (c) the association between the mediating variable and dependent variable (Path 3) is significant. Furthermore, on Path 4, which casts the mediating variable as a control variable onto Path 2, the association between the mediating variable and dependent variable is significant. In this Path4, significant decreases in coefficients signify a mediated (indirect) effect of health-related behaviors. To evaluate significant decreases in coefficients, we performed the Sobel test[34] using Preacher's Sobel test web page. The Sobel test has been the best method of testing the significance of

Table 2   **Logistic regression analyses of neighborhood trust on health-related behaviors (Path 1)**

		Breakfast intake[a]		Smoking[b]		Alcohol intake[c]		Sleep duration[d]		Physical activity[e]	
		AOR	(95% CI)	AOR	(95% CI)	AOR	(95% CI)	AOR	(95% CI)	AOR	(95% CI)
Men											
Neighborhood trust	Trust	1.6	(0.9-2.8)	1.1	(0.6-1.9)	**2.0**	(1.2-3.5)	1.1	(0.5-2.5)	1.4	(0.7-2.8)
	Mistrust	1.0		1.0		1.0		1.0		1.0	
Women											
Neighborhood trust	Trust	**1.8**	(1.1-3.0)	2.2	(1.0-4.8)	0.8	(0.4-1.5)	**2.6**	(1.3-5.2)	1.2	(0.7-1.9)
	Mistrust	1.0		1.0		1.0		1.0		1.0	

All models are controlled for age, marital status and education level
[a] Reference category: Don't or sometime eat. [b] Reference category: Smoking. [c] Reference category: Binge drinking. [d] Reference category: < 7 h. [e] Reference category: Low
Stastistical significance are in bold
AOR: adjusted odds ratio. 95%CI: 95% confidence interval.

Table 3   **Logistic regression analyses of self-rated health and neighborhood trust, and health-related behavior on men (Path 2, 3 and 4)**

	Path 2		Path 3		Path 4	
	AOR	(95% CI)	AOR	(95% CI)	AOR	(95% CI)
Neighborhood trust (ref: mistrust)	**3.2**	(1.8-5.9)			**3.0**	(1.7-5.5)
Alcohol intake (ref: binge drinking)			**2.1**	(1.3-3.3)	**2.0**	(1.2-3.1)
Sobel test						
Test statistic					2.070	
S.E					0.250	
p-value					**0.038**	

Dependent variable of all model is self-rated health (Reference category: poor / very poor)
All models are controlled for age, marital status and education level
ref: reference category
Stastistical significance are in bold
AOR: adjusted odds ratio. 95% CI: 95% confidence interval.

mediation effects, because it have been shown to have higher power than another method[35], especially on large enough samples (i.e., n > 400)[36]. For all analyses, we controlled for age, education level, and marital status as potential confounders. To address the issue of missing data for these variables, we imputed missing data using the multiple imputation model and created five imputed data sets pooled together by Rubin's rules[37] using SPSS version 20.0J. Multiple imputation is a method in which missing data are predicted based on known data and on the pattern of the missing data[38]. In the most general methods, participants with missing data are excluded from statistical analysis or missing data are substituted with the average of observed data for that variable in other participants. However, both methods have severe drawbacks potentially leading to smaller sample sizes and resulting in biased estimates and/or standard errors[39]. Such biases can be overcome using multiple imputations that allow individuals with incomplete data to be included in analysis[40].

RESULTS

Table 1 presents the descriptive characteristics of the participants. More than 80% of participants reported that their neighbors trust each other. The proportion of participants who evaluated their general health as good or very good was 79.2%. Regarding health-related behaviors, two-thirds of participants had healthy behaviors for all behaviors except physical activity. Table 2 shows that living in a neighborhood with perceived high trust was associated with increased odds of moderate alcohol intake in men (Path 1). As neighborhood trust was not associated with breakfast intake, smoking, sleep duration, or physical activity, these health behaviors did not serve as mediators in men. In contrast, in women, living in neighborhoods with perceived high trust was significantly associated with increased odds of good breakfast intake and good sleep duration. Smoking, alcohol intake, and physical activity were not associated with neighborhood trust in women. Therefore these three behaviors did not serve as mediators. Path 2 in Table 3 shows results of the direct effect of neighborhood trust on self-rated health in men. Participants who decided that their neighbors trusted each other were 3.2 times more likely to perceive their health as good compared with participants who decided that their neighbors did not trust each other(AOR = 3.2, 95% CI= 1.8-5.9). Path 3 in Table 3 shows results of the association between alcohol intake as a mediator and self-rated health in men. Moderate alcohol intake was associated with good self-rated health (AOR = 2.1, 95% CI = 1.3-3.3). Path 4 in Table 3 shows results of the mediating effect of neighborhood trust with

Table 4   **Logistic regression analyses of self-rated health and neighborhood trust, and health-related behavior on women (Path 2, 3 and 4)**

	Path 2		Path 3-1		Path 3-2		Path 4-1		Path 4-2	
	AOR	(95% CI)	AOR	(95% CI)	AOR	(95% CI)	AOR	(95% CI)	AOR	(95% CI)
Neighborhood trust (ref: mistrust)	**2.1**	(1.1-3.9)					**2.0**	(1.1-3.8)	1.9	(1.0-3.6)
Breakfast intake (ref: don't or sometime eat)			1.3	(0.7-2.2)			**1.2**	(0.7-2.1)		
Sleep duration (ref: sleep time < 7 h)					**2.4**	(1.3-4.5)			**2.2**	(1.2-4.2)
Sobel test										
Test statistic									2.066	
S.E									0.401	
p-value									**0.039**	

Dependent variable of all model is self-rated health (Reference category: poor / very poor)
All models are controlled for age, marital status and education level
ref: reference category
Stastistical significance are in bold
AOR: adjusted odds ratio. 95%CI: 95% confidence interval.

self-rated health. The direct effect of neighborhood trust on self-rated health shown in Path 2 was notably attenuated but remained significant by including alcohol intake (mediating effect), and the significance of the reduction was observed by the Sobel test (test statistics = 2.07, p = 0.038). Path 2 in Table 4 shows the direct effect of neighborhood trust on self-rated health in women. That is, Women participants who decided their neighbors trusted each other were 2.1 times more likely to perceive their health as good than those who decided that their neighbors did not trust each other (*AOR* = 2.1, 95% *CI* = 1.1-3.9). Path 3-1 in Table 4 shows results of the association between eating habits as a mediator and self-rated health. The association between intake and self-rated health in women was non-significant (*AOR* = 1.3, 95% *CI* = 0.7-2.2). Path 3-2 in Table 4 shows that good sleep duration as a mediator was associated with good self-rated health (*AOR* = 2.4, 95% *CI* = 1.3-4.5) in women. Path 4 in Table 4 shows results of the mediating effect of sleep duration on the association between neighborhood trust and self-rated health in women. The direct effect of neighborhood trust on self-rated health shown in Path 2 was considerably attenuated and not significant even for sleep duration, and the Sobel test revealed that the attenuation was significant (test statistics = 2.06, p = 0.039).

DISCUSSION

This study revealed that neighborhood trust was significantly associated with self-rated health in both men and women, that the magnitude of the association was higher in men than in women, and that the associations were mediated by health-related behaviors such as drinking intake in men and sleep duration in women.

Neighborhood trust was positively correlated with self-rated health in both men and women. In other words, people with good perceived neighborhood trust were likely to have good self-rated health. Although our results are consistent with this previous study[4-6, 8], the association between neighborhood trust and self-rated health was gendered, and the magnitude of the association was greater in men than in women. Given one major cited criticism of prior studies was not examining differential effects of social capital by gender[15], the study by Stafford et al.[41], revealed a significant association in women but not in men. Frank et al.[42] found no association between country-level social capital and self-rated health in both men and women. The above findings on gender differences in the association were inconsistent. In general, women were more likely to spend more time in neighborhoods conducting domestic work such as shopping at local grocery stores or caring for children and the elderly, and were more likely to effectively create and maintain local social networks[43, 44]. In addition, gender differences were observed even regarding judgments of self-rated health. Self-rated health in men was intimately connected to negative experiences mainly linked to serious diseases. In contrast, women were dependent on problems concerning other family members and their living environment[45]. Therefore, we expect the influence of neighborhood social capital on self-rated health to be greater in women than in men. Although reasons for the greater association found in men than in women in the present study remain unclear, we can suggest several possibilities related to changes in the sociocultural background in recent years, such as women's role in the family and workplace social environment. The employment rate of women was 62.5%, and it has become the highest rate ever in Japan[46]. With increased women employment, the childcare participation in men has increased and is a very high rate in the study area (41.8%) compared with that in Japan (25.4%)[47]. Furthermore, in the study area, many workers were employed by family-owned businesses (about 30%)[48], which suggests that the traditional work environment has been thought to strengthen men's ties to their community and influence self-rated health. In fact, previous studies have found workplace environment to be associated with self-rated health[5, 22], which leads us to conjecture that changes in women's domestic roles, men's participation in housework, and a traditional work environment affect the relationship between workplace environment and self-rated health, and that the magnitude of the effect of neighborhood social capital on health is greater in men. Further investigation is needed on gender patterns regarding neighborhood trust and self-rated health.

Although little has been reported on the mechanisms underlying the link between

neighborhood social capital and health outcomes, the Dutch National Survey found a positive association between neighborhood trust and self-rated health, mediated by health-related behaviors such as physical activity[12] . When we investigated the mediation effects of the association between neighborhood trust and self-rated health by gender, we found gender differences in the mechanism underlying the relationship. That is, neighborhood trust influences individual health in two directions in men: the direct effect of neighborhood trust and the mediating effect of alcohol habits. On the other hand, neighborhood trust does not directly affect self-rated health but does have a mediating effect on self-rated health via sleeping habits in women.

Concerning about the association between neighborhood social capital and drinking behaviors, Lin et al.[49] suggested that individuals who perceived their neighborhood as more cohesive had lower quantities of consumption per drinking occasion although higher annual frequencies of alcohol consumption at the individual level. The results indicate that neighborhood social capital at the individual level is an important factor in decreasing alcohol consumption. One explanation for the association is that neighborhood trust can be beneficial for coping with stress[49] , which reduces binge drinking because social support to help cope with daily stress is more easily obtained by people with perceived high trust in their neighborhoods[20, 43] . Also, neighborhood trust can be beneficial for social control in terms of reducing alcohol consumption[49] . Drinking alcohol is an important social event, especially among men, and social networks were better among moderate drinkers compared with nondrinking or heavy drinkers among middle-aged Japanese men[50, 51] . As described above, these results lead us to conjecture that higher perceived neighborhood trust might reduce an individual's deviant drinking due to lower levels of stress, and good drinking habits enhance good self-rated health in men.

Although few studies have found an association between neighborhood trust and sleep[12, 52] , comparing our results with those of previous studies is difficult because previous studies evaluated social capital or sleep conditions by different components and analysis methods, and included both men and women. In the present study, the relationship between self-rated health and neighborhood trust was mediated by sleep duration in women but not in men. The reasons for the gender difference in sleep disturbance are that women and men are at risk for different types of stress-related disorders, with men at greater risk for alcohol-use disorders and women at greater risk for depression, anxiety, and insomnia[53], and women typically have a greater share of household responsibilities which lead to increased difficulty falling or staying asleep[54] . People with perceived low neighborhood trust have limited access to resources such as medical care, information, and emotional support from their neighbors. Such resources might help women reduce their household responsibilities and work-family conflicts that can lead to worse mental health[55] . Also, high trust levels could be a reflection of low levels of perceived social stress and anxiety. In fact, Takagi et al.[55] reported an association between high neighborhood trust and low crime victimization, leading to less stress and anxiety[55] . This finding suggests that perceived high trust in one's neighborhood has a positive effect on sleep duration, and good sleep habits have good health effects, especially in women.

LIMITATIONS

This study has some limitations. First, we measured neighborhood social capital as cognitive neighborhood social capital using a questionnaire item commonly used in previous studies[21, 56] , even though some of the most confusing and critical aspects of social capital are that it is vaguely defined and lacks a unified approach to measurement. Second, the cross-sectional design makes it impossible to clarify causal associations between neighborhood trust and self-rated health. A longitudinal study is needed to confirm causal associations. Finally, the overall response rate in this study was low (17.2%) and, therefore, selection bias might exist and generalizability of the present findings might be limited.

CONCLUSION

Despite these limitations, this study demonstrated the importance of neighborhood

trust for health, especially in men's health, and showed that the association with neighborhood trust and health was mediated by health-related behaviors, and that the mediation effect was gendered. In other words, the association was mediated by drinking in men and by sleep duration in women. Our findings suggest that intervention measures to increase neighborhood trust might improve drinking behaviors in men and sleep duration in women, and its effect on health behaviors could lead to improved self-rated health, which is a powerful predictor of mortality and morbidity.

REFERENCES

1) A Basic Direction for Comprehensive Implementation of National Health Promotion. Portal site of Ministry of health, Labor and welfare. Establishment of a social environment where health of individuals is protected and supported. Available at http://www.mhlw.go. jp/stf/seisakunitsuite/bunya/kenkou_iryou/ kenkou/kenkounippon21.html. (in Japanese)

2) Putnam R.D., Leonardi R., and Nanetti R.Y.: Making Democracy Works: Civic Traditions in Modern Italy. Princeton University press: 163-185, 1993.

3) Murayama H., Fujiwara Y. and Kawachi I.: Social capital and health: a review of prospective multilevel studies. Journal of Epidemiology. 22: 179-187, 2012.

4) Ali S.M., Merlo J., Rosvall M., Lithman T. and Lindström M.: Social capital, the miniaturisation of community, traditionalism and first time acute myocardial infarction: a prospective cohort study in southern Sweden. Social Science & Medicine. 63(8): 2204-2217, 2006.

5) Oksanen T., Kouvonen A., Kivimäki M., Pentti J., Virtanen M., Linna A. and Vahtera J.: Social capital at work as a predictor of employee health: multilevel evidence from work units in Finland. Social Science & Medicine. 66(3): 637-649, 2008.

6) Hamano T., Fujisawa Y., Ishida Y., Subramanian S.V., Kawachi I. and Shiwaku K.: Social capital and mental health in Japan: A multilevel analysis. PLoS ONE. 5(10): e13214. doi:10.1371/journal.pone.0013214, 2010.

7) Volker B., Flap H. and Lindenberg S.: When are neighbourhoods communities? Community in Dutch neighbourhoods. European Sociological Review. 23(1): 99-114, 2007.

8) Aida J., Kuriyama S., Ohmori-Matsuda K., Hozawa A., Osaka K. and Tsuji I.: The association between neighborhood social capital and self-reported dentate status in elderly Japanese-The Ohsaki Cohort 2006 Study. Community Dentistry and Oral Epidemiology. 39: 239-249, 2011.

9) Aida J., Kondo K., Kawachi I., Subramanian S.V., Ichida Y., Hirai H., Kondo N., Osaka K., Sheiham A., Tsakos G. and Watt R.G.: Does social capital affect the incidence of functional disability in older Japanese? A prospective population-based cohort study. Journal of Epidemiology and Community Health. 67(1): 42-47, 2013.

10) Idler E.L. and Benyamini Y.: Self-rated health and mortality: a review of twenty-seven community studies. Journal of Health and Social Behavior. 38(1): 21-37, 1997.

11) Gilbert K.L., Quinn S.C., Goodman R.M., Butler J. and Wallace J.: A meta-analysis of social capital and health: A case for needed research. Journal of Health Psychology. 18(11): 1385-1399, 2013.

12) Mohnen S.M., Völker B., Flap H. and Groenewegen P.P.: Health-related behavior as a mechanism behind the relationship between neighborhood social capital and individual health - a multilevel analysis. BMC Public Health 12: 116 doi:10.1186/1471-2458-12-116, 2012.

13) Kawachi I. and Berkman L. Social cohesion, social capital, and health. In: Berkman L, Kawachi I editors. Social epidemiology. New York: Oxford University Press: 174-190, 2000.

14) Poortinga W.: Do health behaviors mediate the association between social capital and health? Preventive Medicine. 43(6): 488-493, 2006.

15) Kavanagh A.M., Bentley R., Turrell G., Broom D.H. and Subramanian S.V.: Does gender modify associations between self-rated health and the social and economic characteristics of local environments? Journal of Epidemiology and Community Health. 60: 490-495, 2006.

16) Skrabski A., Kopp M. and Kawachi I.: Social capital in a changing society: cross sectional

associations with middle aged female and male mortality rates. Journal of Epidemiology and Community Health. 57(2): 114-119, 2003.

17) Ota H.: Associations between individual-level social capital and self-rated health or depression among elderly men and women. Japanese Society of Public Health 61(2): 71-85, 2014. (in Japanese)

18) Eriksson M., Ng N., Weinehall L. and Emmelin M.: The importance of gender and conceptualization for understanding the association between collective social capital and health: a multilevel analysis from northern Sweden. Social Science & Medicine. 73(2): 264-273. 2011.

19) Mohnen S.M., Groenewegen P.P., Völker B. and Flap H.: Neighborhood social capital and individual health. Social Science & Medicine. 72(5): 660-667, 2011.

20) Fujiwara T. and Kawachi I.: A prospective study of individual-level social capital and major depression in the United States. Journal of Epidemiology and Community Health. 62: 627-633, 2008.

21) Murayama H., Wakui T., Arami R., Sugawara I. and Yoshie S.: Contextual effect of different components of social capital on health in a suburban city of the greater Tokyo area: a multilevel analysis. Social Science & Medicine. 75(12): 2472-2480, 2012.

22) Suzuki E., Takao S., Subramanian S.V., Komatsu H., Doi H. and Kawachi I.: Does low workplace socia1 capital have detrimental effect on workers' health? Social Science & Medicine. 70: 1367-1372, 2010.

23) Cappuccio F.P., D'Elia L., Strazzullo P. and Miller M.A.: Sleep duration and all-cause mortality: a systematic review and meta-analysis of prospective studies. Sleep. 33(5): 585-592, 2010.

24) Lin Y., Kikuchi S., Tamakoshi A., Wakai K., Kawamura T., Iso H., Ogimoto I., Yagyu K., Obata Y. and Ishibashi T (JACC Study Group).: Alcohol consumption and mortality among middle-aged and elderly Japanese men and women. Annals of Epidemiology. 15: 590-597, 2005.

25) Ma Y., Bertone E.R., Stanek E.J., Reed G.W., Hebert J.R., Cohen N.L., Merriam P.A. and Ockene I.S.: Association between eating patterns and obesity in a free-living US adult population. American Journal of Epidemiology. 158: 85-92, 2003.

26) Yunsheng M., Elizabeth R.B., Edward J., Stanek I., George W. R., James R. H., Nancy L. C., Philip A. M., and Ira S. O.: Association between Eating Patterns and Obesity in a Free-living US Adult Population. American Journal of Epidemiology. 158 (1): 85-92, 2003.

27) Speechly D.P. and Buffenstein R.: Greater appetite control associated with an increased frequency of eating in lean males. Appetite. 33 (3): 285-297, 1999.

28) Ministry of Health, Labour and Welfare. The second term of National Health Promotion Movement in the twenty first century (Health Japan 21 (the second term)). *Life-style as nutrition and dietar*y. Available at http://www1.mhlw.go.jp/topics/kenko21_11/pdf/b1.pdf#search='http%3A%2F%2Fwww1.mhlw.go.jp%2Ftopics%2Fkenko21_11%2Fpdf%2Fb1.pdf.' (in Japanese)

29) Craig C.L., Marshall A.L., Sjöström M., Bauman A.E., Booth M.L., Ainsworth B.E., Pratt M., Ekelund U., Yngve A., Sallis J.F. and Oja P.: International physical activity questionnaire: 12-country reliability and validity. Medicine and Science in Sports and Exercise. 35: 1381-1395, 2003.

30) IPAQ international physical activity questionnaire. Guidelines for data processing and analysis (IPAQ). Short forms and long forms. 2005.

31) Baron R.M. and Kenny D.A.: The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology. 51(6):1173-1182, 1986.

32) Peduzzi P., Concato J., Kemper E., Holford T.R. and Feinstein A.R.: A simulation study of the number of events per variable in logistic regression analysis: Journal of Clinical Epidemiology. 49(12): 1373-1379. 1999.

33) Buss C., Entringer S., Davis E.P., Hobel C.J., Swanson J.M., Wadhwa P.D. and Sandman C.A.: Impaired executive function mediates the association between maternal pre-pregnancy body mass index and child ADHD symptoms. PLoS One. 7(6): e37758. doi: 10.1371/journal.

pone.0037758. 2012.

34) Sobel M.E.: Asymptotic confidence intervals for indirect effects in structural equation models. In Sociological Methodology. Edited by Leinhardt S. San Francisco: Jossey-Bass: 290-313, 1982.

35) Mackinnon D.P., Lockwood C.M., Hoffman J.M., West S.G. and Sheets V.: A comparison of methods to test mediation and other intervening variable effects: Psychological Methods. 7 (1): 83-104, 2002.

36) Bollen, K. A. and Stine, R.: Direct and indirect effects: Classical and bootstrap estimates of variability. Sociological Methodology, 20, 115-140. MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. Psychological Methods. 7:83-104. 1999.

37) Rubin D.: Multiple imputation for nonresponse in surveys. New York: John Wiley & Sons.1987.

38) Donders A.R., van der Heijden G.J., Stijnen T. and Moons K.G.: Review: a gentle introduction to imputation of missing values. Journal of Clinical Epidemiology. 59: 1087-1091, 2006.

39) Moniek C.M., Merel D., Kitty J.J., Giovanni T., Carmine Z. and Friedo W.D.: Multiple imputations: dealing with missing data. Nephrol. Dial. Transplant.1-6, 2013.

40) Horton N.J. and Lipsitz S.R.: Multiple imputation in practice: comparison of software packages for regression models with missing variables. American Statistic. 55(3): 244-254, 2001.

41) Stafford M., Cummins S., Macintyre S., Ellaway A. and Marmot M.: Gender differences in the associations between health and neighbourhood environment. Social Science & Medicine. 60: 1681-1692, 2005.

42) Elgar F.J., Davis C.G., Wohl M.J., Trites S.J., Zelenski J.M. and Martin M.S.: Social capital, health and life satisfaction in 50 countries. Health & Place 17: 1044-1053, 2011.

43) Kawachi I. and Berkman L.F.: Social Ties and mental health. Journal of Urban Health. 78(3): 458-467, 2001.

44) Warr D.J.: Gender, Class, and the art and craft of social capital. Sociological Quarterly. 47: 497-520, 2006.

45) Benyamini Y., Leventhal E.A. and Leventhal H.: Gender differences in processing information for making self-assessments of health. Psychosomatic Medicine. 62(3): 354-364, 2000.

46) The Statistics Bureau and the Director-General for Policy Planning of Japan. Ministry of international affairs and communications. Available at http://www.stat.go.jp/english/data/handbook/. (in Japanese)

47) The Statistics Bureau and the Director-General for Policy Planning of Japan. Sociological research about fundamental aspects of social life (2011). Ministry of international affairs and communications. Available at http://www.stat.go.jp/data/shakai/2011/h23kekka.htm#a04. (in Japanese)

48) Okinawa General Bureau. Okinawa Prefecture employment structure characteristic basic research report. Okinawa General Bureau, Cabinet Office. Available at http://www.ogb.go.jp/soumu/koyoukouzou.pdf. (in Japanese)

49) Lin E.Y., Witten K., Casswell S. and You R.Q.: Neighborhood matters: perceptions of neighborhood cohesiveness and associations with alcohol, cannabis and tobacco use. Drug Alcohol Review. 31(4): 402-412, 2012.

50) Ikeda A., Kawachi I., Iso H., Inoue M. and Tsugane S.: Gender difference in the association between social support and metabolic syndrome in Japan: the 'enkai' effect? Journal of Epidemiology and Community Health. 65(1): 71-77, 2011.

51) Tsugane S., Fahey M.T., Sasaki S. and Baba S.: Alcohol consumption and all-cause and cancer mortality among middle-aged Japanese men: seven-year follow-up of the JPHC study Cohort I. Japan Public Health Center. American Journal of Epidemiology. 150(11): 1201-1207, 1999.

52) Nomura K., Yamaoka K., Nakao M. and Yano E.: Social determinants of self-reported sleep problems in South Korea and Taiwan. Journal of Psychosomatic Research. 69(5): 435-40, 2010.

53) Bianchi S.M., Robinson J.P. and Milkie M.A.: Changing rhythms of American family life. Russell Sage Foundation; New York. 2006.

54) Chandola T., Martikainen P., Bartley M., Lahelma E., Marmot M., Michikazu S., Nasermoaddeli A. and Kagamimori S.: Does

conflict between home and work explain the effect of multiple roles on mental health? A comparative study of Finland, Japan, and the UK. International Journal of Epidemiology 33(4): 884-893, 2004.

55) Takagi D., Ikeda K. and Kawachi I.: Neighborhood social capital and crime victimization: Comparison of spatial regression analysis and hierarchical regression analysis. Social Science & Medicine 75: 1895-1902, 2012.

56) Yang T.C. and Matthews S.A.: The role of social and built environments in predicting self-rated stress: A multilevel analysis in Philadelphia. Health & Place 16: 803-810, 2010.