Social participation and the onset of hypertension among middle-aged and old population: Longitudinal evidence from the China Health and Retirement Longitudinal Study

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Complete List of Authors:	Tu, Raoping; Nagasaki University, Department of International Health, Institute of Tropical Medicine (NEKKEN); Nagasaki Unniversty, Leading Program, Graduate School of Biomedical Sciences Inoue, Yosuke; University of North Carolina at Chapel Hill, Carolina Population Center Yazawa, Aki; University of Fukui, Research Center for Child Mental Development Hao, Xiaoning; China National Health and Development Research Center Li, Yueping; Fujian Medical University, Department of Health Management, School of Public Health Lin, Xinquan; Fujian Provincial Center for Disease Control and Prevention, Department for Chronic and Non-communicable Disease Control and Prevention He, Fei; Fujian Medical University, Department of Epidemiology, School of Public Health Yamamoto, Taro; Nagasaki University, Department of International Health, Institute of Tropical Medicine (NEKKEN)

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Title:

Social participation and the onset of hypertension among middle-aged and old population: Longitudinal evidence from the China Health and Retirement Longitudinal Study

Authors:

Raoping Tu[1,2], Yosuke Inoue[3*], Aki Yazawa[4], Xiaoning Hao[5], Yueping Li[6], Xiuquan Lin[7], Fei He[8], Taro Yamamoto[1]

[1] Department of International Health, Institute of Tropical Medicine (NEKKEN), Nagasaki University, Nagasaki 852-8523, Japan

[2] Leading Program, Graduate School of Biomedical Sciences, Nagasaki University, Nagasaki 852-8523, Japan

[3] Carolina Population Center, The University of North Carolina at Chapel Hill, Chapel Hill, NC 27516, USA

[4] Research Center for Child Mental Development, University of Fukui, 23-3 Matsuoka-Shimoaizuki, Eiheiji-cho, Yoshida-gun, Fukui 910-1193, Japan

[5] China National Health and Development Research Center, Beijing 100191, China

[6] Department of Health Management, School of Public Health, Fujian Medical University, Fujian 350122, China

[7] Department for Chronic and Non-communicable Disease Control and Prevention, Fujian Provincial Center for Disease Control and Prevention, Fujian 350001, China

[8] Department of Epidemiology, School of Public Health, Fujian Medical University, Fujian 350122, China

* Correspondence to: Yosuke Inoue

Carolina Population Center, The University of North Carolina at Chapel Hill, Chapel Hill, NC 27516, USA;

E-mail: yosuke.yoshi.yosky@gmail.com

Phone: 1-919-593-3765

Short running title: Social participation and hypertension

Abstract

Aim: While previous studies have examined the association between health-related behaviors and hypertension, comparatively little focus has been paid to the role of social participation (i.e., participating in community organizations). The aim of this study is to investigate the longitudinal association between social participation and hypertension among middle-aged and old population (aged ≥ 45) in China.

Methods: Data came from the China Health and Retirement Longitudinal Study conducted in two waves in 2011 and 2013. Information was obtained from 5,504 participants on blood pressure, social participation and covariates. A sex-stratified Poisson regression model with a robust variance estimator was used to investigate the association.

Results: Participating in community organizations once a week or more frequently was inversely associated with the onset of hypertension in women (incidence rate ratio = 0.80, 95% confidence interval = 0.67 – 0.95, p = 0.011). Among men, no such association was found.

Conclusion: This study suggests that promoting social participation might help mitigate the disease burden associated with hypertension in China, particularly among women.

Keywords: Blood Pressure; Longitudinal Studies; Social Participation

Text:

Introduction

Hypertension is one of the most important risk factors of cardiovascular diseases.[1] Globally, it has been estimated that there were 1.39 billion people living with hypertension in 2010[2] and this figure was projected to increase to 1.56 billion in 2025.[1] It is of note that the prevalence of hypertension has been increasing disproportionately in developing countries[2], such as China. For example, the prevalence of hypertension increased from 11.3% to 33.6% during the period between 1991 and 2010 in China[3], which was possibly caused by rapid urbanization, westernization of lifestyle and population aging of the country.[4]

While previous research in China has focused on the association between hypertension and individual lifestyle-related risk factors, such as obesity[5], alcohol consumption[6], smoking[7], physical activity[8] and diet[9], comparatively little attention has been paid to the role of social participation (i.e., participation in community organizations). This refers to involvement in the activities of formal and informal societal groups[10] and has recently attracted broad attention from public health researchers and practitioners in relation to promoting healthy aging and creating age-friendly cities.[11]

Several research has demonstrated a protective role of social participation on hypertension in developed countries. For example, Yazawa et al.[12] showed that participation in horizontal organizations (i.e., groups that are characterized by non-hierarchical, egalitarian relationships among group members; volunteer, sport and hobby groups in their study) was inversely associated with hypertension among older people in Japan. Kamiya et al.[13] showed that participating in a greater number of organizations was associated with a lower odds of hypertension among older population living in the U.K.

This study was designed to extend the previous studies in several ways. First, we used a longitudinal dataset and investigated the association to deal with the issue of reverse causality. Previous studies used cross-sectional design to investigate the association.[12, 13] Second, few study was conducted in China, which exemplifies rapid economic development and population aging in the last several decades better than any other country and thus, the increasing trend of hypertension.[4, 14] Social participation could be a potential cost-

effective means to help mitigate disease burden associated with hypertension in China which must meet the demand of a rapidly aging population with limited financial and medical resources.

The aim of this study, therefore, is to investigate the longitudinal association between social participation and hypertension in China, using data from the China Health and Retirement Longitudinal Study (CHARLS), which is a nationally representative survey of the middle and old-aged people in China.

Methods

Data

CHARLS is a nationally representative longitudinal study which was conducted in Waves 2011 and 2013.[15] As shown in Figure 1, out of 17,638 people who participated in Wave 2011, we excluded those with missing information on blood pressure (n = 3,925) and covariates (n = 69). We further excluded those who were hypertensive in Wave 2011 (n = 5,584). Out of 8,060 participants who were not hypertensive in Wave 2011, 7,434 people participated in Wave 2013. After excluding those who did not provide information on blood pressure in Wave 2013 (n = 1,951), we had an analytic sample of 5,483 people (2,591 men and 2,892 women).

The current study was a secondary analysis of the CHARLS dataset, which is publicly available (http://charls.pku.edu.cn/en). The study protocol of the CHARLS was originally approved by the Ethical Review Committee of Peking University, China. Subjects gave informed consent for participation.

Dependent variable

Blood pressure was measured at participants' houses by trained interviewers. It was measured three times on their left arm with 45-second intervals. Participants were requested to sit down with their left arm placed on the table and palm facing up. Participants were considered to be hypertensive if systolic blood pressure (SBP) ≥ 140 mmHg, diastolic blood pressure (DBP) ≥ 90 mmHg, or having self- reported taking antihypertensive medication.[16]

Independent variables

Social participation at baseline was defined by participants saying yes to participating in any of the following activities once a week or more frequently in the previous one month: (1) interact with friends; (2) play mahjong (i.e., a Chinese tile-based game), chess or cards, or go to a community club; (3) go to a sport, social, or other kind of club; (4) take part in a community-related organization; and (5) attend volunteer or charity work.

Covariates

Baseline information collected on respondents' socio-demographic characteristics include: age (in years), marital status (married; unmarried), educational attainment (<9 years; 9 years; >9 years). Body mass index (BMI) was calculated as weight (in kg) divided by squared height (m^2); it was then categorized in the following categories: < 18.5 (underweight); 18.5 – 23.99 (normal); 24 – 27.99 (overweight); and ≥ 28 (obese).[17] Location of residence (urban / rural) was also incorporated into models to account for urban/rural differences in the association between social participation and health.[18]

The health-related behaviors include smoking status (never smoke; used to smoke; and currently smoke), alcohol consumption (never drink; less than once a month; and once a month or more frequently), self-reported poor health (1: very poor or poor; 0: fair, good or very good) and depressive symptoms (evaluated with the 10-item version of the Center for Epidemiologic Studies Depression Scale (CES-D 10). The CES-D 10 score ranges from 0 to 30 and participants were categorized into two groups based on their scores (i.e., CES-D 10 < 10: no depressive symptoms; CES-D 10 ≥ 10: depressive symptoms).[19]

Statistical analysis

Descriptive characteristics of the study participants were compared by presence of hypertension in 2013 using χ^2 tests for each sex. We used a multilevel Poisson regression model with a robust variance estimator to investigate the association between social participation and hypertension while accounting for multiple individuals within community. We stratified the analysis by sex since previous research suggested that the health impact of social participation may differ by sex.[20] We also incorporated sampling weights to produce nationally representative estimates of variables. Those who did not provide information on depressive

symptoms and BMI were categorized as "missing" in order to retain statistical power.

We used Stata 13.0 (Stata Corp, College Station, TX, USA) for statistical analyses. Results are presented as incidence rate ratios (IRRs) with 95% confidence intervals (CI). The level of statistical significance was set at $p < 0.05$ (two-tailed).

Results

Table 1 shows the baseline characteristics of the study participants stratified by sex and presence of hypertension in Wave 2013. Out of 5,483 participants, 52.7% were women, and 20.6% and 17.2% of men and women respectively developed hypertension during the period between 2011 and 2013. Those who became hypertensive in 2013 tended to be older ($p < 0.001$), not married among women ($p < 0.001$), less educated among men ($p = 0.053$), more obese ($p = 0.006$ for men and $p = 0.001$ for women) and less likely to participate in community organizations among women ($p = 0.070$). There was no marked difference in relation to location or residence (urban or rural), smoking status, alcohol consumption, self-reported poor health and depressive symptoms.

Table 2 shows results of a Poisson regression model investigating the association between social participation and the onset of hypertension among men and women. Among men, social participation was not statistically significantly associated with the onset of hypertension. Age was positively associated with the onset of hypertension; for example, those aged 70 years or older had 1.82 times higher the IRR of hypertension compared to those aged 45 to 49 (reference category). Those who were more educated were less likely to become hypertensive (e.g., schooling of more than 9 years: IRR = 0.74, 95%CI = 0.55 – 0.98). A higher frequency of alcohol consumption was positively associated with the onset of hypertension (IRR = 1.20, 95%CI = 1.01 – 1.42). Among women, social participation was inversely associated with the onset of hypertension (IRR = 0.80, 95%CI = 0.67 – 0.95). In addition, higher age (e.g., those aged 70 years or older: IRR = 3.00, 95%CI = 2.22 – 4.05) and higher BMI (≥ 28: IRR = 2.30, 95%CI = 1.60 – 3.30) were associated with the onset of hypertension.

Discussion

Using nationally representative data from among the middle and old-aged Chinese population, this prospective study revealed that among women, participating in community organizations once a week or more frequently was inversely associated with the onset of hypertension. On the other hand, no such association was observed among men.

The inverse association between social participation and hypertension observed in this study was in line with Yazawa et al.[12] who showed in their cross-sectional study in Japan that participating in horizontal organizations (i.e., groups that are characterized by non-hierarchical, egalitarian relationships among group members; volunteer, sport and hobby groups in their study) once a month or more frequently was associated with a lower prevalence of hypertension among the older Japanese population (≥ 65 years old). As we used information on similar types of community organizations/activities (e.g., interaction with friends, community club, a sport, social, or other kind of club, community-related organization, and voluntary or charity work) to those included in Yazawa et al., this study extends their study by providing longitudinal evidence of the association between social participation and hypertension.

Several possible mechanisms linking social participation and hypertension have been proposed, which can be divided into two potential aspects (i.e., health behavior and psychological stress). For health behavior, Lindström et al.[10] used data from the Malmö Diet and Cancer Study which involved 11,837 participants in Sweden and showed that social participation (defined by taking part in the activities of 13 formal and informal groups in society) was associated with elevated level of light physical activity. They also showed that health behavior was positively associated with vegetable and fruit consumption[21] and smoking cessation[22] among the same study population. In terms of psychological stress, the association between social participation and hypertension may operate through providing a sense of companionship and belonging, which could enhance people's ability to cope with stressors.[23, 24] Future study should focus on elucidating these detailed mechanisms in the Chinese context to better inform the development of intervention techniques.

We did not observe a statistically significant association among men. Sex differences in the association between social participation and health outcomes have been reported in previous literature as well. For

example, in Japan, participation in social activities was associated with a relatively stable transition of instrumental activities of daily living and cognitive function among women but not among men.[25, 26] Another study undertaken in Korea showed that participation in formal and informal group activities had a protective effect on self-rated health among old people, which was larger among women than men.[20]

While the exact mechanism has yet to be determined, there are several possible reasons to explain the null findings among men. First, we can hypothesize that men are less affected by a neighborhood environment due to comparatively less time spent in the community[27, 28]; for instance, Stafford et al.[27] investigated the association between a variety of neighborhood environmental indicators and self-reported health in U.K. and showed that the effects were larger in women than in men. While social participation was operationalized as an individual-level variable in this study, it can be hypothesized that social or physical environments which engender more social participation also affect health, particularly health of individuals who stay longer in the environment (i.e., women). Another possibility is that men are more likely to be in key positions of the community organizations which could be a psychological stressor offsetting the beneficial health effect of social participation. Some previous studies also reported that frequent participation in community organizations does not always have a health protecting effect.[29] However, it should also be noted that Takagi et al.[18] reported that occupying a key positions within an organization rather promoted mental health of Japanese old men, interpreting that men might feel being rewarded by seeking authoritative positions in their Japanese culture. Future study should focus on more detailed pathways linking social participation and hypertension.

The findings of our study have important public health implications. Given that China's social and medical infrastructure must meet the demands of a rapidly growing, aging population, the government should implement an efficient and cost-effective policy, which can help mitigate morbidity and mortality associated with hypertension. In this respect, promoting social participation could be one of the possible solutions. Several studies in China investigating the association between social participation and health outcomes other than hypertension and showed a beneficial effect of social participation. For example, Li et al.[30] showed that participating in volunteer group was associated with lower depressive symptoms, less functional limitation and better self-reported health among urban Chinese.

There are several limitations to this study. First, study participants in this study might not have fully

represented the Chinese middle and old-aged population. For example, an estimated 260 million people migrant workers in 2010[4] may not have been accurately represented in this population-based survey. Given that they have limited access to social and medical services and are subject to discrimination and stigmatization[4], this omission might have biased our results. Another possibility is that those who were hypertensive might feel reluctant to participate in the survey. Second, there are several other variables which would have better explained the association between social participation and hypertension, such as information on how long they had participated in community organizations, physical activity level, diet (e.g., sodium and potassium consumption), performance of the key role in the community organizations and geographic location of residence.

In conclusion, our study suggests that participating in community organizations more than once a week or more frequently reduces the onset of hypertension among middle and old-aged populations in China, particularly among women. Promoting social participation might be one of the productive ways to mitigate the disease burden associated with hypertension in China.

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Disclosure statement

The authors declare that they have no competing interests.

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Figure legend

Figure 1. CHARLS participant flow chart (2011-2013)

Table 1. Baseline characteristics of the study participants in the China Health and Retirement Longitudinal Study (CHARLS) (2011)

	Men (n = 2,591)			Women (n = 2,892)		
	Not hypertensive in 2013 (n = 2,057)	Hypertensive in 2013 (n = 534)	p-value [a]	Not hypertensive in 2013 (n = 2,394)	Hypertensive in 2013 (n = 498)	p-value [a]
Age, n (%)						
45 – 49	388 (18.9)	74 (13.9)	< 0.001	746 (31.2)	104 (20.9)	< 0.001
50 – 59	788 (38.3)	179 (33.5)		929 (38.8)	170 (34.1)	
60 – 69	625 (30.4)	178 (33.3)		550 (23.0)	137 (27.5)	
70 +	256 (12.4)	103 (19.3)		169 (7.1)	87 (17.5)	
Marital status (married), n (%)	1910 (92.9)	485 (90.8)	0.114	2153 (89.9)	418 (83.9)	< 0.001
Education, n (%)						
< 9 years	1210 (58.8)	342 (64.0)	0.053	1815 (75.8)	391 (78.5)	0.171
9 years	552 (26.8)	133 (24.9)		387 (16.2)	79 (15.9)	
> 9 years	295 (14.3)	59 (11.0)		192 (8) .0	28 (5.6)	
Location of residence, n (%)						

Urban	336 (16.3)	102 (19.1)	0.129	441 (18.4)	96 (19.3)	0.655
Rural	1721 (83.7)	179 (33.5)		1953 (81.6)	402 (80.7)	
Smoking, n (%)						
Never	535 (26.0)	132 (24.7)	0.789	2222 (92.8)	455 (91.4)	0.123
Quit	307 (14.9)	84 (15.7)		36 (1.5)	14 (2.8)	
Smoke	1215 (59.1)	318 (59.6)		136 (5.7)	29 (5.8)	
Alcohol consumption, n (%)						
Don't drink	912 (44.3)	222 (41.6)	0.150	2063 (86.2)	438 (88.0)	0.447
Less than once a month	244 (11.9)	54 (10.1)		143 (6.0)	29 (5.8)	
Once a month or more frequently	901 (43.8)	258 (48.3)		188 (7.9)	31 (6.2)	
Body mass index, n (%)						
< 18.5	157 (7.6)	47 (8.8)	0.006	181 (7.6)	33 (6.6)	0.001
18.5 - 23.99	1375 (66.8)	315 (59)		1264 (52.8)	230 (46.2)	
24 - 27.99	400 (19.4)	124 (23.2)		706 (29.5)	159 (31.9)	
≥ 28	83 (4.0)	28 (5.2)		191 (8.0)	67 (13.5)	
Missing	42 (2.0)	20 (3.7)		52 (2.2)	9 (1.8)	
Self-rated health (poor), n (%)	481 (23.4)	115 (21.5)	0.366	705 (29.4)	138 (27.7)	0.438

Depressive symptoms, n (%)						
Not depressed	1358 (66)	369 (69.1)	0.370	1278 (53.4)	268 (53.8)	0.669
Depressed	601 (29.2)	144 (27)		975 (40.7)	196 (39.4)	
Missing	98 (4.8)	21 (3.9)		141 (5.9)	34 (6.8)	
Social participation, n (%)						
Less than once a week	1418 (68.9)	354 (66.3)	0.242	1567 (65.5)	347 (69.7)	0.070
Once a week or more	639 (31.1)	180 (33.7)		827 (34.5)	151 (30.3)	

[a] Characteristics of the participants were compared using χ^2 test.

Table 2. Results of sex-stratified multilevel Poisson regression model investigating the association between social participation and the incidence of hypertension in China (2011-2013)

	Men (n = 2,591)				Women (n = 2,892)			
	IRR	95% CI		p-value	IRR	95% CI		p-value
Social participation (ref. no)[1]	1.10	0.93	1.31	0.261	0.80	0.67	0.95	0.011
Age group (ref. 45 - 49)								
50 - 59	1.17	0.91	1.49	0.213	1.31	1.04	1.66	0.022
60 - 69	1.35	1.06	1.73	0.016	1.77	1.36	2.30	< 0.001
70 +	1.82	1.38	2.40	< 0.001	3.00	2.22	4.05	< 0.001
Marital status (ref. unmarried)	0.87	0.67	1.12	0.285	0.87	0.69	1.09	0.227
Education (ref. < 9 years)								
9 years	0.91	0.76	1.11	0.359	1.12	0.91	1.39	0.279
> 9 years	0.74	0.55	0.98	0.037	0.82	0.56	1.21	0.323
Urban residence (ref. rural)	1.15	0.90	1.47	0.252	1.03	0.77	1.37	0.854
Smoking (ref. never)								

Quit	1.02	0.81	1.29	0.86	1.37	0.88	2.15	0.162
Smoke	1.07	0.88	1.30	0.487	0.97	0.70	1.36	0.877
Alcohol consumption (ref. none)								
Less than once a month	1.02	0.78	1.34	0.889	1.02	0.74	1.41	0.882
Once a month or more frequently	1.20	1.01	1.42	0.036	0.79	0.56	1.12	0.186
Self-rated health (ref. good)	0.93	0.76	1.13	0.463	0.86	0.72	1.03	0.100
Depressive symptoms								
Depressed	0.91	0.76	1.09	0.327	0.96	0.82	1.14	0.656
Missing	0.77	0.51	1.16	0.215	1.04	0.77	1.42	0.780
BMI (ref. < 18.5)								
18.5 - 23.99	0.88	0.69	1.14	0.338	1.21	0.89	1.64	0.232
24 - 27.99	1.19	0.89	1.58	0.243	1.52	1.10	2.10	0.012
≥ 28	1.30	0.87	1.94	0.197	2.30	1.60	3.30	< 0.001
Missing	1.58	1.07	2.35	0.023	1.11	0.54	2.25	0.782

IRR: incidence rate ratio; CI: confidence interval

[(1)] Social participation was defined by participants saying yes to participating in any of the following activities once a week or more frequently in the previous one month: interact with friends; play mahjong, chess or cards, or go to a community club; go to a sport, social, or other kind of club; take part in a community-related organization; or attend volunteer or charity work.

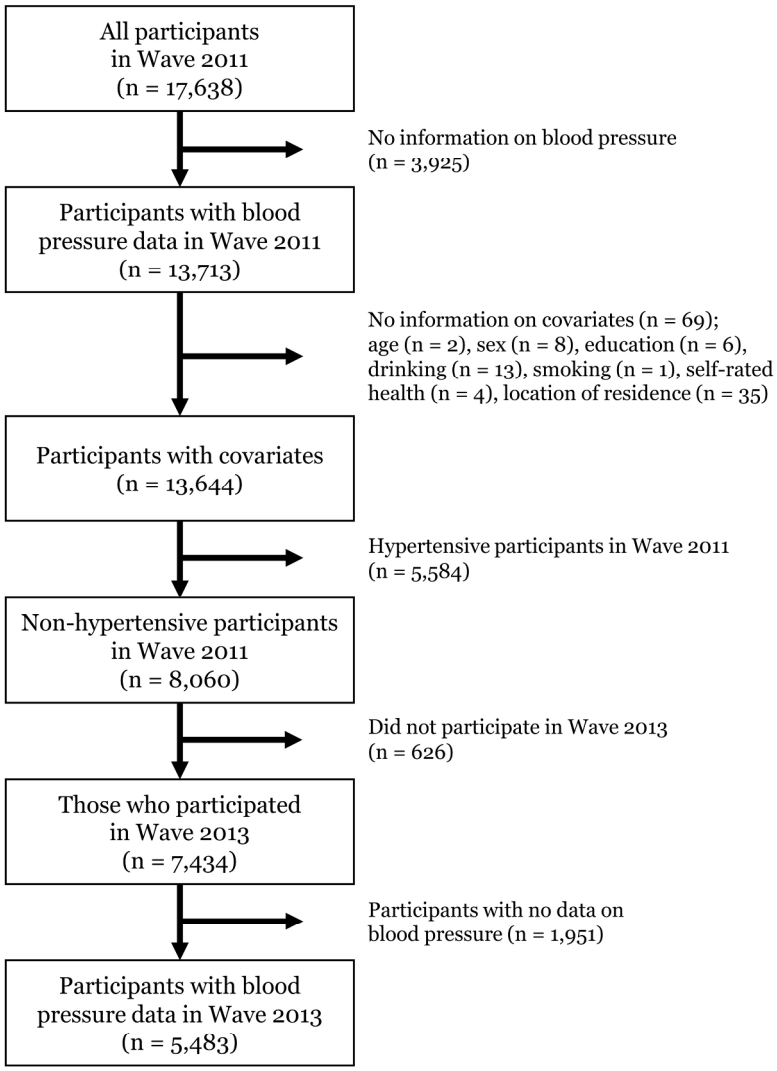

Figure 1. CHARLS participant flow chart (2011-2013)

215x282mm (300 x 300 DPI)