Title

Social participation among older adults not engaged in full- or part-time work is associated with more physical activity and less sedentary time

Authors

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This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the Version of Record. Please cite this article as doi: [10.1111/ggi.12995](https://doi.org/10.1111/ggi.12995)

Running title:

Social participation and physical activity

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Abstract

Aim

Social participation provides health benefits for older adults. However, there is the need to identify whether higher social participation is associated with older adults being more physically active and less sedentary (sitting time). We examined the associations of social participation with physical activity, and sedentary time, in a population-based sample of older Japanese adults.

Methods

A population-based, cross-sectional mail survey conducted in 2010 was used to collect data on social participation, physical activity, sedentary time and socio-demographic characteristics. Data were examined from 1146 community-dwelling, unemployed older adults (mean age: 70.1 years, 43% men). Multivariate logistic regression analyses were used to calculate odds ratios (ORs) for associations of social participation with physical activity and total sedentary time; and, for associations with passive and mentally-active sedentary (sitting) time.

Results

For both men and women, those with higher social participation were more physically active (OR=2.10, [95% confidence interval (CI): 1.44-3.06] among men; OR=1.93, [1.39-2.68] among women). Total sedentary time had significant associations among men

(OR=0.62, [0.42-0.90]), but not among women (OR=0.80, [0.58-1.11]). Social participation was associated with less passive sedentary time (OR=0.55, [0.38-0.81] for men; OR=0.72 [0.51-0.99] for women).

Conclusions

Promoting social participation among older adults may contribute to increasing physical activity and reducing sedentary time, with potential benefits for chronic disease. Further research is required to elucidate the deleterious and beneficial roles of passive and mentally-active sedentary time for older adults.

Key-words: Aged, Cross-Sectional Studies, Motor activity, Sedentary Lifestyle, Social participation

Introduction

Regular moderate-to-vigorous physical activity (MVPA) is related to lower risk of all-cause and cardiovascular mortality^{1,2}, obesity³ and type 2 diabetes⁴. Recently, sedentary behaviors (prolonged sitting as distinct from lack of MVPA) have been found to be associated with increased cardio-metabolic risk⁵ and indices of poorer health⁶. There are also preliminary findings suggesting that passive sedentary behaviors may be deleterious and that mentally-active sedentary behaviors may be beneficial to health⁷. Evidence to inform how increasing physical activity and decreasing sedentary behavior may be employed as complementary strategies for reducing health risk is a research priority^{8,9}.

The World Health Organization's Active Ageing: A Policy Framework includes community participation as one of three basic pillars of active aging¹⁰. The Toronto Charter for Physical Activity outlines the utility of physical activity to improve well being, physical and mental health and to enhance social connectedness and quality of life¹¹. In this context, enhancing social participation could be regarded as an effective active-aging intervention strategy.

Several longitudinal studies have shown beneficial relationships of social participation with all-cause mortality^{12,13} and social participation can provide older adults with benefits such as better physical functioning¹⁴, maintaining cognitive performance¹⁵ and mental well-being¹⁶. There is, however, limited evidence on whether higher social participation by

older adults is associated with being more physically active and having less sedentary time. A study of 11,837 Swedish older adults showed low social participation to be the strongest predictor of physical inactivity¹⁷. Further clarifying associations of social participation with physical activity and sedentary time would provide evidence to develop more informed health policies and initiatives for older adults in the future.

We examined the associations of social participation with physical activity, total sedentary time and passive and mentally-active sedentary time, in a population-based sample of older Japanese adults.

Methods

Participants and data collection

Detailed sampling procedures are described elsewhere¹⁸. Briefly, this population-based, cross-sectional study was conducted in three Japanese municipalities; Bunkyo Ward in Tokyo, Fuchu City in Tokyo, and Oyama Town in Shizuoka Prefecture. Older adults aged between 65 and 74 years old were randomly selected from the registry of residential addresses of each municipality, stratified by gender and by age (65-69 years and 70-74 years). In total, 2,700 community-living older adults were identified. Of those initially identified, 2,046 returned the survey. After data cleaning, the data from 1,816 participants were deemed valid for this study (response rate: 67.3%). Among these respondents, 670 subjects engaging in full-time or part-time jobs were excluded to avoid potential confounding. The final sample size was 1,146. All data was collected from February to

March 2010. The study received approval from the Tokyo Medical University Ethics Committee.

Measures

Social Participation

Social participation was assessed using a scale from the Japanese national survey (Comprehensive Survey of Living Conditions)¹⁹. The questionnaire asks: “How often do you engage in the following activities?” with answer choices of “hobby or cultural classes”, “socials with friends or acquaintances”, “senior citizen clubs”, “volunteer groups”, “community events or festivals” and “talking with family or friends”. Participation in each activity could be identified as either: “(1) frequent”, “(2) often”, or “(3) seldom”. Levels of social participation were calculated by summing these frequencies, ranging from 6 (highest social participation) to 18 (lowest social participation). Then, they were dichotomized by median values, separately by gender. (13 and below versus 14 and above for men; 12 and below versus 13 and above for women).

Physical Activity

For MVPA, the Japanese version of the International Physical Activity Questionnaire Short-version was used²⁰. Participants were asked to report the frequency and duration of three types of physical activity: vigorous-intensity, moderate-intensity (excluding walking), and walking. Total time spent in MVPA, including walking, was calculated by adding these three activities together. For the present analyses, MVPA was dichotomized at the median

into lower (<360 min/week for men, ≤ 300 min/week for women) and higher (≥ 360 min/week for men, >300 min/week for women). This classification was used because a large proportion of participants (about 75%) reported 150 min/week or more of MVPA, the current recommendation for older adults ²¹.

Sedentary behaviors

Leisure time sedentary behaviors (LTSBs) were determined from participants' self-reported frequency and average duration (minutes/day) over the past 7 days. Participants were asked about five types of LTSBs – television viewing, computer use, reading books or newspapers, listening or talking while sitting, and sitting around. These question items were translated into Japanese from an Australian questionnaire on LTSBs ²². The questionnaire is known to have good test-retest reliability (ICC= 0.56–0.82) and acceptable validity (correlation with a three-day log: $r = 0.2\text{--}0.4$) ²². For analysis, total time of LTSBs was dichotomized at the median into lower (<1,900 min/week for men, $\leq 1,740$ min/week for women) and higher (1,900 min/week for men, >1,740 min/week for women).

In our previous study, sedentary behavior was able to be classified into two distinct types: passive sedentary behaviors (consisting of “television viewing”, “sitting around”, and “listening or talking while sitting”) and mentally-active sedentary behaviors (consisting of “computer use” and “reading books or newspapers”) ⁷. These two categories of sedentary time were calculated and dichotomized at the median into lower (<1,340 min/week of passive sedentary time, <420 min/week of mentally-active sedentary time among men; <1,290 min/week of passive sedentary time, <300 min/week of mentally-active sedentary

time among women) and higher ($\geq 1,340$ min/week of passive sedentary time, ≥ 420 min/week of mentally-active sedentary time among men; $\geq 1,290$ min/week of passive sedentary time, ≥ 300 min/week of mentally-active sedentary time among women).

Covariates

Age and gender were obtained from the registry of residential addresses of each municipality. Educational attainment (years of education) and living arrangement (living with others, living alone) were obtained through self-report by each respondent.

Participants were categorized according to education (up to high school [< 13 years] and college degree or more [≥ 13 years]).

Statistical Analysis

Multivariate logistic regressions were employed to calculate the odds ratios (ORs) and 95% confidence intervals (95% CI) for the associations of higher social participation with higher total LTSB time. ORs were calculated, adjusting for age and municipality (minimally-adjusted model), then further adjusting for living arrangement and education (fully-adjusted model). In the fully-adjusted model, MVPA or total time of LTSB were also adjusted in estimating ORs of higher MVPA or higher LTSB, respectively.

Finally, the ORs for associations of higher social participation with higher time in each LTSB category (passive and mentally-active) were calculated, adjusting for age, municipality, living arrangement, education, and MVPA. Similar analyses were conducted

by city of residence.

Before the multiple logistic regression analyses, Hosmer-Lemeshow's goodness of fit test was calculated, with the null hypothesis being that the distribution fits the data. All statistical analyses were conducted separately by gender using STATA software (version 12); the level of significance was set at $p < 0.05$.

Results

Table 1 shows characteristics of participants. The sample consisted of 43% men, and the mean age of participants was 70.1 years. Higher social participation was significantly associated with physical limitation status.

Table 2 shows the summary statistics for LTSB and MVPA by social participation status. For both genders, those with higher social participation spent about 50% more time in MVPA and 10% to 20% less time for LTSB. Regarding specific sedentary behaviors; television viewing time, which accounted for 70% of the total passive sedentary time, was significantly associated with social participation. Among men, time "doing nothing special" was also associated with lower social participation, whereas, time for "computer use" was longer among men with higher social participation.

INSERT TABLES 1, 2 & 3 ABOUT HERE

Table 3 shows the adjusted odds ratios for higher MVPA and lower total LTSB time by social participation status. For both genders, those with high social participation were more physically active (OR: 2.10, [95%CI: 1.44-3.06] among men, OR: 1.93, [1.39-2.68] among women) than those with lower participation. Higher social participation was inversely associated with sedentary time among men (OR: 0.62, [0.42-0.90]), but not among women (OR: 0.80, [0.58-1.11]). Men with higher social participation had significantly lower odds of passive sedentary behaviors (OR: 0.55, [95%CI: 0.38-0.81]), but not significantly higher odds of mentally-active sedentary behaviors (OR: 1.36, [0.91-2.02]). Women with higher social participation have significantly lower odds for passive sedentary behaviors (OR: 0.72, [0.51-0.99]).

Table 4 represents the adjusted odds ratio for MVPA and LTSB by city of residence. In each city, those with higher social participation were physically active than those with lower participation. Among men in urban area, social participation was positively associated with inversely sedentary behaviors (OR: 0.41, [0.18-0.91]), and associated with mentally active sedentary behaviors (OR: 3.27, [1.24-8.63]). In addition, passive sedentary time were inversely associated with social participation among those in regional area (OR=0.43, [0.23-0.82] for men; OR=0.56 [0.31-1.00] for women). Whereas, no clear association was observed between sedentary time and social participation among those in suburban area.

Discussion

Older Japanese adults with higher social participation were more likely to be physically active. Significant inverse associations between total sedentary time and social participation status were observed among men, but not women. However, for both men and women, higher social participation was associated with less passive sedentary time.

With older adults who have higher social participation being more likely to have physically active life-styles, this study provides supportive evidence for health policies aimed at social participation^{10, 23}. The results of our study suggested that promoting social participation may contribute to reducing sedentary time, simultaneously. There is as yet no evidence on effective, population-based countermeasures for reducing sedentary time⁵. In this context, promoting social participation could be one practical strategy not only to promote physical activity, but also to reduce sedentary time for older adults.

There are several possible mechanisms to explain why older adults with higher social participation are more physically active and less sedentary. Obviously, social participation itself provides more opportunities to go outside. Thus, older adults with higher social participation may walk more to join activities, and may spend less time sitting at home. In addition, a Japanese longitudinal study showed that social participation improves older peoples' mental health²⁴, which may promote their physical activity²⁵. Furthermore, social participation has been reported to improve access to social support²⁶, which may also contribute to increased physical activity²⁷.

Interestingly, older men with higher social participation spent more time in computer use. Speculatively, computer use may help in contacting friends or gathering information, which may provide more opportunities for older adults to have engagements outside of the home²⁸. Whereas, computer use has been treated as an unfavorable behavior among younger or middle-aged adults^{29,30}. However, computer use may be a favorable attribute for older adults, in that it may promote social participation.

A strength of our study is that we recruited community-dwelling older adults randomly-selected from three different localities (urban, suburban, and regional), and assessed the association between multiple sedentary behavior and several health-related attributes. The response rate to our survey and the availability of complete data was acceptable (59%).

A notable finding was that social participation was associated with passive sedentary time more than with total sedentary time, especially among women. Targeting passive sedentary time rather than total sedentary time may be more useful in initiatives to promote older adults' health⁷. Certainly, we found that total sedentary time was not associated with social participation status among women. However, this would not justify a conclusion that promoting social participation may not contribute to reducing chronic diseases related to sedentary behavior among women, because passive sedentary time was significantly associated with social participation. Future studies are warranted to focus not only on

overall sitting time, but also on subtypes of sedentary behavior in examining the health impacts of sitting⁷.

In conclusion, promoting social participation among older adults may contribute to increasing physical activity and reducing sedentary time, with potential benefits for chronic disease. Further research is required to elucidate the deleterious and beneficial roles of passive and mentally-active sedentary time for older adults.

Acknowledgement

This study was supported by the Grant-in-Aid for Scientific Research (B): 25282209 from the Japan Ministry of Education, Culture, Sports and Science and Technology. Owen is supported by NHMRC Program Grant (#569940) and a Senior Principal Research Fellowship (1003960) and by the Victorian Government's Operational Infrastructure Program.

Disclosure statement

The authors declare no conflict of interest.

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Table1. Characteristic of participants

	Men				p	Women				p
	Social Participation Higher		Social Participation Lower			Social Participation Higher		Social Participation Lower		
	n	(%)	n	(%)		n	(%)	n	(%)	
n	245	(50.1%)	244	(49.9%)		321	(48.9%)	336	(51.1%)	
Age group (years)					n.s.					n.s.
65-69	125	(49.8%)	126	(50.2%)		162	(47.2%)	181	(52.8%)	
70-74	120	(50.4%)	118	(49.6%)		159	(50.6%)	155	(49.4%)	
City of residence					n.s.					n.s.
Central capital (Bunkyo)	68	(58.6%)	48	(41.4%)		94	(47.0%)	106	(53.0%)	
Suburban (Fuchu)	94	(46.3%)	109	(53.7%)		112	(48.7%)	118	(51.3%)	
Rural (Oyama)	82	(48.2%)	88	(51.8%)		115	(50.7%)	112	(49.3%)	
Living arrangements					n.s.					n.s.
Living with others	223	(51.3%)	212	(48.7%)		282	(49.1%)	292	(50.9%)	
Living alone	22	(40.7%)	32	(59.3%)		39	(47.0%)	44	(53.0%)	
Physical limitations					<0.05					<0.001
No	234	(51.8%)	218	(48.2%)		308	(51.1%)	295	(48.9%)	
Yes	11	(29.7%)	26	(70.3%)		13	(24.1%)	41	(75.9%)	

Body mass index (kg/m ²)					n.s.					n.s.
<25	199	(50.6%)	194	(49.4%)		264	(49.3%)	272	(50.7%)	
≥25	46	(47.9%)	50	(52.1%)		57	(47.1%)	64	(52.9%)	
Educational attainment (education years)					n.s.					n.s.
College degree or more (≥13)	54	(48.2%)	58	(51.8%)		90	(53.6%)	78	(46.4%)	
Up to high school (< 13)	191	(50.7%)	186	(49.3%)		231	(47.2%)	258	(52.8%)	

p-values were calculated by chi-square test, S.D.: standard deviation

Table 2. Durations of physical activity and sedentary time by gender and by social participation status (hours/day)

	Social Participation Higher				Social Participation Lower				p
	Mean	(S.D.)	Median	(25th-75th percentile)	Mean	(S.D.)	Median	(25th-75th percentile)	
Men									
Moderate-to-vigorous physical activity time	1.34	(1.39)	1.00	(0.42-1.71)	0.93	(1.15)	0.57	(0.14-1.33)	<0.001
Sedentary Time (<i>Total</i>)	4.98	(3.08)	4.57	(2.93-6.57)	5.90	(3.63)	5.86	(3.43-8.01)	<0.001
<i>(Passive Sedentary Behavior)</i>									
TV viewing	2.74	(2.09)	2.00	(1.29-4.00)	3.50	(2.43)	3.00	(2.00-5.00)	<0.001
Listening to music or talking	0.58	(0.82)	0.36	(0.00-0.86)	0.58	(0.89)	0.14	(0.00-1.00)	n.s.
Doing nothing special	0.48	(1.16)	0.00	(0.00-0.48)	1.08	(1.76)	0.12	(0.00-2.00)	<0.001
<i>(Mentally-active sedentary behavior)</i>									
Computer use	0.55	(1.13)	0.00	(0.00-0.57)	0.30	(0.85)	0.00	(0.00-0.05)	<0.001
Reading books or newspaper	1.03	(1.01)	1.00	(0.43-1.16)	1.03	(1.20)	0.75	(0.17-1.42)	n.s.
Women									
Moderate-to-vigorous physical activity time	1.39	(1.83)	0.85	(0.38-1.57)	0.89	(1.23)	0.50	(0.19-1.08)	<0.001
Sedentary Time (<i>Total</i>)	4.50	(2.96)	4.07	(2.47-6.29)	5.17	(3.41)	4.76	(2.58-7.41)	<0.05
<i>(Passive Sedentary Behavior)</i>									
TV viewing	2.73	(2.06)	2.00	(1.29-4.00)	3.21	(2.52)	3.00	(1.50-4.00)	<0.05
Listening to music or talking	0.74	(0.94)	0.50	(0.00-1.00)	0.73	(0.88)	0.50	(0.00-1.00)	n.s.
Doing nothing special	0.43	(1.30)	0.00	(0.00-0.43)	0.55	(1.47)	0.00	(0.00-0.50)	n.s.
<i>(Mentally-active sedentary behavior)</i>									

Computer use	0.14	(0.48)	0.00	(0.00-0.00)	0.12	(0.43)	0.00	(0.00-0.00)	n.s.
Reading books or newspaper	0.88	(0.83)	0.67	(0.33-1.00)	0.91	(1.03)	0.50	(0.20-1.00)	n.s.

p-values were calculated by ranksum test, S.D.: standard deviation

Table 3. Associations of social participation categories with physical activity and with sedentary time (multivariate logistic regression)

Social Participation		Minimally-adjusted Model			Fully-adjusted Model		
		OR	(95% C I)	p	OR	(95% C I)	p
<i>Physical Activity Time</i>							
Men	Lower Higher	(1.00) 2.18 ^{a)}	(1.50-3.16)	<0.001	(1.00) 2.10 ^{b)}	(1.44-3.06)	<0.001
Women	Lower Higher	(1.00) 2.07 ^{a)}	(1.59-2.85)	<0.001	(1.00) 1.93 ^{b)}	(1.39-2.68)	<0.001
<i>Sedentary Time</i> <i>(Total Sedentary Time)</i>							
Men	Lower Higher	(1.00) 0.59 ^{a)}	(0.41-0.86)	0.005	(1.00) 0.62 ^{c)}	(0.42-0.90)	0.013
Women	Lower Higher	(1.00) 0.79 ^{a)}	(0.58-1.08)	0.140	(1.00) 0.80 ^{c)}	(0.58-1.11)	0.186
<i>(Passive Sedentary Time)</i>							
Men	Lower Higher	(1.00) 0.53 ^{a)}	(0.37-0.77)	0.001	(1.00) 0.55 ^{c)}	(0.38-0.81)	0.003
Women	Lower Higher	(1.00) 0.66 ^{a)}	(0.48-0.89)	0.008	(1.00) 0.72 ^{c)}	(0.51-0.99)	0.046
<i>(Mentally-Active Sedentary Time)</i>							
Men	Lower Higher	(1.00) 1.51 ^{a)}	(1.04-2.20)	0.029	(1.00) 1.36 ^{c)}	(0.91-2.02)	0.135
Women	Lower Higher	(1.00) 1.33 ^{a)}	(0.97-1.81)	0.074	(1.00) 1.17 ^{c)}	(0.83-1.63)	0.360

Adjustments for covariates

- a) age and city of residence
 b) age, city of residence, educational attainment, living arrangement, body mass index, physical limitation and total sedentary time
 c) age, city of residence, educational attainment, living arrangement, body mass index, physical limitation and MVPA
 BMI: body mass index, MVPA: moderate-to-vigorous physical activity, OR: odds ratio, CI: confidence interval

Table 4. Associations of social participation categories with physical activity and with sedentary time by city of residence

Social Participation		Bunkyo Ward (Urban)			Fuchu City (Suburban)			Oyama Town (Regional)		
		OR	(95% C I)	p	OR	(95% C I)	p	OR	(95% C I)	p
<i>Physical Activity Time</i>										
Men	Lower	(1.00)			(1.00)			(1.00)		
	Higher	2.00	(0.88-4.54)	0.099	2.55	(1.35-4.82)	0.004	2.08	(1.14-3.80)	0.017
Women	Lower	(1.00)			(1.00)			(1.00)		
	Higher	1.76	(0.97-3.18)	0.061	1.88	(1.08-3.26)	0.025	2.17	(1.21-3.90)	0.009
<i>Sedentary time (Total Sedentary Time)</i>										
Men	Lower	(1.00)			(1.00)			(1.00)		
	Higher	0.66	(0.29-1.46)	0.300	0.82	(0.42-1.62)	0.575	0.49	(0.26-0.90)	0.022
Women	Lower	(1.00)			(1.00)			(1.00)		
	Higher	0.97	(0.54-1.76)	0.926	0.75	(0.43-1.30)	0.302	0.70	(0.39-1.26)	0.236
<i>(Passive Sedentary Time)</i>										

Men	Lower	(1.00)			(1.00)			(1.00)		
	Higher	0.41	(0.18-0.91)	0.028	0.94	(0.48-1.83)	0.862	0.43	(0.23-0.82)	0.011
Women	Lower	(1.00)			(1.00)			(1.00)		
	Higher	1.01	(0.55-1.85)	0.973	0.63	(0.36-1.10)	0.106	0.56	(0.31-1.00)	0.052
<i>(Mentally-Active Sedentary Time)</i>										
Men	Lower	(1.00)			(1.00)			(1.00)		
	Higher	3.27	(1.24-8.63)	0.017	0.88	(0.43-1.78)	0.716	1.34	(0.72-2.47)	0.354
Women	Lower	(1.00)			(1.00)			(1.00)		
	Higher	1.32	(0.74-2.38)	0.351	1.18	(0.67-2.06)	0.570	1.03	(0.57-1.86)	0.921

Odds ratios were adjusted by age, city of residence, educational attainment, living arrangement, body mass index, physical limitation and MVPA

BMI: body mass index, MVPA: moderate-to-vigorous physical activity, OR: odds ratio, CI: confidence interval

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Title:

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Date:

2017-11-01

Citation:

Kikuchi, H., Inoue, S., Fukushima, N., Takamiya, T., Odagiri, Y., Ohya, Y., Amagasa, S., Oka, K. & Owen, N. (2017). Social participation among older adults not engaged in full- or part-time work is associated with more physical activity and less sedentary time. GERIATRICS & GERONTOLOGY INTERNATIONAL, 17 (11), pp.1921-1927. <https://doi.org/10.1111/ggi.12995>.

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