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Association between Volunteer Activity Participation and Daily Sedentary Time among Adults in Japan: A Cross-sectional Study

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Abstract:

Introduction: Sedentary behavior, involving low energy expenditure while sitting or reclining, is linked to health risks. Volunteering may help reduce sedentary time through social interaction and physical activity, but this relationship is understudied in non-Western contexts. This study investigated the association between volunteer activity frequency and daily sitting time among adults in Aichi and Kanagawa Prefectures, Japan, regions with higher aging.

Methods: A cross-sectional study was conducted in two regions of Japan, with a sample of 1,224 adults (585 men and 639 women) from these regions. Data on volunteer activity frequency and daily sitting time were collected using questionnaires. Multiple regression models explored the relationship between volunteer frequency and sitting time, adjusting for confounders.

Results: The mean daily sitting time was 357.66 ± 240.40 minutes. Participants volunteering four or more times weekly reported significantly shorter sitting times compared to non-participants, with an average difference of 131.96 minutes (95% CI: -253.83 to -10.08) in the multivariable-adjusted model. This association was stronger among males (difference: 180.51 minutes; 95% CI: -353.84 to -7.28) and older adults aged ≥65 years (difference of 142.48 minutes; 95% CI: -272.58 to -12.38).

Conclusion: Frequent volunteering is associated with shorter sitting times, particularly among males and older adults. However, due to the cross-sectional design, causal inferences cannot be made, and the associations should be interpreted with caution. Compared to Western populations, sitting time was lower, but it still exceeded public health recommendations. Future research should explore the longitudinal effects and identify specific volunteer activities that promote active lifestyles.

Keywords: Sedentary behavior, Volunteer activities, Physical activity, Public health, Aging population, Health risks.

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1. INTRODUCTION

Sedentary behavior, defined as any waking activity characterized by an energy expenditure of 1.5 metabolic equivalents (METs) or less while in a sitting, reclining, or lying posture, has emerged as a significant global public health concern [1, 2]. This includes activities such as sitting while working at a desk, watching television, or traveling by car, bus, or train. Across diverse populations, prolonged sedentary behavior has been associated with a range of adverse health outcomes, including cardiovascular disease, obesity, type 2 diabetes, and increased mortality risk [3, 4]. Recent research further highlights that reducing sedentary time is crucial for improving population health, as sedentary behavior is strongly linked to increased all-cause mortality risk [5]. As lifestyles become more sedentary worldwide, there is an urgent need for effective strategies to reduce sitting time and promote more active lifestyles across all age groups [6, 7].

Volunteering has emerged as a promising approach to mitigating sedentary behavior. Recent studies have emphasized the health benefits of volunteering, such as improvements in physical and mental well-being, especially among older adults [8]. Volunteer activities are typically defined as unpaid work or service provided to benefit others or the community, often organized by nonprofit organizations, community groups, or other entities [9]. Engaging in these activities may encourage social interaction and purposeful movement, helping to reduce sitting time and promote overall well-being [10, 11]. This aligns with global efforts to increase physical activity and reduce sedentary lifestyles, as highlighted by recent global health research [12]. Although the specific content of volunteer activities can vary, the act of volunteering itself is associated with lower levels of sedentary behavior and increased physical activity across various populations, including adults of different ages [8]. Environmental volunteering, such as park clean-ups or tree planting, often involves moderate physical activities like walking and lifting, which can positively impact overall health [8]. Physical activity is well-documented for its role in improving health outcomes, such as reducing the risk of cardiovascular diseases and diabetes [11]. Conversely, sedentary behavior has been linked to increased health risks, making it crucial to find effective interventions to counteract these effects, particularly in aging populations [8]. Promoting physical activity through community engagement, such as volunteering, may, therefore, offer a viable approach to addressing these health risks. Furthermore, research suggests that there may be gender differences in how individuals engage in volunteer activities, with men and women often participating in different types of volunteering, which can influence their physical activity levels and health outcomes [13].

Prior research on sedentary behavior and volunteering has focused on Western countries, where individualistic cultural norms prevail [14]. In contrast, Japan's collectivist culture emphasizes community engagement and social responsibility, particularly among older adults [15]. These cultural differences influence the types of volunteer activities and their health benefits. For example, Japanese seniors often participate in community-based activities that foster social cohesion. Moreover, motivations for volunteering in Japan differ from those in Western countries, where individual benefits like personal satisfaction or career advancement are more prominent [16]. By understanding these unique cultural factors, this study provides insights into how volunteering in a collectivist context relates to sedentary behavior, offering perspectives not applicable to Western settings.

Despite the potential benefits of volunteering, this relationship has not remained extensively studied, particularly outside Western contexts. Most existing research primarily targets older adults due to their vulnerability to the health risks associated with prolonged sitting. However, sedentary lifestyles are prevalent across all adult age groups, making it essential to understand how volunteering impacts sitting time in a broader demographic context [17]. This study aims to examine the association between volunteer frequency and daily sitting time among adults in Japan.

2. MATERIAL AND METHODS

2.1. Study Population

In this cross-sectional study, we selected 2,452 individuals from two regions in Japan (Area A in Aichi Prefecture and Area B in Kanagawa Prefecture) during the first quarter of 2022. These areas were chosen because they both exhibit higher population aging rates (A: 38.6%, B: 45.5%) compared to the national average of 26.7% [18]. Known as new towns [19], both regions are experiencing significant challenges related to extreme aging and population decline. To ensure the study's feasibility, these areas were selected with the consent and support of the neighborhood council chairpersons. As prior information about residents was unavailable, community association directors distributed questionnaires to every household in the two selected neighborhoods. A reminder was included, encouraging the head of the household to complete the survey. One week after distribution, the neighborhood association directors collected the completed questionnaires. No financial or other incentives were provided to encourage participation, and submission of the questionnaire was considered as giving consent for participation in the study. The responses to the questionnaire were consent to the study. This study was approved by the Ethics Review Committee of the Osaka Metropolitan University Graduate School of Human Life and Ecology (no. 22-53). Among 1569 respondents (response rate: 64.0%), those with missing data on the frequency of volunteer activities (n = 143), the average daily sitting time (n = 177), sex (n = 9), age (n = 4), living situation (n = 4), smoking habits(n = 4), exercise habit(n = 4) were excluded. As a result, 1,224 individuals (585 men and 639 women) were included in the final analyses.

2.2. Data Collection

Information on the frequency of participation in

volunteer activities was collected through self-administered questionnaires using the following question: "How often do you participate in volunteer activities?" Possible answers were not participating, several times a year, 1–2 times a month, once a week, 2–3 times a week, or ≥4 times a week.

Average daily sitting time was assessed using the Global Physical Activity Questionnaire (GPAQ) [20, 21]. Participants were asked, "How much time do you usually spend sitting or reclining on a typical day?" In this instrument, the total time they usually spent sitting or reclining at work, at home, getting to and from places, or with friends (*e.g.*, sitting at a desk, sitting with friends, traveling in a car, bus, or train, reading, playing cards, or watching television), excluding time spent sleeping, was evaluated.

2.3. Statistical Analysis

The characteristics of the study participants according to the frequency of participation in volunteer activities were expressed as mean ± standard deviation for continuous variables and as numbers (percentages) for categorical variables. Analysis of variance was used to compare continuous variables, while the χ^2 test was used to compare categorical variables. Multiple regression models were employed to explore the relationship between the frequency of participation in volunteer activities and the average daily sitting time. Multivariable regression coefficients (β) and 95% confidence intervals (CIs) were estimated, with individuals in the 'Not participating' group as the reference. The regression models were adjusted for potential confounders, including sex (male, female), age (as a continuous variable), living situation (living alone, living with others), smoking habits (non-smokers, former smokers, current smokers), weekly exercise habits (presence, absence), and self-rated health (very healthy, fairly healthy, not very healthy, unhealthy). Subgroup analyses were conducted by sex and age categories (<65, ≥65 years). To calculate the p for trend, we converted the categorical responses into numerical values representing times per week (0, 0.05, 0.35, 1, 2.5, 5.5 times/week) and included them as a continuous variable in the model. An α level of 0.05 was considered statistically significant. All statistical analyses were performed using R version 4.4.1 [22].

3. RESULTS

The mean ± standard deviation of daily sitting time was 357.66 ± 240.40 minutes per day (male: 392.46 ± 247.10, female: 325.80 ± 229.71).

Table **1** describes the characteristics of the study participants according to the frequency of participation in volunteer activities. The mean age increased with higher participation frequency, from 66.5 years in non-participants to 74.7 years in the most frequent group (P = 0.008). Regular exercise was significantly more common among frequent volunteers ($p < 0.001$).

Table 1. Characteristics of the study participants according to the frequency of participation in volunteer activities (n = 1,224).

Frequency of Participation in Volunteer Activities							
Variables	**Not participating**	**Several times/year**	**1–2 times/month**	**Once/week**	**2–3 times/week**	**≥4 times/week**	**p-value[1]**
Number of participants	944	126	82	34	23	15	-
Sex							
Male	448(47.5)	59(46.8)	43(52.4)	17(50.0)	10(43.5)	8(53.3)	0.943
Female	496(52.5)	67(53.2)	39(47.6)	17(50.0)	13(56.5)	7(46.7)	-
Age (years)	66.54 ± 15.45	68.50 ± 15.68	69.90 ± 13.38	72.79 ± 12.88	72.00 ± 8.18	74.67 ± 9.28	0.008
Living situation							
Living alone	88(9.3)	11(8.7)	12(14.6)	3(8.8)	3(13.0)	1(6.7)	0.69
Living with others	856 (90.7)	115 (91.3)	70 (85.4)	31(91.2)	20(87.0)	14 (93.3)	-
Smoking habits							
Non-smokers	161(17.1)	18(14.3)	18(22.0)	3(8.8)	5(21.7)	3(20.0)	0.68
Former smokers	730(77.3)	103 (81.7)	57(69.5)	28(82.4)	16(69.6)	11(73.3)	-
Current smokers	53(5.6)	5(4.0)	7(8.5)	3(8.8)	2(8.7)	1(6.7)	-
Weekly exercise habits							
Presence	566(60.0)	92(73.0)	69(84.1)	26(76.5)	16(69.6)	12(80.0)	<0.001
Absence	378(40.0)	34(27.0)	13(15.9)	8(23.5)	7(30.4)	3(20.0)	-
Self-rated health							
Very healthy	156(16.5)	23(18.3)	14(17.1)	4(11.8)	1(4.3)	7(46.7)	0.094
Fairly healthy	670(71.0)	95(75.4)	61(74.4)	28(82.4)	21(91.3)	8(53.3)	-
Not very healthy	93(9.9)	7(5.6)	6(7.3)	2(5.9)	1(4.3)	0	-
Unhealthy	25(2.6)	1(0.8)	1(1.2)	0	0	0	-

Note: Variables are expressed as mean ± standard deviation for continuous variables and as numbers (percentages) for categorical variables.

[1] Analysis of variance was used to compare continuous variables, while the χ^2 test was used to compare categorical variables.

Table 2 shows the associations between the frequency of participation in volunteer activities and average daily sitting time. Participants who volunteered ≥4 times per week had significantly shorter average daily sitting times compared to non-participants, with β = -126.65 minutes (95% CI: -249.34 to -3.96) in the area-adjusted model and β = -131.96 minutes (95% CI: -253.83 to -10.08) in the multivariable-adjusted model. A significant trend was observed, as increased participation frequency was associated with shorter sitting times.

Table 3 presents the associations between the frequency of participation in volunteer activities and average daily sitting time by sex. Among males, participants who volunteered ≥4 times per week had significantly shorter sitting times (area-adjusted β = -180.51 minutes, 95% CI: -353.84 to -7.28), with similar results in the multivariable model. No significant associations were found among females, although shorter sitting times were observed.

Table 4 examines the associations between the frequency of participation in volunteer activities and average daily sitting time by age group, with wide confidence intervals and non-significant β values. However, among those aged ≥65 years, volunteering ≥4 times per week was associated with significantly shorter sitting times in the area-adjusted model (β = -142.48 minutes, 95% CI: -272.58 to -12.38). The trend remained significant in this age group (P for trend = 0.02), indicating that frequent volunteering is associated with shorter sitting times in older adults.

4. DISCUSSION

The findings of this study revealed a significant inverse relationship between the frequency of participation in volunteer activities and daily sitting time among adults. This association was particularly pronounced among males and older adults aged ≥65 years, suggesting that those who engage in volunteer activities may tend to have less sedentary behavior among these populations.

Table 2. Associations between the frequency of participation in volunteer activities and average daily sitting time (n = 1,224).

Frequency of Participation in Volunteer Activities							
Category	**Not participating**	**Several times/year**	**1–2 times/month**	**Once/week**	**2–3 times/week**	**≥4 times/week**	**P for Trend**
Number of participants	944	126	82	34	23	15	-
Area-adjusted β (95% CI)	Ref	-27.98 (-72.69, 16.73)	-2.69 (-56.99, 51.61)	-33.20 (-115.47, 49.06)	-43.51 (-142.98, 55.95)	-126.65 (-249.34, -3.96)*	0.03
Multivariable β (95% CI)[1]	Ref	-24.76 (-69.28, 19.77)	-10.36 (-64.81, 44.09)	-36.74 (-118.60, 45.12)	-49.38 (-145.09, 49.32)	-131.96 (-253.83, -10.08)*	0.02

Note: β: regression coefficient. CI: confidence interval. Ref: reference. *p <0.05.
[1]Adjusted for sex, age, living situation, smoking habits, weekly exercise habits, and self-rated health.
P for trend was calculated across the frequency in volunteer activities (times/week).

Table 3. Associations between the frequency of participation in volunteer activities and average daily sitting time by sex (n = 1,224).

Frequency of Participation in Volunteer Activities							
Category	**Not participating**	**Several times/year**	**1–2 times/month**	**Once/week**	**2–3 times/week**	**≥4 times/week**	**P for Trend**
Male							
Number of participants	448	62	45	18	11	8	-
Area-adjusted β (95% CI)	Ref	-12.91 (-80.12, 54.31)	-4.40 (-82.19, 73.40)	-22.81 (-142.80, 97.18)	-97.51 (-252.79, 57.76)	-180.51 (-353.84, -7.28)*	0.02
Multivariable β (95% CI)[1]	Ref	-10.67 (-78.74, 57.40)	-10.55 (-8 9.97, 68.87)	-19.07 (-140.93, 102.80)	-96.54 (-252.92, 59.84)	-183.80 (-358.40, -9.20)*	0.02
Female							
Number of participants	496	75	54	25	17	9	-
Area-adjusted β (95% CI)	Ref	-41.83 (-100.55, 16.89)	-12.81 (-87.77, 62.15)	-42.33 (-153.57, 68.91)	5.62 (-121.01, 132.26)	-77.54 (-249.11, 94.03)	0.43
Multivariable β (95% CI)[1]	Ref	-44.02 (-102.92, 14.88)	-23.52 (-99.10, 52.05)	-43.91 (-154.76, 66.28)	0.02 (-126.70, 127.01)	-83.88 (-254.93, 87.17)	0.38

Note: β: regression coefficient. CI: confidence interval. Ref: reference. *p <0.05.
[1]Adjusted for age, living situation, smoking habits, weekly exercise habits, and self-rated health.
P for trend was calculated across the frequency in volunteer activities (times/week).

Table 4. Associations between the frequency of participation in volunteer activities and average daily sitting time by age group (n = 1,224).

Frequency of Participation in Volunteer Activities							
Category	**Not participating**	**Several times/year**	**1–2 times/month**	**Once/week**	**2–3 times/week**	**≥4 times/week**	**P for Trend**
Age <65 years							
Number of participants	383	1	5	6	24	38	-
Area-adjusted β(95% CI)	Ref	-75.41 (-152.81, 1.99)	-29.35 (-125.11, 66.42)	77.55 (-109.80, 264.91)	82.10 (-122.75, 286.96)	-46.35 (-502.30, 409.59)	0.58
Multivariable β(95% CI)[1]	Ref	-77.40 (-153.25, 1.56)	-37.10 (-131.24, 57.05)	108.56 (-75.90, 293.02)	99.39 (-101.08, 299.86)	-123.06 (-572.47, 326.36)	0.59
Age ≥65 years							
Number of participants	561	14	18	28	58	88	-
Area-adjusted β(95% CI)	Ref	-9.45 (-64.58, 45.68)	3.29 (-63.11, 69.68)	-61.46 (-197.01, 33.07)	-81.99 (-197.04, 33.07)	-142.48 (-272.58, -12.38)*	0.01
Multivariable β(95% CI)[1]	Ref	2.46 (-52.92, 57.83)	7.54 (-59.49, 74.57)	-46.13 (-139.66, 47.41)	-80.59 (-195.51, 34.33)	-120.72 (-150.69, 9.25)	0.02

Note: β: regression coefficient. CI: confidence interval. Ref: reference. *p <0.05.
[1]Adjusted for sex, living situation, smoking habits, weekly exercise habits, and self-rated health.
P for trend was calculated across the frequency in volunteer activities (times/week).

The observed mean daily sitting time of approximately 6 hours is lower than the sitting time reported, where adults were found to spend about 9.4 hours per day in sedentary behavior [3]. Nevertheless, both figures indicate high levels of sedentary behavior in adult populations. This finding underscores the pervasive nature of sedentary lifestyles in contemporary society and highlights the need for effective interventions to address sitting time. Our results also revealed a notable gender difference in sitting time, with males spending more time sitting than females. This disparity is consistent with other studies that have reported higher sedentary time among men [23]. The reasons for this gender difference may be multifaceted, potentially involving factors such as occupational characteristics, leisure-time activities, or sociocultural norms.

Several mechanisms may explain the observed associations. Volunteering often involves physical activities, social interactions, and purposeful engagement, all of which can contribute to lower sitting time [11]. First, engaging in volunteer activities often requires individuals to leave their homes and engage in physical tasks, which inherently reduces time spent sitting [10]. Additionally, the social aspect of volunteering may increase motivation to be active, as social interaction is known to encourage physical activity and discourage prolonged sedentary behavior [11]. Volunteering also provides a sense of purpose, which has been linked to increased adherence to health-promoting behaviors, including regular physical activity [8]. Furthermore, structured volunteer commitments help individuals break up prolonged sitting periods, an approach recognized as effective in managing sedentary time [6]. The structured nature of volunteer commitments may help individuals break up prolonged sitting periods throughout the day, an approach that is increasingly recognized as important in sedentary behavior management [6]. The positive association between volunteering frequency and regular exercise further supports the notion that community engagement may foster overall healthier lifestyles. This aligns with previous research indicating that volunteering can enhance physical activity levels and promote better health behaviors [8].

Participants who volunteered ≥4 times per week reported approximately 132 minutes less daily sitting time compared to non-volunteers in the fully adjusted model. This difference of over 2 hours could have meaningful health implications, given the established links between prolonged sitting and various adverse health outcomes [4]. Even reducing sitting time by an hour can improve metabolic health, reducing the risk of cardiovascular disease and type 2 diabetes [24]. This gender disparity may reflect differences in the types of volunteer activities undertaken or other gender-specific factors influencing physical activity patterns, as suggested by research on gender differences in socially productive activities [25]. For example, in a study examining the association between participation in social activities and sitting time among 1,146 Japanese older adults, a significant association with total sitting time was observed only in men, whereas a significant negative association with passive activities, such as watching television was found in both men and women [26]. Thus, further research is needed to explore these gender-specific associations and their underlying mechanisms. Our age-stratified analysis also revealed that the association between volunteering and lower sitting time was most pronounced among older adults (≥65 years). In this group, frequent volunteering (≥4 times per week) was associated with significantly shorter sitting times. This finding is especially relevant given the increased health risks associated with sedentary behavior in older populations and the potential benefits of shorter sitting times in this age group [27].

5. LIMITATIONS OF THE STUDY

Our study has important implications for public health

strategies aimed at reducing sedentary behavior. Encouraging participation in volunteer activities, particularly among older adults and men, could be an effective approach to promoting more active lifestyles and potentially decreasing sitting time. Community-based interventions that facilitate volunteering opportunities may offer the dual benefits of enhancing social engagement and reducing sedentary behavior [10]. However, this study has several limitations that should be considered when interpreting these results. First, the cross-sectional nature of our study precludes establishing temporal relationships. The observed associations are correlational, meaning that while volunteering is linked to sedentary behavior, causation cannot be determined. Reverse causation is also possible: less sedentary individuals may be more inclined to volunteer. Longitudinal research is needed to clarify the relationship between volunteering and changes in sitting time. Second, self-reported measures of sitting time and volunteering frequency may be subject to recall bias and social desirability bias, which can lead to inaccurate estimates. To address these biases, we used the validated Global Physical Activity Questionnaire (GPAQ) [20].

Nevertheless, future studies should use objective tools like accelerometers or activity trackers for more accurate assessments of sedentary behavior and physical activity. Third, although the observed trends align with previous research, the wide confidence intervals in smaller subgroup analyses suggest that larger sample sizes would be beneficial in future studies to confirm these findings with greater precision. Fourth, Aichi and Kanagawa Prefectures were selected due to their high aging rates, making them suitable for studying the effect of volunteering on sedentary behavior in older adults. However, this focus may limit the generalization of our findings to younger populations or other regions. Future research should include more diverse regions to ensure broader applicability. Fifth, due to excluding participants with missing data, selection bias may have been introduced into our results, which affects the generalizability of our findings. Sixth, we selected confounders based on the established associations with sedentary behavior in prior research. Although dietary habits and work conditions are relevant [28], data on these factors were not collected. Future studies should include these factors for a more comprehensive analysis. Seventh, our study did not collect detailed information on the specific types or frequencies of volunteer activities. This limitation restricts our ability to fully analyze how different volunteer activities contribute to physical activity levels. Environmental volunteering, such as park clean-ups or tree planting, involves moderate activity such as walking and lifting, which has been shown to improve physical and mental health [8, 29]. Community service activities, like assisting at events or distributing food, often require standing or light lifting, which can help reduce sedentary time [30]. Future research should collect detailed data on the nature and frequency of volunteer activities to better understand the impact of these activities on physical activity and sedentary behavior.

CONCLUSION

Our findings indicate that frequent participation in volunteer activities may be associated with shorter daily sitting time, particularly among older adults and males. These results suggest that community engagement could be a potential strategy to help address sedentary behavior. However, further research is needed to explore the longitudinal effects of volunteering on sedentary patterns and to investigate which specific types of volunteer activities might be most effective in promoting more active lifestyles.

AUTHORS' CONTRIBUTIONS

S.U. and K.M.: Contributed to the study conception and design; Y.K., Y.L., H.S., and K.O.: Collected the data; S.U.: Contributed to the analysis and interpretation of results and drafted the manuscript.

LIST OF ABBREVIATIONS

β	=	Regression Coefficients
CI	=	Confidence Interval

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Ethics Review Committee of the Osaka Metropolitan University, Japan. Graduate School of Human Life and Ecology (no. 22-53).

HUMAN AND ANIMAL RIGHTS

All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

Submission of self-completed questionnaires was considered an agreement to participate in the research. Authors only accessed fully anonymized data.

STANDARDS OF REPORTING

STROBE and SAGER guidelines were followed.

AVAILABILITY OF DATA AND MATERIAL

The data of current study are available from author, [S.U.], on a reasonable request.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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