Correlates of engaging in sports and exercise volunteering among older adults in Japan

Taishi Tsuji1,2*, Satoru Kanamori3,4, Mitsuya Yamakita5, Ayane Sato6, Meiko Yokoyama2, Yasuhiro Miyaguni7 & Katsunori Kondo2,8

This study aimed to identify factors associated with engaging in sports and exercise volunteering among older adults. We used cross-sectional data from the Japan Gerontological Evaluation Study (JAGES), a nationwide mail survey of 20,877 older adults from 60 municipalities. Multilevel mixed-effects logistic regression analysis was used to investigate the correlation between engaging in sports and exercise volunteering and 39 variables classified into five factors: (1) demographic and biological, (2) behavioral, (3) psychological, cognitive, and emotional, (4) social and cultural, and (5) environmental factors. Among the analyzed samples, 1580 (7.6%) participants volunteered a few times/year or more often. Factors that showed positive association with the volunteering were older age, a current drinking habit, excellent self-rated health, high proportion of sports group participants in a living area, low municipal population density, and rich social and cultural features (i.e., social cohesion, support, network, and participation). Meanwhile, those that had a negative association were women, low level of education, deteriorated instrumental activities of daily living, having a past or current smoking habit, poor self-rated health, and depressive symptoms. We clarified the characteristics of the population that is more likely to participate in sports and exercise volunteering as well as those of the population that is less likely to participate and requires support.

It is well-known that a proper amount of leisure-time physical activity including sports and exercise is crucial for improving one's personal health, well-being, and quality of life; there is no exception for older adults1–3. Therefore, several studies have explored the factors that promote or hinder the sports and exercise activities of older adults4–6. Various factors, including demographic, biological, behavioral, psychological, emotional, social, and environmental aspects have been comprehensively examined.

In recent years, from the perspective of public health and sports promotion, the involvement with sports and exercise other than “playing/doing” has attracted attention. For example, the Second Sport Basic Plan established by The Ministry of Education, Culture, Sports, Science, and Technology, which forms the basis of policies on sports promotion in Japan, encourages people to engage in sports and exercise activities by not only playing but by also “watching” and “supporting” these activities7; “supporting” sports and exercise includes volunteer activities (e.g., instruction in exercise and sports, and organizing or supporting sports competitions, events, and club activities)8. As the population ages, it is more important to promote “supporting” activities such as volunteering and peer support among older adults as well as rely on an expert instruction and management to disseminate sports and exercise activities more broadly. Several previous studies reported that provision of exercise programs by older volunteers and peers had a positive effect on increasing the physical activity of the participants and spreading the exercise program to the community9,10. These benefits to other individuals, combined with the contribution to the healthy aging of the volunteers themselves, encourage volunteer activities in the community, in support of age-friendly cities11. In particular, sports and exercise volunteers are expected to acquire a more

1Faculty of Health and Sport Sciences, University of Tsukuba, 3-29-1 Otsuka, Bunkyo City, Tokyo 112-0012, Japan. 2Center for Preventive Medical Sciences, Chiba University, 1-33 Yayoi-cho, Inage Ward, Chiba City, Chiba 263-8522, Japan. 3Teikyo University Graduate School of Public Health, 2-11-1 Kaga, Itabashi City, Tokyo 173-8605, Japan. 4Department of Preventive Medicine and Public Health, Tokyo Medical University, 6-1-1 Shinjuku, Shinjuku City, Tokyo 160-8402, Japan. 5Faculty of Nursing, Yamanashi Prefectural University, 1-6-1 Ikeda, Kofu City, Yamanashi 400-0062, Japan. 6Faculty of Regional Collaboration, Kochi University, 2-5-1 Akebono-cho, Kochi City, Kochi 780-8520, Japan. 7Faculty of Social Welfare, Nihon Fukushi University, Okuda, Mihama-cho, Chita-gun, Aichi 470-3295, Japan. 8Center for Gerontology and Social Science, National Center for Geriatrics and Gerontology, 7-430 Morioka-cho, Obu City, Aichi 474-8511, Japan. *email: tsuji.taishi.gn@u.tsukuba.ac.jp
active lifestyle, since they are more involved in community organizations and less likely to have health problems as barriers to participation, compared to those who participate in general volunteering\(^{12}\).

Elucidating relevant factors might be helpful for promoting “supporting” sports and exercise activities (i.e., engaging in sports and exercise volunteering) among older adults. However, most of the prior studies have reported the characteristics of younger adults engaging in volunteer activities in a specific club, sports event, or region\(^{13–15}\). In these reports, associations with various factors, including demographic, behavioral, psychological, social, and environmental factors, were examined; the results showed that, for example, being a male, having a higher educational background, and a richer social network are positively associated with engagement in sports and exercise volunteering\(^{13–15}\). On the other hand, little is known about the status of participation in sports and exercise volunteering in a population-based sample of older adults and its related factors. In terms of general volunteer activities among older adults (i.e., not limited to sports and exercise), some relevant factors have been identified\(^{16–18}\); however, there is no proof that they are similarly applicable since their associations were not consistent in studies of younger adults. As an example, although there are no clear and consistent gender differences with respect to general volunteering\(^{18}\), sports and exercise volunteers encompass a notably larger proportion of men\(^{14}\). Therefore, this study aimed (1) to clarify the prevalence of sports and exercise volunteering and its specific activities and (2) to identify demographic, biological, behavioral, psychological, emotional, social, and environmental factors associated with engaging in sports and exercise volunteering, using data from a large-scale cohort of older adults in Japan across multiple regions. The findings of the present study provide useful information on the types of sports and exercise volunteer activities that are more approachable for older adults. Furthermore, the study will clarify the characteristics of those who are likely to participate in these volunteer activities, which will suggest avenues for efficient dissemination.

**Methods**

**Study design.** We used cross-sectional data from the Japan Gerontological Evaluation Study (JAGES), which is an ongoing cohort study exploring social, environmental, and behavioral factors related to the loss of health with regard to functional decline or cognitive impairment among individuals aged ≥ 65 years\(^{19,20}\). Between December 2019 and January 2020, we mailed a set of questionnaires to 345,356 community-dwelling people aged ≥ 65 years selected from 60 municipalities including metropolitan, urban, semi urban, and rural communities in 24 prefectures from as far north as Hokkaido (i.e., the northernmost prefecture) and as far south as Kyushu (i.e., the southernmost region) in Japan. A random sample from the official residence registers in 43 large municipalities and a complete census of the older residents of the remaining 17 smaller municipalities were obtained. A total of 240,889 individuals responded to our mail, with a response rate of 69.8% (range, 54.4%–89.8% throughout the 60 municipalities). The questionnaire that included the item of engaging in sports and exercise volunteering was distributed to one-eighth of the participants (n = 29,444) who were randomly selected. We excluded 8567 respondents who did not provide informed consent or information on sex, age, or residence area (n = 5757), had no independence in activities of daily living (n = 2739), or lived in communities with ≤ 30 respondents (n = 71) to avoid non-precise community-level aggregated values due to small samples. In total, we used data from 20,877 eligible respondents (10,123 men and 10,754 women). This data had three levels of hierarchy, with individual-level data (level 1) nested in 1139 community areas defined primarily by the school district (level 2) and then in 60 municipalities (level 3). Within the Japanese context, school districts are the primary residential units of individuals and comprise the geographical settings where older individuals may readily travel via foot or bicycle\(^{21}\). Ethical approval for the study was obtained from the Ethics Committee at Chiba University, Japan (Approval number: 2493), the National Center for Geriatrics and Gerontology, Japan (Approval number: 992–3), and the University of Tsukuba, Japan (Approval number: tai020-76). This study was performed in accordance with the principles of the Declaration of Helsinki. All participants were informed that participation in the study was voluntary and that completing the questionnaire, selecting the acceptance checkbox, and returning it via mail indicated their consent to participate in the study.

**Measures.** **Engagement in sports and exercise volunteering.** With reference to the survey items of the Japan Sports Agency\(^{4}\), participants were queried on their frequency of engaging in sports and exercise volunteering by the following questions: “How often, on average, did you engage in sports and exercise volunteering such as instruction, organizing competitions or events, supporting clubs that you and your family belong to (e.g., transporting participants for practice and competitions, or preparing drinks and lunch) in the past year?” The four possible responses included the following: ≥ 1 day/week, 1–3 days/month, a few times/year, or zero. In addition, we asked those who answered a few times/year or more often about their specific activities from the following options: (1) sports and exercise instruction, (2) sports referee, umpire, and judge, (3) organizing/managing clubs and groups, (4) supporting activities in managing sports facilities, (5) organizing/managing competitions and events, (6) supporting activities in clubs and groups, and (7) other.

**Selection and categorization of variables.** The measures on the questionnaire were selected and classified into the following five categories based on reports of correlates of participation in physical activity among adults\(^{22}\) and in sports groups among older adults\(^{5}\): (1) demographic and biological, (2) behavioral, (3) psychological, cognitive and emotional, (4) social and cultural, or (5) environmental factors.

**Demographic and biological factors.** We collected the following data as demographic and biological factors: sex, age groups (65–69, 70–74, 75–79, 80–84, ≥ 85 years), marital status (married or unmarried), living alone (no or yes), occupational status (employed, retired, or never employed), and years of education (≥ 13, 10–12, or <10 years). Annual equivalent income was calculated by dividing household income by the square root of the
number of household members and categorized into three groups: ≥ $40,000; $20,000–$39,999; or < $20,000 per year (1 dollar = 100 yen). Disease status was assessed with yes or no answers and included hypertension, stroke, heart diseases, diabetes mellitus, hyperlipidemia, musculoskeletal disorders, and cancer. Body mass index was calculated from self-reported height and weight (kg/m²) and categorized as underweight (< 18.5), normal weight (18.5–24.9), or overweight/obese (≥ 25.0). Instrumental activities of daily living (IADL) were assessed using the Tokyo Metropolitan Institute of Gerontology Index of Competence\(^{23}\), and the results were classified as good (5 points) or poor (≤ 4 points).

Behavioral factors. Alcohol drinking status (none, past, or current) and smoking status (none, past, or current) were collected as behavioral factors.

Psychological, cognitive, and emotional factors. We collected the data on self-rated health (excellent, good, poor, or very poor) and divided into three categories (excellent, good, or poor/very poor). We measured depressive symptoms using the short version of the 15-item Geriatric Depression Scale\(^{24,25}\) and categorized them into 3 groups: no (0–4 points), mild (5–9 points), or moderate to severe (10–15 points). We rated subjective well-being as 0–10, and binarized 8 points or more as high and 7 points or less as low subjective well-being\(^{26}\).

Social and cultural factors. We evaluated social and cultural factors in four dimensions: social cohesion (i.e., general trust, norms of reciprocity, and attachment to the neighborhood), social support (i.e., receiving/giving emotional and instrumental social support), social network (i.e., frequency at which participants met with friends, the number of friends met, and interactions with neighbors), and social participation. General trust, norms of reciprocity, and attachment to the neighborhood were categorized as yes (very, moderately) or no (neutral, slightly, not at all)\(^{27}\). We dichotomized emotional and instrumental social support, both received and given, as yes or no\(^{27}\). Frequency of meeting friends was categorized as almost every day, 2 or 3 times per week, once a week, once or twice per month, or a few times a year or less. We categorized the number of met friends as 0, 1–2, 3–5, 6–9, or ≥ 10. Interactions with neighbors were categorized into 3 groups: cooperating in daily life, standing and chatting frequently, or no more than an exchange of greetings/none. For social participation, we asked respondents about the frequency of participation in hobby activity groups, community associations, senior citizen clubs, study or cultural groups, or activities to teach skills or pass on experiences to others (≥ 1 day/month or < 1 day/month)\(^{27}\).

Environmental (community- and municipality-level) factors. As community-level (i.e., level 2) factors, the proportion of sports group participants and the perception of park access and sidewalk for each community area was calculated. We defined participating 1 day/month or more as participation in a sports group, and aggregated individual-level sports group participation according to community area\(^{28,29}\). In addition, we asked participants if there were parks or sidewalks suitable for exercise or walking within approximately 1 km from their homes, and the percentage of respondents who answered “yes” was calculated by community area. We calculated the population density per km² of inhabitable area and categorized it into a quartile category: ≥ 3,000, 940–2,999, 270–939, and < 270 individuals per km² as a municipality-level (i.e., level 3) factor.

Statistical analysis. To examine the association between each factor and engaging in sports and exercise volunteering a few times/year or more often, we carried out multilevel mixed-effects logistic regression (the individual as level 1, the community as level 2, and the municipality as level 3) with random intercepts and fixed slopes, which resulted in an odds ratio (OR) and 95% confidence interval (CI) for each variable. Model 1 included demographic and biological, behavioral, psychological, cognitive, and emotional, and environmental factors. We separately added social cohesion, social support, social network, and social participation to model 1 (i.e., model 2, 3, 4, and 5, respectively) because it was assumed that they would strongly correlate with each other. To address potential bias caused by missing values, we adopted multiple imputation under the missing at random assumption (i.e., a missing mechanism is related to the other variables measured in the same survey for that participant). We imputed incomplete variables using a multivariate normal imputation method. We created 20 imputed datasets using all the variables introduced in the current analyses, after which estimated parameters were combined using Rubin’s combination methods\(^{30,31}\). We also conducted complete-case analyses as sensitivity analyses. Stata/MP 16.1 (StataCorp, College Station, Texas, USA) was used for all statistical analyses, with P<0.05 indicating the statistical significance.

Results

Table 1 summarizes the descriptive data before the implementation of multiple imputation for missing values. Among the 20,877 analyzed participants, 1580 (7.6%) engaged in sports and exercise volunteering a few times/year or more often. Table 2 shows the specific activities of the volunteering they were engaged in. In descending order, it was organizing/managing competitions and events (34.9%), supporting activities in clubs and groups (25.9%), sports and exercise instruction (19.5%), sports referee, umpire, and judge (9.0%), and supporting activities in managing sports facilities (6.9%).

Table 3 shows the ORs for engaging in sports and exercise volunteering according to demographic and biological, behavioral, psychological, cognitive, and emotional, and environmental factors. In the model 1, women, lower level of educational (< 10 years), past and current smoking habit, poor IADL, poor or very poor self-rated health, and mild to severe depressive symptoms were negatively associated with engaging in the volunteering. Age 75 years or older, current drinking habit, excellent self-rated health, higher proportion of sports group...
| Individual-level variables | n | Proportion (%) | Engaging in sports volunteering (a few times a year or more) (%) |
|---------------------------|---|----------------|-----------------------------------------------------------------|
| Total                     | 20,877 | 100.0 | 7.6 |
| Engaging in sports and exercise volunteering | | | |
| Zero                      | 17,284 | 82.8 | |
| A few times/year          | 991 | 4.7 | |
| 1–3 days/month            | 327 | 1.6 | |
| ≥ 1 day/week              | 272 | 1.3 | |
| Missing                   | 2,013 | 9.6 | |
| Demographic and biological factors | | | |
| Sex                       | | | |
| Men                       | 10,123 | 48.5 | 9.9 |
| Women                     | 10,754 | 51.5 | 5.4 |
| Age groups (years)        | | | |
| 65–69                     | 5,232 | 25.1 | 7.7 |
| 70–74                     | 6,268 | 30.0 | 8.0 |
| 75–79                     | 5,064 | 24.3 | 8.0 |
| 80–84                     | 2,910 | 13.9 | 6.7 |
| ≥ 85                      | 1,403 | 6.7 | 5.0 |
| Marital status            | | | |
| Married                   | 15,114 | 72.4 | 8.4 |
| Unmarried                 | 5,417 | 25.9 | 5.3 |
| Missing                   | 346 | 1.7 | 7.5 |
| Living alone              | | | |
| No                        | 17,539 | 84.0 | 8.0 |
| Yes                       | 3,085 | 14.8 | 5.2 |
| Missing                   | 253 | 1.2 | 9.5 |
| Occupational status       | | | |
| Employed                  | 5,839 | 28.0 | 9.0 |
| Retired                   | 11,985 | 57.4 | 8.0 |
| Never employed            | 1,128 | 5.4 | 4.3 |
| Missing                   | 1,925 | 9.2 | 2.6 |
| Education (years)         | | | |
| ≥ 13                      | 6,448 | 30.9 | 9.1 |
| 10–12                     | 8,936 | 42.8 | 7.9 |
| < 10                      | 4,092 | 23.4 | 4.9 |
| Missing                   | 601 | 2.9 | 7.8 |
| Annual equivalent income  | | | |
| ≤ $40,000                 | 2,416 | 11.6 | 8.7 |
| $20,000–$39,999           | 7,292 | 34.9 | 8.8 |
| < $20,000                 | 8,518 | 40.8 | 6.9 |
| Missing                   | 2,651 | 12.7 | 5.2 |
| Disease status (multiple answer) | | | |
| Hypertension              | 8,960 | 42.9 | 7.7 |
| Stroke                    | 467 | 2.2 | 6.6 |
| Heart diseases            | 1,850 | 8.9 | 7.2 |
| Diabetes mellitus         | 2,737 | 13.1 | 8.5 |
| Hyperlipidemia            | 3,038 | 14.6 | 7.2 |
| Musculoskeletal disorders | 2,036 | 9.8 | 5.4 |
| Cancer                    | 847 | 4.1 | 6.4 |
| Missing                   | 842 | 4.0 | 6.8 |
| Body mass index           | | | |
| < 18.5                    | 1,349 | 6.5 | 4.7 |
| 18.5–24.9                 | 14,095 | 67.5 | 7.7 |
| ≥ 25                      | 4,600 | 22.0 | 8.0 |
| Missing                   | 833 | 4.0 | 7.0 |
| Instrumental activities of daily living | | | |
| Good                      | 18,771 | 89.9 | 7.8 |
| Poor                      | 3,449 | 6.9 | 5.5 |
| Missing                   | 657 | 3.1 | 6.8 |
| Behavioral factors        | | | |
| Continued                 | | | |
|                                | n   | Proportion (%) | Engaging in sports volunteering (a few times a year or more) (%) |
|--------------------------------|-----|----------------|---------------------------------------------------------------|
| **Drinking status**            |     |                |                                                               |
| None                           | 9,412| 45.1           | 6.1                                                          |
| Past                           | 2,091| 10.0           | 5.5                                                          |
| Current                        | 8,071| 41.1           | 10.0                                                         |
| Missing                        | 803  | 3.8            | 4.5                                                          |
| **Smoking status**             |     |                |                                                               |
| None                           | 12,069| 57.8          | 7.0                                                          |
| Past                           | 6,306| 30.2           | 8.6                                                          |
| Current                        | 2,115| 10.1           | 8.2                                                          |
| Missing                        | 387  | 1.9            | 5.4                                                          |
| **Psychological, cognitive, and emotional factors** |     |                |                                                               |
| **Self–rated health**          |     |                |                                                               |
| Excellent                      | 3,081| 14.8           | 11.8                                                         |
| Good                           | 15,288| 73.2          | 7.3                                                          |
| Poor or very poor              | 2,375| 11.4           | 3.8                                                          |
| Missing                        | 133  | 0.6            | 6.0                                                          |
| **Depressive symptoms (Geriatric Depression Scale)** |     |                |                                                               |
| No (0–4 points)                | 15,940| 76.4          | 8.8                                                          |
| Mild (5–9 points)              | 3,513| 16.8           | 3.8                                                          |
| Moderate to severe (10–15 points) | 938 | 4.5            | 2.8                                                          |
| Missing                        | 486  | 2.3            | 3.5                                                          |
| **Subjective well-being**      |     |                |                                                               |
| Low (0–7 points)               | 10,219| 48.9          | 6.3                                                          |
| High (8–10 points)             | 9,874| 47.3           | 9.0                                                          |
| Missing                        | 784  | 3.8            | 5.4                                                          |
| **Social and cultural factors** |     |                |                                                               |
| **Social cohesion**            |     |                |                                                               |
| General trust                  |     |                |                                                               |
| No                             | 5,745| 27.5           | 4.7                                                          |
| Yes                            | 14,664| 70.2          | 8.8                                                          |
| Missing                        | 468  | 2.2            | 4.3                                                          |
| **Norms of reciprocity**       |     |                |                                                               |
| No                             | 9,032| 45.4           | 5.6                                                          |
| Yes                            | 11,245| 55.9          | 9.4                                                          |
| Missing                        | 580  | 2.8            | 3.3                                                          |
| **Attachment to the neighborhood** |     |                |                                                               |
| No                             | 4,079| 19.5           | 4.2                                                          |
| Yes                            | 16,356| 78.3          | 8.5                                                          |
| Missing                        | 442  | 2.1            | 4.1                                                          |
| **Social support**             |     |                |                                                               |
| **Receiving emotional support**|     |                |                                                               |
| No                             | 936  | 4.5            | 4.2                                                          |
| Yes                            | 19,561| 93.7          | 7.8                                                          |
| Missing                        | 380  | 1.8            | 5.0                                                          |
| **Providing emotional support**|     |                |                                                               |
| No                             | 1,135| 5.4            | 3.2                                                          |
| Yes                            | 19,217| 92.0          | 7.9                                                          |
| Missing                        | 525  | 2.5            | 3.2                                                          |
| **Receiving instrumental support** |     |                |                                                               |
| No                             | 1,017| 4.9            | 3.6                                                          |
| Yes                            | 19,518| 93.5          | 7.9                                                          |
| Missing                        | 342  | 1.6            | 2.9                                                          |
| **Providing instrumental support** |     |                |                                                               |
| No                             | 4,275| 20.5           | 5.2                                                          |
| Yes                            | 15,757| 75.5          | 8.4                                                          |
| Missing                        | 845  | 4.0            | 4.5                                                          |
| **Social network**             |     |                |                                                               |
| Frequency of meeting friends   |     |                |                                                               |
| A few times a year or less     | 5,575| 26.7           | 2.9                                                          |
| 1–3 times/month                | 4,978| 23.8           | 5.6                                                          |
participants in a community, and low municipal population density were positively associated with engaging in the volunteering.

Table 4 shows the results of models 2–5 with social cohesion, social support, social network, and social participation added to model 1, respectively. All variables except for receiving emotional and instrumental support were positively associated with engaging in sports and exercise volunteering.

Supplementary Tables 1 and 2 show the results of the complete-case analysis for each model. Among the analyzed participants, data from 11,854 (56.8%) individuals had no missing values. Of the 9,023 participants with missing values, the mean number of missing values was 4.1. The complete-case analyzes produced similar

| Table 1. Descriptive statistics of individual-, community-, and municipality-level variables. Missing values were imputed by using a multivariate normal imputation method in the main regression analysis. |
results to those of the multiple-imputation analyzes, other than that the positive association in the 80+ age category disappeared.

**Discussion**

To the best of our knowledge, this is the first study that examines the current state of sports and exercise volunteering among older adults and that comprehensively elucidates its correlates by using data from a large population-based sample. We found that 7.6% of older adults engaged in sports and exercise volunteering once a year or more often, and the main activities were organizing, managing, or supporting competitions, events, clubs, or groups, and instruction. Further, we clarified various demographic, biological, behavioral, psychological, cognitive, emotional, social, cultural, and environmental factors related to the activity. Although there have been several reports of the characteristics of older adults who participate in sports and exercise groups as well as general volunteer activities, the present study provides new insights specific to sports and exercise volunteering.

In the survey conducted by the Japan Sports Agency^{8}, which was the basis of the volunteering items in the present study, 5.3% of respondents in their 60's and 5.2% of those in their 70's engaged in sports and exercise volunteering within a year. Among these, the specific activities of each age group (60's and 70's) were as follows: organizing/managing competitions and events (31.4% and 29.1%), exercise and sports instruction (25.4% and 20.6%), and organizing/managing sports clubs and groups (19.5% and 24.8%)^{8}; the results found in the present study approximately corroborated these reports.

We confirmed that participants with advanced age engaged more often, and women had less engagement in sports and exercise volunteering. In general, it has been shown that the frequency of participation in sports groups among older men with more advanced age was low compared to older women with younger age^{6}; however, confirming an opposite association in the present study was noteworthy. In addition, age and volunteer activities have been reported to be negatively^{20} or not correlated^{16,17}; the findings of this study are also inconsistent with these previous reports. To conduct volunteer activities related to sports and exercise (e.g., organizing/managing competitions, events, clubs, and instructing/refereeing sports), participants would need to have a certain experience with the sports and exercise. It is speculated that if they become veterans by continuing to participate in sports and exercise activities, they will play various leading and management roles. In particular, men may tend to play such roles, partly because they have more administrative job experience than women during their active career^{33}.

Participants with lower levels of education were less likely to engage in sports and exercise volunteering. In Western countries, there is a positive association between volunteer activities at an older age and educational attainment^{18,34}, whereas no significant association has been observed in Japan^{17}. Namely, in the Japanese context, the present results may be specific to sports and exercise volunteering. As for sports and exercise group participation, in Japan, the participation rate is lower among older adults with lower education levels^{6}, and this aspect may have affected the results of the current study. According to the other demographic and biological factors and psychological, cognitive, and emotional factors, the findings of a negative association between poor IADL, having depressive symptoms and a positive association between excellent self-rated health were mostly similar to the findings of prior studies on the correlates of sports and physical activities^{6,35,36} or volunteer activities^{17,18} among older adults; these factors are commonly associated with activities related to sports, exercise, and volunteering among older adults.

Regarding behavioral factors, current alcohol drinking habits were positively associated, and smoking habits in the past and current were negatively associated with sports and exercise volunteering. In a systematic review of adults that summarized correlates associated with physical activity, drinking and smoking habits were reported to be inconclusive^{25}. Conversely, according to a report that comprehensively examined the factors related to sports group participation in older adults in Japan, similar to the findings of the present study, drinking habits showed a positive association and smoking habits showed a negative association^{6}. Participation in sports or volunteer groups naturally involves interaction with others, unlike individual physical activity; therefore, a link to these behavioral factors may obviously emerge. Especially in recent years in Japan, smoking in public places has been strictly controlled to prevent involuntary or passive smoking. This may keep smokers away from participating in public activities.
|                                 | Model 1 | 95% CI       |
|---------------------------------|---------|--------------|
| **Individual-level variables**  |         |              |
| Sex (ref. men)                  |         |              |
| Women                           | 0.60    | (0.52–0.69)  | <0.001 |
| **Age groups (ref. 65–69 years)**|         |              |
| 70–74 years                     | 1.16    | (1.00–1.35)  | 0.049  |
| 75–79 years                     | 1.38    | (1.18–1.62)  | <0.001 |
| 80–84 years                     | 1.41    | (1.17–1.70)  | <0.001 |
| ≥ 85 years                      | 1.38    | (1.07–1.78)  | 0.013  |
| **Marital status (ref. married)**|         |              |
| Unmarried                       | 0.88    | (0.72–1.07)  | 0.208  |
| **Living alone (ref. no)**      |         |              |
| Yes                             | 0.95    | (0.76–1.18)  | 0.619  |
| **Occupational status (ref. retired)**|       |              |
| Employed                        | 1.03    | (0.92–1.14)  | 0.654  |
| Never employed                  | 0.94    | (0.73–1.21)  | 0.631  |
| **Education (ref. ≥ 13 years)** |         |              |
| 10–12 years                     | 0.91    | (0.80–1.02)  | 0.112  |
| < 10 years                      | 0.75    | (0.65–0.87)  | <0.001 |
| **Annual equivalent income (ref. ≥ $40,000)**|   |              |
| $20,000–$39,999                 | 1.07    | (0.91–1.26)  | 0.387  |
| < $20,000                       | 1.09    | (0.93–1.28)  | 0.269  |
| **Disease status (ref. none of each)**|    |              |
| Hypertension                    | 1.03    | (0.92–1.14)  | 0.609  |
| Stroke                          | 0.92    | (0.63–1.34)  | 0.670  |
| Heart diseases                  | 0.93    | (0.79–1.10)  | 0.421  |
| Diabetes mellitus               | 1.15    | (0.98–1.34)  | 0.089  |
| Hyperlipidemia                  | 0.91    | (0.78–1.06)  | 0.211  |
| Musculoskeletal disorders       | 1.01    | (0.81–1.26)  | 0.918  |
| Cancer                          | 0.90    | (0.68–1.19)  | 0.456  |
| **Body mass index (ref. 18.5–24.9)**|       |              |
| < 18.5                          | 0.83    | (0.66–1.05)  | 0.122  |
| ≥ 25                            | 1.05    | (0.92–1.20)  | 0.482  |
| **Instrumental activities of daily living (ref. good)**|      |              |
| Poor                            | 0.67    | (0.53–0.84)  | 0.001  |
| **Drinking status (ref. none)** |         |              |
| Past                            | 0.87    | (0.71–1.07)  | 0.176  |
| Current                         | 1.23    | (1.06–1.43)  | 0.006  |
| **Smoking status (ref. none)**  |         |              |
| Past                            | 0.78    | (0.67–0.91)  | 0.002  |
| Current                         | 0.81    | (0.66–0.99)  | 0.044  |
| **Self-rated health (ref. good)**|         |              |
| Poor or very poor               | 0.70    | (0.57–0.87)  | 0.001  |
| Excellent                       | 1.49    | (1.31–1.71)  | <0.001 |
| **Depressive symptoms (ref. no)**|         |              |
| Mild                            | 0.62    | (0.51–0.75)  | <0.001 |
| Moderate to severe              | 0.56    | (0.38–0.83)  | 0.004  |
| **Subjective well-being (ref. low, 0–7)**|      |              |
| High, 8–10                      | 1.11    | (0.98–1.26)  | 0.108  |
| **Community- and municipality-level variables** | | |
| Proportion of sports group participants | 1.12 | (1.04–1.21) | 0.004  |
| Perception of park access and sidewalk | 0.97 | (0.92–1.02) | 0.283  |
| Population density (persons per square km of inhabitable area) (ref. the highest quartile, Q1) | 1.25 | (1.06–1.48) | 0.009  |
As for environmental factors, municipality-level low population density and high proportion of community-level sports group participation showed a positive relationship with the engagement of sports and exercise volunteering. A previous study comparing the social participation among older adults in Japan between urban and rural areas confirmed that rural areas have more volunteer group participants and less sports group participants than urban areas. There is a possibility that people tend to participate in sports and exercise by utilizing public and private services and facilities in urban areas; while in non-urban areas, they are likely to organize and manage sports and exercise groups themselves especially in active area of sports group participation. Fertile social and cultural factors (i.e., social cohesion, support, network, and participation) were widely positively associated with engagement of sports and exercise volunteering. The present findings partially supported the results of earlier studies that investigated correlates of volunteer participation among older adults, not limited to sports and exercise volunteering. These studies reported that older adults engaging in volunteer activities had a higher level of community interactions evaluated from the aspect of community involvement and satisfaction, and more often participated in hobby and continuing education activities compared to those who did not engage in. Volunteering is often motivated by interacting with friends and gaining the approval of others.

Table 3. Associations between engaging in sports and exercise volunteering and demographic, biological, behavioral, psychological, cognitive, emotional, and environmental factors. n = 20,877. All variables shown were simultaneously added in the model. OR odds ratio, CI confidence interval.

| Model 1 | OR     | 95% CI   | P      |
|---------|--------|----------|--------|
| Q3      | 1.78   | (1.46–2.15) | < 0.001 |
| Q4      | 1.58   | (1.22–2.05) | < 0.001 |

Table 4. Associations between engaging in sports and exercise volunteering and social cohesion, support, network, and participation. n = 20,877. All variables shown were simultaneously added in each corresponding model. OR odds ratio, CI confidence interval.

| Model 2: model 1 + social cohesion (ref. none of each) | OR     | 95% CI   | P      |
|------------------------------------------------------|--------|----------|--------|
| General trust, yes                                    | 1.16   | (1.01–1.33) | 0.038  |
| Norms of reciprocity, yes                            | 1.27   | (1.11–1.44) | < 0.001|
| Attachment to the neighborhood, yes                   | 1.25   | (1.05–1.49) | 0.014  |

| Model 3: model 1 + social support (ref. none of each) | OR     | 95% CI   | P      |
|------------------------------------------------------|--------|----------|--------|
| Receiving emotional support, yes                      | 1.10   | (0.77–1.56) | 0.609  |
| Providing emotional support, yes                      | 1.50   | (1.07–2.11) | 0.019  |
| Receiving instrumental support, yes                   | 1.26   | (0.90–1.78) | 0.175  |
| Providing instrumental support, yes                   | 1.33   | (1.14–1.54) | < 0.001|

| Model 4: model 1 + social network                     | OR     | 95% CI   | P      |
|------------------------------------------------------|--------|----------|--------|
| Frequency of meeting friends (ref. a few times a year or less) | 1.28 | (1.05–1.55) | 0.014  |
| 1 time/week                                           | 1.80   | (1.48–2.19) | < 0.001|
| 2–3 times/week                                        | 2.35   | (1.94–2.84) | < 0.001|
| Almost every day                                      | 2.08   | (1.68–2.57) | < 0.001|
| Number of met friends (ref. zero)                     | 1.57   | (1.03–2.37) | 0.034  |
| 3–5                                                  | 1.87   | (1.25–2.81) | 0.003  |
| 6–9                                                  | 2.11   | (1.39–3.18) | < 0.001|
| ≥ 10                                                 | 3.33   | (2.25–4.93) | < 0.001|
| Interactions with neighbors (ref. no more than exchange greetings/none) | 1.32 | (1.14–1.52) | < 0.001|
| Standing and chatting frequently                      | 1.75   | (1.49–2.06) | < 0.001|

| Model 5: model 1 + social participation (ref. none of each) | OR     | 95% CI   | P      |
|------------------------------------------------------------|--------|----------|--------|
| Hobby activity groups, yes                                 | 2.00   | (1.75–2.29) | < 0.001|
| Community associations, yes                               | 1.71   | (1.49–1.97) | < 0.001|
| Senior citizen club, yes                                  | 1.60   | (1.39–1.83) | < 0.001|
| Study or cultural groups, yes                             | 1.20   | (1.04–1.38) | 0.012  |
| Activities to teach skills or pass on experiences to others, yes | 2.81 | (2.44–3.24) | < 0.001|
considered to be important by addressing community concerns and social needs, rather than monetary rewards. Therefore, social cohesion, support, network, and participation could be considered a non-monetary motivation and benefit for engagement of sports and exercise volunteering. Furthermore, sports and exercise volunteering may also provide potential physical benefits, such as the inclusion of a physical activity component within the activity itself and more frequent time outside of the house due to broader social participation and social networks.

The strength of the present study was its large, nationwide, and population-based sample enabling municipality-, community-, and individual-level multilevel analyses for elucidating the correlates of sports and exercise volunteering among older adults. However, some limitations of this study warrant discussion. First, we could not infer a causal relationship because of the nature of the cross-sectional design; further longitudinal studies are required to address this limitation. Second, regarding behavioral and environmental factors, relationships with only a few items were investigated. Furthermore, environmental factors were mainly variables based on self-report and perception, and it was not possible to fully consider the built environment based on objective evaluation. Future studies should use geographic information systems to collect more detailed information. Third, external validity of the findings obtained in this study could not be discussed. Different relationship could be found, especially in Western countries where the culture, manners, and customs of sports and volunteering are independent in their daily living activities; together, these factors may have biased the results toward those with a higher health status. Therefore, the proportion of volunteers may have been overestimated, and the association with each factor may have been either over- or underestimated. Fourth, there was a different association with age in the multiple-imputation and complete-case analysis. As such, the finding that adults aged 80 years and older were more likely to engage in sports and exercise volunteering should be interpreted with caution.

Conclusion
We found that 7.6% of the population-based sample of older adults in Japan engaged in sports and exercise volunteering such as organizing, managing, or supporting competitions, events, clubs, or groups, and instruction. We clarified factors that show a positive association with the activity (i.e., high age, having current drinking habit, excellent self-rated health, high proportion of sports group participants in a living area, low municipal population density, and rich social and cultural features) and those that show a negative association (i.e., women, low educational attainment, deteriorated IADL, having past or current smoking habit, poor self-rated health, and depressive symptoms). We equally characterized the population that is more likely to participate in sports and exercise volunteering and the population that is less likely to participate and requires support, and provided clues for strategic dissemination of “supporting” sports and exercise. Recruiting volunteers from the populations that are more likely to participate at first, and then involving more people by making good use of their social networks and support might be an effective strategy.

Data availability
The data underlying this study is from the JAGES and contain sensitive information. Data for research purposes is available upon request. Requests for the JAGES data can be made to dataadmin.ml@jages.net.

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References
1. Dipietro, L. et al. Physical activity, injurious falls, and physical function in aging: An umbrella review. *Med. Sci. Sports Exerc.* 51, 1303–1313. https://doi.org/10.1249/MSS.0000000000001942 (2019).
2. McPhee, J. S. et al. Physical activity in older age: Perspectives for healthy ageing and frailty. *Biogerontology* 17, 567–580. https://doi.org/10.1007/s10522-016-9641-0 (2016).
3. Nelson, M. E. et al. Physical activity and public health in older adults: Recommendation from the American College of Sports Medicine and the American Heart Association. *Med. Sci. Sports Exerc.* 39, 1435–1445. https://doi.org/10.1249/0b013e3180616aa2 (2007).
4. Jenkin, C. R., Eime, R. M., Westerbeek, H., O’Sullivan, G. & van Uffelen, J. G. Z. Sport and ageing: A systematic review of the determinants and trends of participation in sport for older adults. *BMJ Public Health* 17, 976. https://doi.org/10.1186/s12889-017-4970-8 (2017).
5. Koemen, M. A., Verheijden, M. W., Chinapaw, M. J. & Hopman-Rock, M. Determinants of physical activity and exercise in healthy older adults: A systematic review. *Int. J. Behav. Nutr. Phys. Act* 8, 142. https://doi.org/10.1186/1479-5868-8-142 (2011).
6. Yamakita, M., Kanamori, S., Kondo, N. & Kondo, K. Correlates of regular participation in sports groups among Japanese older adults: JAGES cross-sectional study. *PLoS ONE* 10, e0141638. https://doi.org/10.1371/journal.pone.0141638 (2015).
7. Ministry of Education, Culture, Sports, Science and Technology. Second Sport Basic Plan. https://www.next.go.jp/sports/content/1383656-002.pdf (2017). [in Japanese]
8. Japan Sports Agency. FY2018 Public Opinion Poll on State of Implementation of Sports. https://www.mext.go.jp/sports/b_menu/oukei/choousa04/sports/1415963.htm (2019). [in Japanese]
9. Ginis, K. A., Nigg, C. R. & Smith, A. L. Peer-delivered physical activity interventions: An overlooked opportunity for physical activity promotion. *Transl. Behav. Med.* 3, 434–443. https://doi.org/10.1007/s13142-013-0215-2 (2013).
10. Layne, J. E. et al. Successful dissemination of a community-based strength training program for older adults by peer and professional leaders: The people exercising program. *J. Am. Geriatr. Soc.* 56, 2323–2329. https://doi.org/10.1111/j.1532-5415.2008.01910.x (2008).
11. World Health Organization. Global age-friendly cities: A guide. World Health Organization, https://apps.who.int/iris/handle/10665/43755 (2007).
12. Doherty, A. *A profile of community sport volunteers*. (Parks and Recreation Ontario and Sport Alliance of Ontario, 2005).
13. Harvey, J., Lévesque, M. & Donnelly, P. Sport volunteerism and social capital. *Soc. Sport J.* 24, 206–223. https://doi.org/10.1123/sjj.24.2.206 (2007).
17. Taylor, P. D., Panagouleas, T. & Nichols, G. Determinants of sports volunteering and sports volunteer time in England. Int. J. Sport Policy Politics 4, 201–220. https://doi.org/10.1080/19406940.2012.656679 (2012).

18. Wicker, P. & Hallmann, K. A multi-level framework for investigating the engagement of sport volunteers. Eur. Sport Manag. Q. 13, 110–139. https://doi.org/10.1080/16184742.2012.744768 (2013).

19. Komp, K., van Tilburg, T. & van Groenou, M. B. Age, retirement, and health as factors in volunteering in later life. Nonprofit Volunt. Sect Q 41, 280–299. https://doi.org/10.1177/0099404110426997 (2012).

20. Takagai, D., Kondo, K. & Kawachi, I. Social participation and mental health: Moderating effects of gender, social role and rurality. BMC Public Health 13, 701. https://doi.org/10.1186/1471-2458-13-701 (2013).

21. Choi, J., Lee, M., Lee, J. K., Kang, D. & Choi, J. Y. Correlates associated with participation in physical activity among adults: A systematic review of reviews and update. BMC Public Health 17, 356. https://doi.org/10.1186/s12889-017-4255-2 (2017).

22. Burke, W. J., Roccaforte, W. H. & Wengel, S. P. The short form of the Geriatric Depression Scale: A comparison with the 30-item form. J. Geriatr. Psychiatry Neurol. 4, 173–178 (1991).

23. Wada, T., Ishine, M., Kita, T., Fujisawa, M. & Matsubayashi, K. Depression screening of elderly community-dwelling Japanese. J. Am. Geriatr. Soc. 51, 1328–1329 (2003).

24. Nakamura, H., Murata, C. & Yamazaki, Y. Social activities and subjective well-being among older persons in Japan. J. Epidemiol. Res. https://doi.org/10.5430/jer.v5n1p58 (2019).

25. Saito, M. et al. Development of an instrument for community-level health related social capital among Japanese older people: The JAGES Project. J. Epidemiol. 27, 221–227. https://doi.org/10.1016/j.je.2016.05.007 (2017).

26. Tsuji, T., Kanamori, S., Miyaguni, Y., Hanazato, M. & Kondo, K. Community-level sports group participation and the risk of cognitive impairment. Med. Sci. Sports Exerc. 51, 2217–2223. https://doi.org/10.1249/MSS.0000000000002650 (2019).

27. Koyano, W., Shibata, H., Nakazato, K., Haga, H. & Suyama, Y. Measurement of competence: Reliability and validity of the TMIG Index of Competence. Arch. Gerontol. Geriatr. 13, 103–116 (1991).

28. Cozijnsen, R., Stevens, N. L. & Van Tilburg, T. G. The trend in sport participation among Dutch retirees, 1983–2007. Int. J. Sport Policy Politics 000, 110–139. https://doi.org/10.1080/16184742.2012.744768 (2013).

29. Kondo, K., Rosenberg, M. & World Health Organization. Advancing universal health coverage through knowledge translation and delivery: A scoping review. Eur. Sport Manag. Q. 004 (2008).

30. Kondo, K. Progress in aging epidemiology in Japan: The JAGES project. J. Epidemiol. 26, 331–336. https://doi.org/10.2188/je. J26016093 (2016).

31. Takagi, D., Kondo, K. & Kawachi, I. Social participation and mental health: Moderating effects of gender, social role and rurality. BMC Public Health 13, 701. https://doi.org/10.1186/1471-2458-13-701 (2013).

32. Choi, J., Lee, M., Lee, J. K., Kang, D. & Choi, J. Y. Correlates associated with participation in physical activity among adults: A systematic review of reviews and update. BMC Public Health 17, 356. https://doi.org/10.1186/s12889-017-4255-2 (2017).

33. Morow-Howell, N. Volunteering in later life: Research frontiers. J. Gerontol. B Psychol. Sci. Soc. Sci. 65B, 461–469. https://doi.org/10.1093/geronb/gq024 (2010).

34. Cozijnsen, R., Stevens, N. L. & Van Tilburg, T. G. The trend in sport participation among Dutch retirees, 1983–2007. Ageing Soc. 33, 698–719. https://doi.org/10.1017/s0144686x12000189 (2013).

35. Rubin, D. B. Multiple Imputation and its Application (Wiley, 2013).

36. Tomioka, K., Kurumatani, N. & Saeki, K. The differential effects of type and frequency of social participation on IADL declines of older people. PLoS ONE 13, e0207426. https://doi.org/10.1371/journal.pone.0207426 (2018).

37. Ide, K. et al. Social participation and functional decline: A comparative study of rural and urban older people, using Japan gerontological evaluation study longitudinal data. Int. J. Environ. Res. Public Health https://doi.org/10.3390/ijerph17020617 (2020).
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Competing interests
The authors declare no competing interests.

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Correspondence and requests for materials should be addressed to T.T.

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