Archives of Public Health

RESEARCH

Open Access

Using women-only fitness club and functional disability: a cross-sectional study using propensity score matching

Kazushige Ide[1*], Kenjiro Kawaguchi[1], Kiyomi Matsumura[1,2] and Katsunori Kondo[1,3]

Abstract

Background As the aging population grows, identifying effective interventions to achieve healthy ageing is crucial. Specific environments, such as Curves, the women-only fitness club (WOFC), may provide a supportive setting for older women to engage in physical activities that promote overall healthy ageing. This study aims to compare the functional disability prediction score between WOFC members and control group in older adults.

Methods Our study design was cross-sectional design. We applied propensity score matching to control for 9 potential confounders, including age, sociodemographic factors, health-related factors. A total of 6,058 participants were matched (3,029 WOFC memberships and 3,029 control groups from the Japan Gerontological Evaluation Study). The functional disability prediction scores we used can predict the risk of functional disability within three years for community-dwelling older adults without activity of daily living limitations.

Results After propensity score matching, the covariates of the two groups were well balanced. The average age after propensity score matching was 72.4 for WOFC members and 72.7 for the control group. The average functional disability prediction score was 0.53 points lower for WOFC members than for the control group ($p=.005$).

Conclusions WOFC members had lower scores on the functional disability prediction score related to healthy aging. Future studies should investigate the long-term impact of such programs.

Keywords Healthy ageing, Public health, Physical inactivity, Pay-for-Success, Fitness club

*Correspondence:
Kazushige Ide
ide.k@chiba-u.jp
[1]Center for Preventive Medical Sciences, Chiba University, Inage-ku, Chiba, Japan
[2]Graduate School of Medicine, Chiba University, Chuo-ku, Chiba, Japan
[3]Institute for Health Economics and Policy, Association for Health Economics Research and Social Insurance and Welfare, Minato-ku, Tokyo, Japan

Text box 1. Contributions to the literature

- Physical inactivity among older adults is a pressing issue in promoting healthy ageing and is particularly prevalent among women than among men.
- The availability of fitness and sports facilities is a key factor in promoting physical activity among older adults.
- This study compared the functional disability prediction scores between Curves, the women-only fitness club (WOFC) members and control group in older adults.
- The average functional disability prediction score was 0.54 points lower for WOFC members than for the control group (p=.005).
- WOFC may serve as an effective intervention to achieve healthy ageing.

Background

Physical inactivity among older adults is a pressing issue in promoting healthy ageing [1]. Physical inactivity is a major cause of non-communicable diseases, premature mortality and economic burden [1–3]. The 2020 World Health Organization guidelines on physical activity and sedentary behavior recommends regular physical exercise for all older adults [4]. Despite these important recommendations, many older adults remain physically inactive [5]. Physical inactivity is particularly prevalent among women than among men [5, 6]. Reducing physical inactivity requires concerted multi-sectoral efforts and should not exacerbate sex and age inequalities [6, 7]. As a public health policy to reduce physical inactivity, there are high expectations for creating an age-friendly environment conducive to physical activity [8, 9]. The availability of fitness and sports facilities is a key factor in promoting physical activity among older adults [10–14]. A systematic review of factors associated with physical activity in older adults suggests the importance of improving access to physical activity opportunities from both environmental and economic perspectives [14]. In addition to promoting physical activity, previous studies have shown that fitness and sports facilities can improve health-related quality of life [12], reduce depression [10], frailty [11], healthcare utilization, cardiovascular events and mortality [13]. Thus, creating accessible fitness and sports facilities for older adults to physical activity could be an innovative public health strategy to promote physical activity among older adults.

In Japan, the most rapidly aging country in the world, nationwide efforts have been made to promote physical activity [15]. Unfortunately, physical activity levels among older adults have been declining over the past 15 years [15], highlighting the need to enhance age-friendly facilities that support physical activity. Curves (Curves Japan Co., Ltd.) [16] is a fitness club that has the potential to create this kind of facility in Japan [17–19]. Curves is a women's-only fitness club that offers 30-minute structured combined exercise program including strength training, aerobic exercises, and stretching [17]. Curve is a club where any woman of any age can easily drop in without a reservation. Curves puts the emphasis on attentive exercise coaching and friendly communication. Most Curves are located in residential and shopping areas, making them easily accessible. For women who worry that they are not good at working out or that they are losing strength as they age, or have other worries, Curves make it easy to start an exercise program and stick to it without stress or strain.

The exercise program offered at Curves, the women-only fitness club (WOFC) has been shown to help prevent type 2 diabetes [17], improve cognitive function [18], reduce chronic musculoskeletal pain, and improve activities of daily living [19]. The World Health Organization defines Healthy Ageing as maintaining a functional ability that enables individuals to meet their needs and contribute to society within their environment [7]. Based on this WHO definition, there is no evidence that using WOFC leads to healthy aging later in life. To demonstrate that WOFC contributes to healthy aging, the relationship between WOFC and functional disability, a determinant of healthy aging needs to be examined.

Therefore, our study aims to determine whether older adults can prevent the risk of functional disability by using WOFC. Our findings can provide evidence about age-friendly fitness facilities.

Methods

Study design

Our study design was a cross-sectional study. We compared the functional disability prediction score between WOFC members and a control group of older adults living in the community. We extracted the control group from the Japan Gerontological Evaluation Study (JAGES) using propensity score (PSM) analysis. JAGES is an ongoing national prospective cohort study that investigates the social determinants of health among people aged 65 and over in Japan [20, 21].

Study participants

Curves (WOFC) membership

We conducted a self-reported survey of WOFC membership between November and December 2023. As of August 2023, Curves supports the health and physical development of 1,962 locations and approximately 777,000 members nationwide in Japan. Of the members, about 58.0% are older adults aged 65 and over.

Figure 1 shows a detailed flowchart of participant selection. Curves mailed self-administered questionnaires to members aged 65 years and over who were not eligible to receive public long-term-care insurance (LTCI) benefits at seven locations in seven municipalities (n = 3,489; response rate: 82.6%). We excluded those without

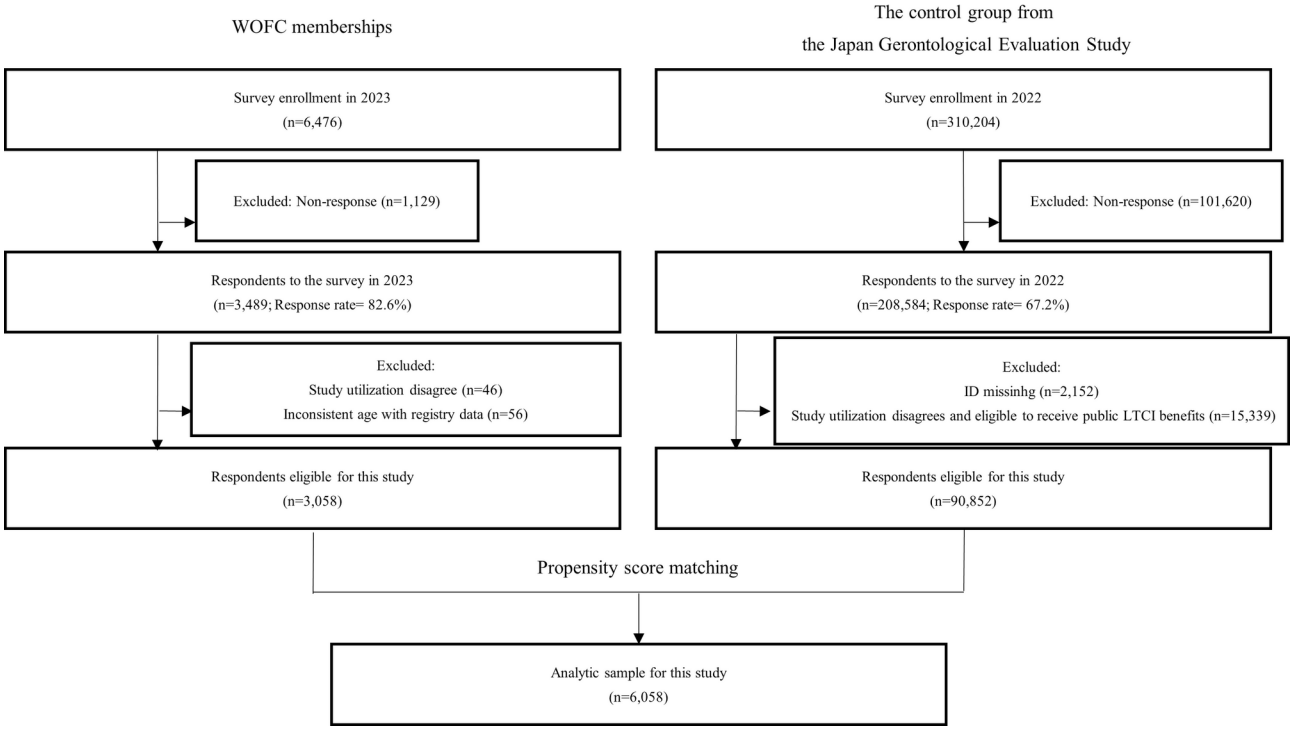

Fig. 1 Figure

consent for study use ($n = 46$) and with missing age data ($n = 56$). We excluded those who had been members for less than a year or who used WOFC less than once a week ($n = 329$), with the goal of targeting older adults who habitually use WOFC. Ultimately, we included 3,058 individuals as WOFC members.

Control group

We used the JAGES data as the control group (Fig. 1). From October to December 2022, JAGES mailed self-administered questionnaires to 310,204 community-dwelling residents aged 65 years and over living in 71 municipalities ($n = 208,584$; response rate: 67.2%). We excluded 117,732 responses from our analysis for the following reasons: (i) ID missing ($n = 2,152$), (ii) study utilization disagrees and eligible to receive public LTCI benefits ($n = 15,339$), (iii) Men ($n = 90,503$), (iv) Inconsistent age and gender with registry data, and (v) activity of daily life non-independent or missing ($n = 8,945$). Since WOFC members were independent women in their daily lives, we applied same conditions to the control group. The control group included 90,852 individuals.

Questionnaire development

For participants in WOFC membership, we developed a paper-based survey questionnaire based on the 2022 JAGES survey questionnaire. Therefore, these questionnaires had most questions in common. These questionnaires consisted of demographic characteristics, physical and psychological health, and social factors. For WOFC membership questionnaire only, we asked about subjective changes in physical, psychological, and social aspects after joining WOFC (Supplementary Table 1).

Outcome variables

Our outcome variable was the functional disability prediction score (Supplementary Table 2) [22, 23]. This score, consisting of sex, age, and 10 essential items from the Needs Survey, was developed to predict the risk of LTCI certification within three years for community-dwelling older adults without activity of daily life limitations [22, 23]. The Needs survey, conducted every three years by municipality, aims to formulate the LTCI plan based on a model provided by the Ministry of Health, Labor and Welfare [24]. These 10 essential items are derived from parts of the "Kihon Checklist" [25, 26] and "Tokyo Metropolitan Institute of Gerontology Index of Competence" [27], which mainly evaluate functional disability and higher-level functional capacity in older adults. This score ranges from 0 to 48, and the higher the score, the greater the risk of functional disability [22, 23]. In addition, this score can estimate subsequent cumulative LTCI cost [28].

Covariates

We selected 9 potential confounders from common question items between the two questionnaires that were hypothesized to be associated with functional disability

[29, 30]. Sociodemographic factors included age (continuous), educational attainment (≥13 years, 10–12 years, and <9 years), annual equivalized income (continuous), marital status (married and single/ other), living alone (yes, or no), frequency of participation in income-generating activities (none, once a week or less, two or three times a week, and four or more times a week) and population density. We classified the municipalities into the following three categories according to the calculated population density of habitable land: metropolitan (≥4000 people/km2), urban (1000–3999 people/km2), and rural (<1000 people/km2) [31, 32]. Health-related factors included self-reported illness, frequency of going out (At least once a week, and less than once a week), daily walking time (more than 60 min, and less than 60 min) [33], and social participation (sports groups and clubs, hobby groups) [34, 35]. Frequent outings, long walking times [33], participation in sports or hobby groups [34, 35] have been reported to be associated with lower cumulative long-term care benefit costs. We assessed self-reported medical conditions with yes or no answers and included hypertension, stroke, heart diseases, diabetes mellitus, musculoskeletal disorders, and cancer. We assumed that frequency of going out, daily walking time, and social participation would change after joining WOFC. Therefore, we asked WOFC members about frequency of going out, daily walking time, and social participation before joining WOFC. Social participation was defined as participation in sports groups, clubs, or hobby groups, and was categorized as participating at least once a month or less than once a month.

Propensity score matching of control participants to WOFC memberships

We conducted PSM analysis to compare the functional disability prediction score between the WOFC memberships and control groups. We estimated propensity scores using a logistic regression model with the 9 covariates listed above. We performed 1:1 caliper matching with replacement using the nearest neighbor matching method. We determined the caliper width to be equal to 0.2 of the standard deviation of the logit of the propensity score. To assess the covariate balance after matching, we calculated the absolute standardized differences between the two groups. An absolute standardized difference of less than 10% is an indication of a good balance between the covariates [36].

Statistical analysis

After PSM, we used the paired t-test to evaluate group differences in the functional disability prediction score between WOFC members and control groups.

We also conducted four additional analyses. In the two additional analyses, we changed the definition of WOFC members to eliminate the possibility of differences results due to differences definition of participants. We conducted additional analyses to confirm that our results were consistent even among frailer WOFC members. First, we limited WOFC memberships to those with the functional disability prediction score of 17 points or more. The risk of developing functional disability increases for older people with a functional disability prediction score of 17 points or more (the sensitivity and specificity were both 0.733) [22]. Next, we analyzed all valid respondents to WOFC membership survey. This analysis also included older adults who had a short membership period or used WOFC infrequently. In the third additional analysis, to explore the factors that affect the functional disability prediction score, each of the 10 items in the functional disability prediction scores, excluding age, was compared. Finally, we used only the data from WOFC membership questionnaire survey. We examined whether long-term WOFC members experienced positive physical, psychological and social changes after joining, compared to members who had shorter memberships. The outcome variable is the subjective change in the 12 items after joining the exercise facility, as listed below: (1) Places to go out, (2) Walking opportunities, (3) Area of activity, (4) Enjoyment in everyday life, (5) Opportunities to feel "Ikigai", (6) Opportunities to laugh, (7) Opportunities to feel cheerful, (8) Opportunities to talk with family, (9) Opportunities to talk with people outside of your family, (10) Opportunities to support each other, (11) Opportunities to participate in community activities, and (12) Opportunities to eat with others (Supplementary Table 1). We defined (1) to (3) as physical aspects, (4) to (7) as psychological aspects, and (10) to (12) as social aspects. We conducted a modified Poisson analysis with robust standard errors [37] to estimate the prevalence ratios of the association between the duration of WOFC membership and positive subjective changes. This analysis served as a reference for understanding the relationship between WOFC members and healthy ageing.

These statistical analyses used Stata 17/IC (StataCorp, College Station, TX, USA). We addressed the issue of multiple testing using the Bonferroni correction and set a more conservative p-value cutoff. The comparison of the functional disability prediction scores between WOFC members and the control group was set at $p=.0166$ (0.05/3), and the comparison of the 10 items of the functional impairment prediction score was set at $p=.0050$ (0.05/10). Similarly, the additional analysis of the WOFC members only was set at $p=.0041$ (0.05/12).

Missing data

Missing values across variables ranged from 0% (age) to 15.3% (income). Missing values were imputed using

random forest imputation, an iterative imputation method based on random forests that creates multiple imputation schemes by averaging many unpruned classification or regression trees [38]. We used R, version 4.2.1, and the missForest packages for this analysis.

Results

Table 1 shows the characteristics of WOFC memberships and control participants. As a result of conducting PSM analysis at a 1:1 ratio, we obtained 3,029 participants in each group. We show the differences in characteristics between the two groups before and after PSM in Tables 1 and 2, respectively. The absolute standardized difference values for all variables were less than 0.10 (Table 2). This finding indicates that the covariates of the two groups were well balanced.

Table 3 shows comparisons of the average functional disability prediction scores for WOFC members and the control group. The average functional disability prediction score was 0.5 points lower for WOFC members than for the control group (p =.007). We conducted two additional analyses with the definition of WOFC membership changed. In all analyses, WOFC members had lower functional disability prediction scores than the control group. After Bonferroni correction, the additional analysis for all WOFC members exceeded the threshold of p =.05. Supplementary Table 3 shows a comparison of the 10 items of the functional disability prediction score, excluding the ages of the WOFC members and the control group. Of the 10 items in the functional disability prediction score, fewer WOFC members had a BMI of 18.5 or less than the control group, and fewer members had reduced the frequency of their outings compared to a year ago. After Bonferroni correction, these associations remained below the p =.05 threshold. After Bonferroni correction, the p-value exceeded the threshold of p =.05, but compared to the control group, WOFC members had a higher ability to go out using trains and buses.

Table 4 shows the relationship between the association between the duration of WOFC membership and the 12 positive subjective changes after joining. Members with more than three years membership were more

Table 1 Characteristics of WOFC members and control groups before propensity score matching

Variables	Before propensity score matching	
	WOFC members n = 3,029	Control groups n = 90,852
Age (years), mean (SD)	72.4 (5.5)	74.8 (6.2)
Education, *n* (%)		
≥ 13 years	1,343 (44.3)	26,866 (29.6)
10–12 years	1,431 (47.3)	42,756 (47.0)
≤ 9 years	255 (8.4)	21,230 (23.4)
Household income (ten thousand yen), mean (SD)	313.3 (177.3)	229.2 (157.9)
Marital status (Married), *n* (%)	2,035 (67.1)	56,847 (62.5)
Living alone, *n* (%)	555 (18.3)	17,250 (18.9)
Frequency of participation in income-generating activities, *n* (%)		
None	1,572 (51.9)	50,322 (55.4)
Once a week or less	180 (6.0)	6,399 (7.0)
Two or three times a week,	322 (10.6)	9,855 (10.9)
Four or more times a week	955 (31.5)	24,276 (26.7)
Population density, *n* (%)		
Metropolitan (≥ 4000 people/km2)	2,073 (68.5)	26,291 (29.6)
Urban (1000–3999 people/km2),	833 (27.5)	26,270 (28.9)
Rural (< 1000 people/km2)	123 (4.0)	37,651 (41.4)
Self-reported illness, *n* (%)		
Hypertension	1,142 (37.7)	40,420 (44.4)
Stroke	40 (1.3)	1,242 (1.3)
Heart diseases	127 (4.1)	5,525 (6.0)
Diabetes mellitus	253 (8.3)	9,672 (10.6)
Musculoskeletal disorders	545 (17.9)	12,963 (14.2)
Cancer	82 (2.7)	2,796 (3.8)
Frequency of going out (Less than once a week), *n* (%)	54 (1.7)	6,279 (6.9)
Daily walking time (≥ 60 min), *n* (%)	1,274 (42.0)	33,175 (36.5)
Social participation (More than once a month), *n* (%)		
Sports group	1,290 (42.5)	24,863 (27.3)
Hobby group	1,498 (49.4)	26,213 (28.8)

Abbreviations: SD, standard deviation. WOFC, Women-only fitness club

Table 2 Characteristics of WOFC members and control groups after propensity score matching

Variables	After propensity score matching		
	WOFC members *n* = 3,029	Control groups *n* = 3,029	ASD
Age (years), mean (SD)	72.4 (5.5)	72.7 (5.3)	0.005
Education, *n* (%)			
≥ 13 years	1,343 (44.3)	1,326 (43.9)	-0.001
10–12 years	1,431 (47.3)	1,464 (48.3)	
≤ 9 years	255 (8.4)	239 (7.9)	
Household income (ten thousand yen), mean (SD)	313.3 (177.3)	310.3 (198.5)	0.016
Marital status (Married), *n* (%)	2,035 (67.1)	2,042 (67.4)	-0.005
Living alone, *n* (%)	555 (18.3)	549 (18.1)	0.005
Frequency of participation in income-generating activities, *n* (%)			
None	1,572 (51.9)	1,645 (54.0)	0.026
Once a week or less	180 (6.0)	156 (5.1)	
Two or three times a week,	322 (10.6)	290 (9.6)	
Four or more times a week	955 (31.5)	948 (31.3)	
Population density, *n* (%)			
Metropolitan (≥ 4000 people/km2)	2,073 (68.5)	2,073 (68.5)	-0.024
Urban (1000–3999 people/km2),	833 (27.5)	833 (27.5)	
Rural (< 1000 people/km2)	123 (4.0)	123 (4.0)	
Self-reported illness, *n* (%)			
Hypertension	1,142 (37.7)	1,148 (37.9)	-0.004
Stroke	40 (1.3)	46 (1.5)	-0.017
Heart diseases	127 (4.1)	113 (3.7)	0.024
Diabetes mellitus	253 (8.3)	251 (8.2)	0.002
Musculoskeletal disorders	545 (17.9)	478 (15.7)	0.059
Cancer	82 (2.7)	76 (2.5)	0.012
Frequency of going out (Less than once a week), *n* (%)	54 (1.7)	48 (1.5)	0.015
Daily walking time (≥ 60 min), *n* (%)	1,274 (42.0)	1,272 (41.9)	0.001
Social participation (More than once a month), *n* (%)			
Sports group	1,290 (42.5)	1,245 (41.1)	0.030
Hobby group	1,498 (49.4)	1,461 (48.2)	0.024

Abbreviations: SD, standard deviation. ASD, absolute standardized difference. WOFC, Women-only fitness club

Table 3 Comparison of the functional disability prediction score between WOFC members and control groups after propensity score matching

The functional disability prediction score	After propensity score matching		
	WOFC members Mean (SD)	Control groups Mean (SD)	*p*-value[a]
Main analysis [b]	11.41 (7.66)	11.94 (7.62)	0.007 ***
Additional analysis 1[c]	21.54 (4.04)	22.11 (4.31)	0.008 ***
Additional analysis 2[d]	11.48 (7.72)	11.84 (7.54)	0.047 *

Abbreviations: SD, standard deviation. WOFC, Women-only fitness club

[a] All analyses performed paired t-tests

[b] WOFC members were defined as those who had been a WOFC member for at least one year and used WOFC at least once a week for the main analysis (*n* = 3,029)

[c] For Additional Analysis 1, only those with the functional disability prediction score of 17 + in the main analysis were considered WOFC members (*n* = 806)

[d] Additional analysis 2 included all valid respondents to WOFC membership survey (*n* = 3,386)

* $p < .05$ before Bonferroni correction; ** $p < .01$ before Bonferroni correction; *** $p < .05$ after Bonferroni correction (the *p*-value cutoff for Bonferroni correction is $p = .05/3$ outcomes = $p < .0166$)

likely to feel that they had more opportunities to laugh and talk with people other than their family after joining than members with less than one year of membership. After Bonferroni correction, these associations remained below the $p = .05$ threshold. Compared with WOFC members with less than one year, WOFC members with more than three years were moderately associated with many opportunities to walk, support each other, participate in community activities, and eat with others. These associations were above the threshold of $p = .05$ after Bonferroni correction.

Table 4 The prevalence ratios of the association between the duration of WOFC membership and positive subjective changes

Ref. Members with membership of less than one year (*n* = 277)	Members with more than one year but less than three years membership (*n* = 770)				Members with more than three years membership (*n* = 2,340)			
Outcome	**PR[a]**	**95%CI**		***p*-value**	**PR[a]**	**95%CI**		***p*-value**
Physical aspects								
Places to go out	1.03	0.90	1.17	0.630	0.98	0.87	1.10	0.773
Walking opportunities	1.10	0.99	1.23	0.069	1.12	1.01	1.24	0.029*
Area of activity	1.02	0.88	1.19	0.702	0.98	0.85	1.12	0.821
Psychological aspects								
Enjoyment in everyday life	1.10	0.96	1.26	0.146	1.08	0.95	1.22	0.208
Opportunities to feel "Ikigai"	1.04	0.89	1.21	0.591	1.09	0.95	1.25	0.197
Opportunities to laugh	1.26	1.06	1.49	0.009**	1.38	1.17	1.61	< 0.001***
Opportunities to feel cheerful	1.07	0.96	1.19	0.218	1.05	0.95	1.17	0.270
Social aspects								
Opportunities to talk with family	1.07	0.87	1.33	0.485	1.03	0.85	1.25	0.727
Opportunities to talk with people outside of your family	1.26	1.07	1.49	0.005	1.51	1.29	1.76	< 0.001***
Opportunities to support each other	1.11	0.87	1.43	0.379	1.34	1.07	1.69	0.011*
Opportunities to participate in community activities	1.13	0.76	1.68	0.532	1.47	1.02	2.12	0.035*
Opportunities to eat with others	1.27	1.02	1.59	0.031	1.25	1.02	1.54	0.030*

Abbreviations: PR, prevalence ratio; CI, confidence interval; Ref., Reference. WOFC, Women-only fitness club

[a] All models were controlled for sociodemographic factors (age, educational attainment, annual equivalized income, marital status, living alone, frequency of participation in income-generating activities and population density) and health-related factors (self-reported illness, frequency of going out, daily walking time and social participation)

* $p < .05$ before Bonferroni correction; ** $p < .01$ before Bonferroni correction; ***$p < .05$ after Bonferroni correction (the p-value cutoff for Bonferroni correction is $p = .05/12$ outcomes $= p < .0041$)

Discussion

Main findings

To the best of our knowledge, this has been the first study to investigate functional disability prediction scores in WOFC offering the structured 30-minute exercise program. There are two main findings. First, WOFC members had lower functional disability prediction scores compared to the control group of community-dwelling older adults. This result was consistent even when the definition of WOFC members was limited to frail people. Specifically, fewer WOFC members had a BMI of 18.5 or less than the control group, and fewer members had reduced the frequency of their outings compared to a year ago. Second, additional analysis limited to WOFC members revealed that those with longer membership experienced positive psychosocial changes in daily life.

The mechanisms that WOFC contributes to healthy aging

Although our study design was cross-sectional, our findings suggest that WOFC, a private fitness club, could potentially contribute to healthy ageing in community-dwelling older adults. In the additional analysis, fewer WOFC members had low BMIs and went out less often than the controls. A low BMI and low frequency of physical activity are factors that are detrimental to healthy aging [23, 26]. The availability of fitness facilities promotes physical activity [14], improves physical and mental health [10, 12], and helps reduce health care costs [11] for older adults. In this study, we found that even among older and higher-risk populations, the fitness facility members had lower functional disability scores compared to control group. The structured programs provided at WOFC align with WHO's recommended multi-component exercises [4], and previous short-term follow-up studies have shown positive associations with various health outcomes [17–19]. The reason why WOFC members had lower functional disability prediction scores than the control group may be because this evidence-based program is delivered under expert guidance. Furthermore, the fact that the program was easy for even older women who were apprehensive about exercise to participate in may explain its effectiveness in reaching a broad demographic. In the future, longitudinal studies using control groups will be necessary.

Psychological benefits in WOFC

The positive psychosocial changes observed in long-term members may offer insights into the mechanisms through which WOFC contributes to healthy ageing. Interestingly, we found these changes more pronounced in psychosocial than physical aspects. More specifically, the longer a person has been a member, the more they feel that they have had more opportunities to laugh and talk with people other than their family. Laughing with others, especially friends, has been shown to contribute to healthy aging [39]. This may be due to staff-member and member communication as well as social interactions at WOFC. Perhaps the friendly communication that

takes place in a space for women only promotes social interaction. In Japan's key healthy aging initiative, "Community Gathering Place [40, 41]," something similar has been observed [42]. Community gathering places function as focal points for local older adults to engage in health-promotion activities, which include both physical and cognitive exercises, as well as artistic, educational, and social activities [42, 43]. Previous studies has shown that participation in community gathering places fosters subsequent social interaction [42, 44]. WOFC may also function as similar community gathering places, fostering social interaction among memberships. While further verification of multiple facilities is needed, age-friendly fitness facilities may strive to promote laughter and interaction among participants in addition to evidence-based exercise programs.

The value of investing in fitness facilities

Our study has the potential to inform policy makers about the value of investment in private fitness facilities for healthy ageing. Innovative strategies at the population level are needed to address physical inactivity and promote healthy ageing [7]. While our study was cross-sectional and should be interpreted with caution, future longitudinal studies that track both facility members and non-members can contribute to the growing evidence on fitness facilities and healthy ageing. The functional disability prediction score used in this study can also estimate cumulative LTCI cost (6 years of cumulative LTCI costs of 31.6 thousand yen per point) [28]. Using the results of the main analysis, the cumulative reduction LTCI cost for 1,000 WOFC members over a six-year period is calculated as 31.6-thousand-yen x 0.54 points x 1,000 people = 16,748 thousand yen. Our results suggest that there is considerable potential for curbing the cumulative LTCI costs of WOFC members. Further studies could facilitate the introduction of pay-for-success financing models [45, 46], encouraging private investors to support fitness facilities development as a preventive healthcare intervention. The kind of monetary estimates produced by this study may help to inform the decision-making of policy makers and private investors.

Limitations

Our study has some limitations. First, our study design was cross-sectional, we cannot rule out reverse causality, where older adults who were already more active and at lower risk of functional disability were more likely to join WOFC members. Longitudinal or experimental study is needed to address this issue. Second, there was a temporal discrepancy between the data collection years for WOFC members and the control group from JAGES—2023 for WOFC members and 2022 for JAGES. In Japan, social restrictions due to the COVID-19 pandemic were mostly lifted by 2022. We cannot deny the possibility that older adults became more active as time passed, and this may have led to an overestimation of the functional disability prediction scores among WOFC members. We have dealt with this issue as much as possible by aligning the survey months and minimizing the seasonal impact on the behavior of older adults. Third, a survival bias may exist, as many WOFC members in this study had long membership durations. However, additional analysis including those with shorter membership durations showed consistent results. Future studies should track new members and account for attrition in their analysis. Fourth, the study was limited to women due to the nature of WOFC. Nevertheless, given that women are a key population at risk for physical inactivity [47] and that limited access to fitness facilities is a barrier to continued exercise for women [48], the focus on women in this study remains valuable. Finally, this study was conducted on WOFC members, a single fitness club, so the transferability and generalizability of the results is limited. Given these limitations, more studies are needed to provide evidence that fitness clubs like WOFC contribute to healthy aging.

Conclusions

With the world's population ageing, there is a need for innovative public health approaches to physical inactivity among older adults. Our study showed that WOFC membership, the women-only fitness club may lead to healthy ageing. Future studies are needed to examine the long-term effects of being a member of a fitness facility such as WOFC on subsequent health and well-being, as well as financial burden. These studies will help policy makers make decisions about introducing pay-for-success for fitness facilities to achieve healthy ageing.

Abbreviations

WOFC	Women-only fitness club
JAGES	Japan Gerontological Evaluation Study
PSM	Propensity score matching
LTCI	Long-term-care insurance

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13690-025-01601-8.

Supplementary Material 1

Acknowledgements

We would like to thank all participants in this study.

Author contributions

K.I., Kenjiro Kawaguchi, and K.M. are expected to have made substantial contributions to the conception OR design of the work; OR the acquisition, analysis, OR interpretation of data; OR the creation of new software used in the work; OR have drafted the work or substantively revised itAll authors have approved the submitted version (and any substantially modified version that

involves the author's contribution to the study); All authors have agreed both to be personally accountable for the author's own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature. FundingThis study used data from JAGES (the Japan Gerontological Evaluation Study). This study was supported by JSPS (Japan Society for the Promotion of Science) KAKENHI Grant Number (JP15H01972, 19K20909, 20H00557, 22K13558), Health Labour Sciences Research Grant (H28-Choju-Ippan-002, 19FA1012, 19FA2001, 21GA0101, 22FA2001, 22FA1010), Japan Agency for Medical Research and Development (AMED) (JP18dk0110027, JP18ls0110002, JP18le0110009, JP20dk0110034, JP21lk0310073, JP21dk0110037), Open Innovation Platform with Enterprises, Research Institute and Academia (OPERA, JPMJOP1831) from the Japan Science and Technology (JST), a grant from Innovative Research Program on Suicide Countermeasures (1-4), a grant from Sasakawa Sports Foundation, a grant from Japan Health Promotion & Fitness Foundation, a grant from Chiba Foundation for Health Promotion & Disease Prevention, the 8020 Research Grant for fiscal 2019 from the 8020 Promotion Foundation (adopted number: 19-2-06), grants from Meiji Yasuda Life Foundation of Health and Welfare and the Research Funding for Longevity Sciences from National Center for Geriatrics and Gerontology (29-42, 30-22, 20-19, 21-20). The views and opinions expressed in this study are those of the authors and do not necessarily reflect the official policies or positions of the respective funding organizations.

Funding
Curves Japan Co., Ltd funded this study. This study used data from JAGES (the Japan Gerontological Evaluation Study). This study was supported by JSPS (Japan Society for the Promotion of Science) KAKENHI Grant Number (JP15H01972, 19K20909, 20H00557, 22K13558, 25K16857), Health Labour Sciences Research Grant (H28-Choju-Ippan-002, 19FA1012, 19FA2001, 21GA0101, 22FA2001, 22FA1010), Japan Agency for Medical Research and Development (AMED) (JP18dk0110027, JP18ls0110002, JP18le0110009, JP20dk0110034, JP21lk0310073, JP21dk0110037), Open Innovation Platform with Enterprises, Research Institute and Academia (OPERA, JPMJOP1831) from the Japan Science and Technology (JST), a grant from Innovative Research Program on Suicide Countermeasures (1–4), a grant from Sasakawa Sports Foundation, a grant from Japan Health Promotion & Fitness Foundation, a grant from Chiba Foundation for Health Promotion & Disease Prevention, the 8020 Research Grant for fiscal 2019 from the 8020 Promotion Foundation (adopted number: 19-2-06), grants from Meiji Yasuda Life Foundation of Health and Welfare and the Research Funding for Longevity Sciences from National Center for Geriatrics and Gerontology (29–42, 30 – 22, 20 – 19, 21 – 20). This work was supported by JST RISTEX Japan Grant Number JPMJRS22B1. The views and opinions expressed in this study are those of the authors and do not necessarily reflect the official policies or positions of the respective funding organizations.

Data availability
Availability of data and materialsThe JAGES data are available upon reasonable request at https://www.jages.net/. However, the data collected specifically for this study (the Curves data), cannot be made publicly available because the participants in this study did not consent to the public release of their data. Acknowledgements We would like to thank all participants in this study.

Declarations

Ethics approval and consent to participate
All protocols associated with our survey have received approval from the Institutional Review Board of Chiba University, with informed consent obtained from all participants.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 23 January 2025 / Accepted: 14 April 2025
Published online: 25 April 2025

References

1. Fukushima N, Kikuchi H, Sato H, Sasai H, Kiyohara K, Sawada SS et al. Dose-response relationship of physical activity with all-cause mortality among older adults: An umbrella review. J Am Med Dir Assoc. 2024;25:417–30. Available from: https://pubmed.ncbi.nlm.nih.gov/37925162/
2. Ding D, Lawson KD, Kolbe-Alexander TL, Finkelstein EA, Katzmarzyk PT, van Mechelen W et al. The economic burden of physical inactivity: a global analysis of major non-communicable diseases. Lancet. Elsevier BV; 2016. pp. 1311–24. Available from: https://pubmed.ncbi.nlm.nih.gov/27475266/
3. Ekelund U, Tarp J, Steene-Johannessen J, Hansen BH, Jefferis B, Fagerland MW et al. Dose-response associations between accelerometry measured physical activity and sedentary time and all cause mortality: systematic review and harmonised meta-analysis. BMJ. 2019;366:l4570. Available from: https://pubmed.ncbi.nlm.nih.gov/31434697/
4. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour. Br J Sports Med. 2020;54:1451–62. Available from: https://doi.org/10.1136/bjsports-2020-102955
5. Strain T, Flaxman S, Guthold R, Semenova E, Cowan M, Riley LM et al. National, regional, and global trends in insufficient physical activity among adults from 2000 to 2022: a pooled analysis of 507 population-based surveys with 5·7 million participants. Lancet Glob Health. 2024;12:e1232–43. Available from: https://pubmed.ncbi.nlm.nih.gov/38942042/
6. Sfm C, Van Cauwenberg J, Maenhout L, Cardon G, Lambert EV, Van Dyck D. Inequality in physical activity, global trends by income inequality and gender in adults. Int J Behav Nutr Phys Act. 2020;17:142. Available from: https://pubmed.ncbi.nlm.nih.gov/33239036/
7. Bauman A, Merom D, Bull FC, Buchner DM, Fiatarone Singh MA. Updating the evidence for physical activity: Summative reviews of the epidemiological evidence, prevalence, and interventions to promote active aging. Gerontologist.2016;56 Suppl 2:S268-80. Available from: https://pubmed.ncbi.nlm.nih.gov/26994266/
8. World Health Organization. Global action plan on physical activity 2018–2030: More active people for a healthier world. Genève, Switzerland: World Health Organization. 2019. Available from: https://iris.who.int/bitstream/handle/10665/272722/9789241514187-eng.pdf. Accessed 8 Jan 2025.
9. Orpana H, Chawla M, Gallagher E, Escaravage E. Developing indicators for evaluation of age-friendly communities in Canada: process and results. Health Promot Chronic Dis Prev Can. 2016;36:214–23. Available from: https://doi.org/10.24095/hpcdp.36.10.02
10. Mu Y, Yi M, Liu Q. Association of neighborhood recreational facilities and depressive symptoms among Chinese older adults. BMC Geriatr. 2023;23:667. Available from: https://pubmed.ncbi.nlm.nih.gov/37848820/
11. Watts P, Webb E, Netuveli G. The role of sports clubs in helping older people to stay active and prevent frailty: a longitudinal mediation analysis. Int J Behav Nutr Phys Act. 2017;14:95. Available from: https://doi.org/10.1186/s12966-017-0552-5
12. Liu C, Gao Y, Jia Z, Zhao L. Association of public sports space perception with health-related quality of life in middle-aged and older adults-evidence from a survey in Shandong, China. Behav Sci (Basel). 2023 [cited 2024 Sep 20];13. Available from: https://pubmed.ncbi.nlm.nih.gov/37754014/
13. Brar R, Katz A, Ferguson T, Whitlock R, Di Nella M, Bohm C et al. Impact of the medical fitness model on long term health outcomes in older adults. BMC Geriatr. 2024 [cited 2024 Sep 19];24:695. Available from: https://pubmed.ncbi.nlm.nih.gov/39164654/
14. Franco MR, Tong A, Howard K, Sherrington C, Ferreira PH, Pinto RZ et al. Older people's perspectives on participation in physical activity: a systematic review and thematic synthesis of qualitative literature. Br J Sports Med. 2015;49:1268–76. Available from: https://doi.org/10.1136/bjsports-2014-094015
15. Nakagata T, Ono R. Data resource profile: Exercise habits, step counts, and sedentary behavior from the National Health and Nutrition Survey in Japan. Data Brief. 2024 [cited 2024 Sep 20];53:110103. Available from: https://pubmed.ncbi.nlm.nih.gov/38328297/
16. CURVES HOLDINGS Co. Ltd. Understanding Curves in Three Minutes| For Investors| Investor Relations| CURVES HOLDINGS Co., Ltd. Available from: https://www.curvesholdings.co.jp/ir/individual/3min.html. Accessed 8 Jan 2025.
17. Sawada SS, Gando Y, Kawakami R, Blair SN, Lee I-M, Tamura Y et al. Combined aerobic and resistance training, and incidence of diabetes: A retrospective cohort study in Japanese older women. J Diabetes Investig. 2019;10:997–1003. Available from: https://doi.org/10.1111/jdi.12973

18. Nouchi R, Taki Y, Takeuchi H, Sekiguchi A, Hashizume H, Nozawa T et al. Four weeks of combination exercise training improved executive functions, episodic memory, and processing speed in healthy elderly people: evidence from a randomized controlled trial. Age. 2014;36:787–99. Available from: https://doi.org/10.1007/s11357-013-9588-x
19. Sato S, Ukimoto S, Kanamoto T, Sasaki N, Hashimoto T, Saito H et al. Chronic musculoskeletal pain, catastrophizing, and physical function in adult women were improved after 3-month aerobic-resistance circuit training. Sci Rep. 2021;11:14939. Available from: https://doi.org/10.1038/s41598-021-91731-0
20. Kondo K. Progress in Aging Epidemiology in Japan: The JAGES Project. J Epidemiol. 2016;26:331–6. Available from: https://doi.org/10.2188/jea.JE20160093
21. Kondo K, Rosenberg M. Advancing universal health coverage through knowledge translation for healthy ageing Lessons learnt from the Japan Gerontological Evaluation Study. apps.who.int; 2018 [cited 2022 Apr 27]. Available from: https://apps.who.int/iris/bitstream/handle/10665/279010/9789241514569-eng.pdf. Accessed 8 Jan 2025.
22. Tsuji T, Kondo K, Kondo N, Aida J, Takagi D. Development of a risk assessment scale predicting incident functional disability among older people: Japan Gerontological Evaluation Study. Geriatr Gerontol Int. 2018;18:1433–8. Available from: https://doi.org/10.1111/ggi.13503
23. Watanabe R, Tsuji T, Ide K, Noguchi T, Yasuoka M, Kamiji K et al. Predictive validity of the modified Kihon Checklist for the incidence of functional disability among older people: A 3-year cohort study from the JAGES. Geriatr Gerontol Int. 2022;22:667–74. Available from: https://doi.org/10.1111/ggi.14439
24. Ministry of Health, Labour and Welfar. The Survey of Needs Guide. 2019. Available from: https://www.mhlw.go.jp/content/12301000/000560423.pdf. Accessed 8 Jan 2025.
25. Arai H, Satake S. English translation of the kihon checklist: Letters to the Editor. Geriatr Gerontol Int. 2015;15:518–9. Available from: https://pubmed.ncbi.nlm.nih.gov/25828791/
26. Sewo Sampaio PY, Sampaio RAC, Yamada M, Arai H. Systematic review of the Kihon Checklist: Is it a reliable assessment of frailty? Kihon Checklist: Systematic review. Geriatr Gerontol Int. 2016 [cited 2024 Sep 23];16:893–902. Available from: https://pubmed.ncbi.nlm.nih.gov/27444395/
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. 1991;13:103–16. Available from: https://doi.org/10.1016/0167-4943(91)90053-s
28. Saito M, Tsuji T, Fujita K et al. Accumulated long-term care benefits by risk assessment scales for incident functional disability: A six-year follow-up study of long-term care receipt data. Japanese Journal of Public Health, 2021;68(11), 743–752. Available from: https://www.jstage.jst.go.jp/article/jph/advpub/0/advpub_21-056/_article/-char/ja/
29. Ide K, Tsuji T, Kanamori S, Watanabe R, Iizuka G, Kondo K. Frequency of social participation by types and functional decline: A six-year longitudinal study. Arch Gerontol Geriatr. 2023;112:105018. Available from: https://doi.org/10.1016/j.archger.2023.105018
30. Tsuji T, Kanamori S, Yamakita M, Sato A, Yokoyama M, Miyaguni Y et al. Correlates of engaging in sports and exercise volunteering among older adults in Japan. Sci Rep. 2022;12:3791. Available from: https://doi.org/10.1038/s41598-022-07688-1
31. Yamamoto T, Kondo K, Aida J, Suzuki K, Misawa J, Nakade M et al. Social determinants of denture/bridge use: Japan gerontological evaluation study project cross-sectional study in older Japanese. BMC Oral Health. 2014;14:63. Available from: https://doi.org/10.1186/1472-6831-14-63
32. Ide K, Jeong S, Tsuji T, Watanabe R, Miyaguni Y, Nakamura H et al. Suggesting Indicators of Age-Friendly City: Social Participation and Happiness, an Ecological Study from the JAGES. Int J Environ Res Public Health. 2022;19:5096. Available from: https://www.mdpi.com/1660-4601/19/9/5096
33. Hirai H, Saito M, Kondo N, Kondo K, Ojima T. Physical Activity and Cumulative Long-Term Care Cost among Older Japanese Adults: A Prospective Study in JAGES. Int J Environ Res Public Health. 2021;18. Available from: https://doi.org/10.3390/ijerph18095004
34. Saito M, Kondo N, Aida J, Saito J, Anezaki H, Ojima T et al. Differences in Cumulative Long-Term Care Costs by Community Activities and Employment: A Prospective Follow-Up Study of Older Japanese Adults. Int J Environ Res Public Health. 2021;18. Available from: https://doi.org/10.3390/ijerph18105414
35. Saito M, Aida J, Kondo N, Saito J, Kato H, Ota Y et al. Reduced long-term care cost by social participation among older Japanese adults: a prospective follow-up study in JAGES. BMJ Open. 2019;9:e024439. Available from: https://doi.org/10.1136/bmjopen-2018-024439
36. Sainani KL. Propensity Scores: Uses and Limitations. PM R. 2012;4:693–7. Available from: https://www.sciencedirect.com/science/article/pii/S1934148212003462
37. Zou G. A modified poisson regression approach to prospective studies with binary data. Am J Epidemiol. 2004;159:702–6. Available from: https://doi.org/10.1093/aje/kwh090
38. Stekhoven DJ, Bühlmann P. MissForest–non-parametric missing value imputation for mixed-type data. Bioinformatics. 2012;28:112–8. Available from: https://pubmed.ncbi.nlm.nih.gov/22039212/
39. Tamada Y, Yamaguchi C, Saito M, Ohira T, Shirai K, Kondo K et al. Does laughing with others lower the risk of functional disability among older Japanese adults? The JAGES prospective cohort study. Prev Med. 2022;155:106945. Available from: https://pubmed.ncbi.nlm.nih.gov/34973283/
40. Kimura M, Ide K, Sato K, Bang E, Ojima T, Kondo K. The relationships between social participation before the COVID-19 pandemic and preventive and health-promoting behaviors during the pandemic: the JAGES 2019–2020 longitudinal study. Environ Health Prev Med.
41. Kojima M, Satake S, Osawa A, Arai H. Management of frailty under COVID-19 pandemic in Japan. Glob Health Med. 2021;3:196–202. Available from: https://doi.org/10.35772/ghm.2020.01118
42. Ide K, Nakagomi A, Tsuji T, Yamamoto T, Watanabe R, Yokoyama M et al. Participation in Community Gathering Places and Subsequent Health and Well-being: An Outcome-wide Analysis. Innov Aging. 2023; Available from: https://academic.oup.com/innovateage/advance-article-pdf/doi/https://doi.org/10.1093/geroni/igad084/51096950/igad084.pdf
43. Nakagawa K, Kawachi I. What types of activities increase participation in community salons? Soc Sci Med. 2019;238:112484. Available from: https://doi.org/10.1016/j.socscimed.2019.112484
44. Hosokawa R, Kondo K, Ito M, Miyaguni Y, Mizutani S, Goto F et al. The Effectiveness of Japan's Community Centers in Facilitating Social Participation and Maintaining the Functional Capacity of Older People. Res Aging. 2019;41:315–35. Available from: https://doi.org/10.1177/0164027518805918
45. Iovan S, Lantz PM, Shapiro S. pay for success projects: Financing interventions that address social determinants of health in 20 countries. Am J Public Health. 2018 [cited 2024 Sep 22];108:1473–7. Available from: https://pubmed.ncbi.nlm.nih.gov/30252524/
46. Dopp AR, Perrine CM, Iovan S, Lantz PM. The potential of pay-for-success as a financing strategy for evidence-based practices: An illustration with multisystemic therapy. Adm Policy Ment Health. 2019;46:629–35. Available from: https://pubmed.ncbi.nlm.nih.gov/31073967/
47. Martins LCG, Lopes MV, de Diniz O, Guedes CM. NG. The factors related to a sedentary lifestyle: A meta-analysis review. J Adv Nurs. 2021;77:1188–205. Available from: https://pubmed.ncbi.nlm.nih.gov/33368524/
48. Magno F, Ten Caten CS, Reppold Filho AR, Callegaro AM, de Ferreira A. CD. Factors related to sports participation in Brazil: An analysis based on the 2015 National Household Survey. Int J Environ Res Public Health. 2020;17:6011. Available from: https://pubmed.ncbi.nlm.nih.gov/32824883/

Publisher's note