Exercising With Others, Motivation, and 1-Year Maintenance of Exercise Behavior Among Workers

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Exercising with others, motivation, and one-year maintenance of exercise behavior among workers

Abstract

Background: Maintaining exercise behavior is important for health. Although exercising with others may be an effective strategy to maintain doing it, the association between exercising with others and maintenance of it and mediators of this association remain unconfirmed. The present study examined whether exercising with others was longitudinally and positively associated with one-year maintenance of exercise behavior and this association was mediated by exercise motivation among workers. **Methods:** This study used data of an online survey-based longitudinal cohort study on 2,819 Japanese workers who performed exercise at baseline and responded to a one-year follow-up survey. This study analyzed one-year follow-up data of participation in exercise, baseline and one-year follow-up data of weekly exercise time, and baseline data of exercising with others, exercise motivation, and demographic factors. Participation in exercise (Model 1) and weekly exercise time (Model 2) after one year were indices of one-year maintenance of exercise behavior. **Results:** Adjusting for demographic factors, path analyses showed that exercising with others at baseline indirectly and significantly predicted one-year maintenance of exercise behavior, mediated by exercise motivation and weekly exercise time at baseline (standardized total associations, 0.07 in Model 1 and 0.18 in Model 2; standardized indirect associations, 0.06 in Model 1 and 0.18 in Model 2). **Conclusions:** This study found that exercising with others was indirectly and positively associated with one-year maintenance of exercise behavior, mediated by exercise motivation. Encouraging participation with others may be effective in supporting motivation and maintaining exercise behavior.

Keywords: exercise; health behavior; environments; motivation; psychology

Introduction

Maintaining exercise behaviors is important for promoting both physical and mental health. While physical activity refers to all body movements produced by the skeletal muscles that require energy expenditure, exercise refers to physical activity performed in leisure domain for health, fitness, or physical performance. [1] While people engage in physical activities in various domains, such as leisure, transportation, occupation, and households,[2] leisure is particularly important for promoting both physical and mental health. A meta-analysis[3] and a review article[4] state that physical activity in leisure domain provides more mental health benefits than other domains. Occupational studies have also indicated that, while physical activity in leisure domains is beneficial for cardiovascular health, engaging physical activity in occupation domain is not beneficial or even harmful to such health among workers.[5] Despite both mental and physical health benefits, many people drop out from maintaining their exercise behavior, as reported in previous studies.[6,7,8,9] As determinants and effective interventions differ according to the settings, behavior-specific approaches are recommended when examining physical activity behavior.[10,11] To develop effective support strategies for maintenance of exercise behavior, identifying the determinants of the maintenance of exercise behavior is essential.[12]

Exercising with others would be a determinant of the maintenance of exercise behavior. The ecological model proposes that multilevel factors, including individual, social, environmental, and policy levels, determine health behaviors.[11] Supporting this, review articles[13,14,15,16] have indicated that maintenance of physical activity behaviors, including exercise, is determined by multi-level factors. Exercising with others can be categorized as a social-level factor. Compared with other social-level factors such as perceived norms,[6] social support,[17] and social network size.[18], one potential advantage of examining exercise with others

as a determinant would be that it can provide more mental health benefits than exercising alone, as several studies have indicated.[19,20,21,22] Moreover, compared with various behavior change techniques,[23] exercising with others is simple and does not require special knowledge and skills; implementing exercising with others would be feasible and acceptable for the general public.

Nonetheless, whether exercising with others is associated with maintenance of exercise or physical activity behavior remains unclear. While most studies have examined the effect of affiliation to organized exercise groups, such as clubs, gyms, or classes.[24,25,26,27], such affiliation is just one type of exercising with others thereby these findings[24,25,26,27] cannot be generalized to exercising with others. Indeed, people have many opportunities to exercise with others without belonging to organized exercise groups. For example, exercising with one's spouse desirably influences marital satisfaction among older married couples,[28] while exercising with one's child desirably influences mothers' affective states.[29] In many cases, older married couples and mothers and their child would exercise together without belonging to such groups. However, only a few studies[22,23] indicated desirable influences of exercising with others on the maintenance of such behaviors among older population. Further longitudinal studies for different populations are necessary to confirm the association between exercising with others and maintenance of exercise behavior.

Furthermore, motivation can mediate the association between exercising with others and maintenance of exercise behavior. Clarification of mediators can reveal behavioral mechanisms, strengthen the theoretical basis of their association, and imply more effective intervention strategies to promote maintenance of exercise behavior. Self-determination theory[31] assumes that more self-determined motivation is associated with better behavioral outcomes and that motivation becomes more self-determined if one's three basic psychological needs—competency, autonomy, and relatedness—are satisfied. Exercise behavior research demonstrates that self-determination theory are reasonable for understanding exercise

behavior .[32] Exercising with others can contribute to satisfying the need for relatedness, and in turn, facilitate self-determined motivation. Supporting self-determination theory, previous studies show that self-determined motivation mediates the association of satisfied relatedness with exercise or physical activity behavior.[33,34,35,36] These findings are applicable for investigating the mediator of the association between exercising with others and maintenance of exercise behavior.

The present study examined whether exercising with others was longitudinally and positively associated with the one-year maintenance of exercise behavior and this association was mediated by exercise motivation among workers. Because 82.7% of Japanese workers perceive severe stress/anxiety regarding their work[37] and longer working time is a well-known barrier against exercise,[38,39,40,41] workers are an important target population for examining the determinants of exercise behavior.

Methods

Transparency and Openness

This was not conducted in the present study. The database used in this study is not publicly available. The database, materials, and analysis scripts supporting the findings of this study are available from the corresponding author upon request.

This study analyzed online survey-based longitudinal cohort study called “Xxx-xxxxx Xxxxxxxxxxx xxxxx xx xxx Xxxx Xxxxxxxxxxx xxx Xxxxxxxxx (XXXXXX)” (anonymized for blinded review).[42] XXXXXX aimed to identify multidisciplinary determinants of mental health among Japanese workers. An overview of XXXXXX has been reported in another paper.[42] From XXXXXX, we have published and plan to submit various papers on multidisciplinary topics. For the topic of exercise, we have published one paper reporting cross-sectional associations of exercise behavior with mental health[43] and plan to submit another paper to report their longitudinal associations. As none of our studies have addressed the

determinants of exercise maintenance, the present study makes unique scientific contributions.

XXXXXX received prior approval from the Research Ethics Committee of the Xxxxxxxx Xxxxxxxxx xx Xxxxxxxxxxx Xxxxxx xxx Xxxxxx, Xxxxx (XXXXX-X-XX) and the Ethics Committee of Xxxxxxxx Xxxxxx xx Xxxxx Xxxxxxxxxxx xxx Xxxxxxxxxxx, Xxxx Xxxxxxxxxx (no. XXX). All procedures involving human participants were performed in accordance with the 1964 Declaration of Helsinki and its later amendments, or comparable ethical standards. Informed consent was obtained from all study participants.

Participants and Procedures

XXXXXX conducted a baseline survey in February 2022 and a one-year follow-up survey from February to March 2023. The participants of the XXXXXX were recruited via a pool of Japanese online survey monitors which a Japanese Internet research service company (i.e., Xxxxx Xxxxxxxxxx) has managed. The detailed process of the baseline survey is reported in our previous study.[42] Because XXXXXX has multidisciplinary purposes, instead of statistical power, the baseline survey was determined to be 20,000 based on available financial resources.

At the baseline survey, the survey company was asked to collect data from randomly sampled workers aged 20–59 years. The exclusion criteria were as follows: (1) agriculture, forestry, fishery, mining, and quarry workers; (2) self-employed or executive workers; (3) workers who had multiple jobs; (4) workers who worked less than 20 hours per week; and (5) workers who inappropriately to the instructional manipulation check[44] or responded to the baseline survey within an extremely short response time (less than 10 minutes). The company managed the number of eligible respondents stratified by gender, age groups, and 20 industry types and terminated the survey when the sample size of the stratified group matched the distribution ratios of Japanese general employees.[45]

In the one-year follow-up survey, the survey company was asked to collect as many

responses as possible from the baseline survey. Actually, 7,970 of the 20,000 individuals (39.9%) responded to the one-year follow-up.

Among the respondents of XXXXXX, the present study included 2,819 individuals who met both criteria: (1) participated in exercise at baseline, and (2) responded to the one-year follow-up survey. We excluded 13,086 and 4,095 individuals due to first and second criteria respectively. From the database of XXXXXX, the present study extracted the baseline and one-year follow-up data of participation and weekly exercise time (outcome), baseline data of exercising with others and exercise motivation (predictors), and demographic factors (potential confounders).

Measures

Exercise Participation

Respondents were asked whether they usually participate in exercise by selecting "yes" or "no." Using the Japanese national survey[46] and physical activity guidelines,[47] the survey defined exercise as "planned and habitual physical activities, such as sports or fitness, for the purpose of maintaining or improving health and physical strength." Because the Japanese national survey[46] did not designate the intensities of exercise and physical activity guidelines recommended at least 30 minutes at least twice a week regardless of the intensities,[47] the survey did not provide explanations about the intensity.

Weekly Exercise Time and Exercise with Others

As described in detail in previous work,[43] the survey asked about the frequency (days per week) and duration (length of time in minutes) of exercising alone and with others, respectively. If the respondents did not participate in exercise alone, or with others, they were asked to answer the corresponding questions for "0" days and "0" minutes. From the answers to these items, the weekly exercise time (hours) was calculated and exercise with others was classified as yes or no. The weekly exercise time at the one-year follow-up was imputed as "0"

hours for those who did not participate in exercise.

Exercise Motivation

As explained in our previous work,[43] the survey developed and employed a single item to measure exercise motivation. This was because XXXXXX has more than 300 items and we were hesitant about using an existing standardized scale, the revised Self-determined Motivation Scale for Exercise (SMSE-2),[48] which has a total of 22 items. The item asked respondents to indicate their biggest reason to participate in exercise from six choices: "I do not know why I exercise (1)", "because other people (e.g., a family member, friend, or doctor) will be pleased with me (2)", "because I feel guilty if I do not exercise (3)", "because exercise is important to me (4):, "because it is consistent with my values, goals, and aims in life (5)", or "because exercising itself as fun (6)". The wording was extracted from one representative item of six subscales (non-regulation, external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic regulation) of the SMSE-2,[48] which entirely follow the regulatory styles of motivation proposed in self-determination theory.[31] The answers to the single item were treated as a continuous variable, and higher scores were considered to represent greater self-determined motivation.

Demographic Factors

This study considered gender (men, women), age (years), marital status (unmarried, married), education from 4 years college (no, yes), annual household income (under 6 million Japanese yen, over 6 million Japanese yen), overweight (no, yes), type of employment (non-regular, regular), engagement in physical work (no, yes), engagement in shift work (no, yes), and weekly work time (hours). Overweight was defined as a body mass index of 25 kg/m^2 or higher via self-reported height and weight.

Analyses

Figure 1 shows a conceptual diagram of the main path analyses. To strengthen the

robustness of the results, dependent variables included the one-year maintenance of exercise behavior using two indices: exercise participation after one year (no, yes: Model 1) and weekly exercise time (hours: Model 2) after one year, adjusting for baseline weekly exercise time. Each model examined six main paths regardless of their statistical significance: (1) path from exercising with others at baseline to one-year maintenance of exercise behavior, (2) path from exercising others at baseline to exercise motivation at baseline, (3) path from exercising others at baseline to weekly exercise time at baseline, (4) path from exercise motivation at baseline to weekly exercise time at baseline, (5) path from exercise motivation at baseline to one-year maintenance of exercise behavior, and (6) path from weekly exercise time at baseline to one-year maintenance of exercise behavior. Additional paths from demographic factors at baseline to exercising with others, exercise motivation, weekly exercise time at baseline, and one-year maintenance of exercise behavior were also examined. For additional paths from the demographic factors, once all paths were included the models, statistically insignificant paths were removed. Correlations among demographic factors were also included. Exercise participation after one year (no=0, yes=1), exercising with others at baseline (no=0, yes=1), gender (men=0, women=1), marital status (unmarried=0, married=1), education from 4 years college (no=0, yes=1), annual household income (under 6 million Japanese yen=0, over 6 million Japanese yen=1), overweight (no=0, yes=1), type of employment (non-regular=0, regular=1), engagement in physical work (no=0, yes=1), and engagement in shift work (no=0, yes=1) were treated as dummy variables. Using the bias-corrected bootstrap method (5000 bootstrap samples), this study estimated the standardized indirect and total associations, and their 95% confidence intervals in the variables at baseline on the one-year maintenance of exercise behavior.

This study also conducted sensitivity analyses. Sensitivity analysis 1 included exercising alone at baseline (no=0, yes=1) as a variable in the main analyses to clarify the

unique contribution of exercising with others on one-year maintenance of exercise behavior, independent of total exercise time. This analysis included paths from exercising alone at baseline to exercise motivation at baseline, weekly exercise time at baseline, and one-year maintenance of exercise behavior. In addition, paths were included from demographic factors at baseline to exercising alone at baseline, as well as the cross-sectional correlations between exercising alone and with others at baseline. Sensitivity analysis 2 replaced the continuous variable for exercise motivation with a categorical variable, recognizing that this item was not standardized. While the original item consisted of six choices, this study combined the choices for external and introjected regulations into a single category owing to the small sample size for external regulation (n = 35) in accordance with our previous study.[43] The five categories had the following sample sizes: 76 for non-regulation, 199 for external or introjected regulation, 1,179 for identified regulation, 403 for integrated regulation, and 962 for intrinsic regulation. This study treated identified regulation as the reference variable for exercise motivation because it had the largest sample size.

This study focused on whether (1) the paths from exercising with others at baseline to exercise motivation at baseline and exercise motivation at baseline to one-year maintenance of exercise behavior were positively significant, and (2) the standardized indirect and total associations between exercising with others and one-year maintenance of exercise behavior were positively significant.

This study did not contain missing data due to the online survey. The comparative fit index (CFI), Tucker‑Lewis index (TLI), and root mean square error of approximation (RMSEA) were computed as model fit indices. Statistical significance was set at $P < 0.05$. IBM SPSS AMOS 25 for Windows was used to conduct path analyses.

Results

Respondent Characteristics

As shown in Table 1, among the respondents, the mean weekly exercise time at baseline and after one year was 4.2 hours (standard deviation, 3.7 hours) and 3.5 hours (standard deviation, 3.9 hours), respectively, and 78.1% of respondents participated in exercise after one year. Compared with non-respondents, follow-up survey were more likely to be male, older, unmarried, educated from four-year college; have higher annual household income; and less likely to engage in physical or shift work.

Path Analyses for Predicting One-year Maintenance of Exercise Behavior

Table 2 shows Pearson's correlation coefficients for associations of the baseline variables with exercise participation and weekly exercise time after one year. Weekly exercise time, exercise with others, and exercise motivation at baseline were positively and significantly correlated with exercise participation and weekly exercise time after one year.

The key results for the standardized path coefficients and total and indirect associations in the main analyses are presented in Figure 2 and Table 3. Supplementary materials indicate the standardized path coefficients (Model 1, Supplementary Figure 1; Model 2, Supplementary Figure 2), and total and indirect associations (Supplementary Table 1) of the demographic factors. As shown in Figure 2, the standardized path coefficients from exercising with others at baseline to exercise motivation at baseline and from exercise motivation at baseline to exercise participation and weekly exercise time after one year were positively significant. As shown in Table 3, the standardized total and indirect associations of exercising with others and exercise motivation with exercise participation and weekly exercise time after one year were positively significant.

Key results for the standardized path coefficients and the total and indirect associations of sensitivity analysis 1 are sown in Supplementary Figure 3 and Supplementary Table 2; key results of sensitivity analysis 2 are shown in Supplementary Figure 4 and Supplementary Table

3. Both sensitivity analyses supported the indirect and longitudinal associations between exercising with others and one-year maintenance of exercise behavior, mediated by exercise motivation, even after adjusting for exercising alone at baseline (sensitivity analysis 1) and treating exercise motivation as a categorical variable instead of a continuous variable (sensitivity analysis 2).

Discussion

This study found that among workers, exercising with others was longitudinally and indirectly associated with the one-year maintenance of exercise behavior, mediated by exercise motivation. Thus, exercising with others emerges as a social-level determinant of maintenance of exercise behavior, and this association is indirect via an individual-level factor. Only a few gerontology studies[22,30] have investigated exercising with others as an additional social-level determinant. Beyond social-level factors such as subjective norms,[6] social support,[17] social network size,[18] and membership in organized exercise groups,[24,25,26,27], this study expands the understanding of social-level determinants of maintenance of exercise or physical activity behaviors. Regarding the mediating role of exercise motivation, self-determination theory[31] and empirical studies[33,34,35,36] have indicated that motivation mediates the association between psychological needs satisfaction to relatedness with physical activity or exercise behavior. Exercising with others would one strategy to satisfy such needs, thereby contributing to motivation and maintenance of exercise behavior.

The path analyses showed that the values of standardized path coefficients from exercising with others to maintenance of exercise behavior were 0.00 to 0.01 and statistically insignificant. This result indicates that self-determined motivation is a major pathway in the link between exercising with others and its maintenance. Studies[49,50,51,52,53] on other social-level factors, such as social support and perceived norms, were not directly but indirectly mediated by individual-level factors. Regarding social support, these studies have reported that it was not

directly but indirectly associated with physical activity behavior mediated by self-efficacy,[49,51] self-regulation,[50] and intrinsic motivation.[49] Meta-analyses of health behaviors,[52,53] including physical activity and exercise behaviors, have concluded that perceived norms indirectly influence health behaviors mediated by behavioral intention, but not directly. The present and previous studies consistently indicate that individual-level factors are more proximal to behavior than social-level factors.

Regarding the generalizability of the findings, this study recruited participants from online survey monitors living in Japan, stratified by age group, gender, and industry type. Recruitment via online survey monitors and the low response rate of the one-year follow-up survey would significantly decrease the generalizability. Moreover, as shown in Table 1, respondent characteristics in the one-year follow-up survey significantly differed from those of non-respondents. Furthermore, as weekly leisure time is entirely different by working status and age group,[54] the behavioral mechanisms of exercise maintenance may also differ by working status and age group. The generalizability of this study's findings to nonworkers and older adults living in Japan remains unclear. Finally, generalizability across different cultures may be limited because of cultural differences in motivations[55] and barriers[56] to physical activity.

As practical implications, encouraging exercising with others may be effective in supporting exercise motivation and maintaining exercise behavior. Because special knowledge, skills, or environment is unnecessary when people attempt to exercise with others, encouraging it may be acceptable and feasible for many people. The current taxonomy[23] of behavior-change techniques and classifications[57,58,59] of motivation and behavior change techniques from self-determination theory have not identified performing behavior with others as a unique technique. Despite the absence of classifications, [57,58,59] encouraging exercising with others can serve as an additional technique for behavior change. Unstandardized total associations between exercise with others and exercise participation (yes or no) and with weekly exercise time (hours

per week) after one year were 0.07 (95% confidence interval (CI): 0.04–0.11) and 1.66 (95% CI: 1.28–2.06), respectively as shown in Table 3. While exercising with others would make a small contribution to the prevention of dropout from exercise participation (< 10%), it would correspond with approximately 1.6 more hours of weekly exercise time after one year compared with exercising alone. As the Japanese ministry recommends increasing daily physical activity by 10 minutes,[47] exercising with others shows promise as a strategy to increase weekly exercise time and achieve these recommendations.[47] However, we should note that the standardized total associations were less than 0.20. The sole impact of exercising with others may be small. Combining other techniques may be more desirable to support exercise motivation and maintenance of exercise behavior.

This study has limitations. First, this study had a selection bias. The one-year follow-up survey response rate was low (39.9 %). More motivated or health-conscious individuals might have been overrepresented in this study. Second, exercise motivation without confirming its validity and reliability. This methodology is not standard in physical activity and exercise behavior Unlike for intrinsic regulations and non-regulations (Supplementary Figure 4 and Supplementary Table 3), this study did not reveal clear and robust longitudinal associations between integrated regulations, and introjected or external regulations, and one-year maintenance of exercise behavior. These results are inconsistent with the assumption of self-determination theory.[31-32] By employing this unstandardized item, this study might have underestimated the mediating role of exercise motivation. Third, this study did not consider occupational physical activity, though systematic review indicated that occupational physical activity is negatively associated with leisure-time physical activity, which is equivalent to exercise.[5] Finally, this study included all exercise intensities. This was because the Japanese government[47] recommended exercises regardless of intensity at the time the study was conducted. However, the World Health Organization[1] recommends moderate-to-vigorous

intensities for health promotion. Accordingly, future studies should weaken the sampling bias, measure exercise motivation using a standardized scale[48] and occupational physical activity and exercise intensity.

Conclusions

The present study examined whether exercising with others was longitudinally and positively associated with the one-year maintenance of exercise behaviors and this association was mediated by exercise motivation among workers. Analyzing the longitudinal data of 2,819 Japanese workers, exercising with others was indirectly and positively associated with the one-year maintenance of exercise behavior, mediated by exercise motivation. Thus, encouraging people to exercise with others may be effective in supporting motivation and maintaining exercise behavior.

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Supplementary materials.

Supplementary Figure 1. Detailed results of standardized path coefficients from path analysis for predicting exercise participation after one year (main analyses).

Supplementary Figure 2. Detailed results of standardized path coefficients from path analysis for predicting weekly exercise time after one year (main analyses).

Supplementary Table 1. Detailed results of standardized total and indirect associations from path analyses for predicting one-year maintenance of exercise behavior (main analyses).

Supplementary Figure 3. Key results of standardized path coefficients from path analyses for predicting one-year maintenance of exercise behavior (sensitivity analyses 1).

Supplementary Table 2. Key results of standardized total and indirect associations in path analyses for predicting one-year maintenance of exercise behavior (sensitivity analyses 1).

Supplementary Figure 4. Key results of standardized path coefficients from path analyses for predicting one-year maintenance of exercise behavior (sensitivity analyses 2).

Supplementary Table 3. Key results of standardized total and indirect associations in path analyses for predicting one-year maintenance of exercise behavior (sensitivity analyses 2).

Table 1. Comparison of characteristics between respondents and non-respondents to one-year follow-up survey among those who participated in exercise at baseline.

	Response at one-year follow-up survey		
	Yes (n=2819)	No (n=4095)	p-value
Gender at baseline, %			<.001[a]
Men	67.1%	62.1%	
Women	32.9%	37.9%	
Age at baseline, M (SD)	45.1 (9.0)	38.8 (10.3)	<.001[b]
Marital status at baseline, %			<.001[a]
Unmarried	56.7%	49.6%	
Married	43.3%	50.4%	
Education from 4-year college at baseline, %			.042[a]
No	38.9%	41.3%	
Yes	61.1%	58.7%	
Annual household income at baseline, %			<.001[a]
<¥ 600 million	43.6%	54.4%	
≥¥ 600 million	56.4%	45.6%	
Overweight at baseline, %			.352[a]
No	82.4%	83.3%	
Yes	17.6%	16.7%	
Type of employment at baseline, %			.950[a]
Non-regular	18.7%	18.8%	
Regular	81.3%	81.2%	
Engagement in physical work at baseline, %			<.001[a]
No	41.4%	37.2%	
Yes	58.6%	62.8%	
Engagement in shift work at baseline, %			<.001[a]
No	89.7%	86.3%	
Yes	10.3%	13.7%	
Weekly work time (hours) at baseline, M (SD)	42.0 (9.9)	41.6 (10.7)	.098[b]
Weekly exercise time (hours) at baseline, M (SD)	4.2 (3.7)	4.3 (3.9)	.471[b]
Exercise with others at baseline, %			.207[a]
No	77.6%	76.3%	
Yes	22.4%	23.7%	
Exercise motivation (score, 1 to 6), M (SD)	4.7 (1.2)	4.6 (1.3)	.225[b]
Exercise participation after one year, %			—
No	21.9%	—	
Yes	78.1%	—	
Weekly exercise time (hours) after one year, M (SD)	3.5 (3.9)	—	—

Note. M, mean; SD, Standard deviation

[a] chi-squared test.

[b] t-test.

Table 2. Pearson's correlation coefficients for associations of demographic factors, weekly exercise time, exercising with others, and exercise motivation at baseline with exercise participation and weekly exercise time after one year.

	Exercise participation after one year (no=0, yes=1)		Weekly exercise time (hours) after one year	
	Pearson's r	p-value	Pearson's r	p-value
Gender at baseline (men=0, women=1)	.02	.318	.07	<.001
Age at baseline (years)	-.11	<.001	-.08	<.001
Current marital status at baseline (unmarried=0, married=1)	.00	.815	-.03	.120
Education from 4-year collage at baseline (no=0, yes=1)	.08	<.001	.06	.001
Annual household income at baseline (<¥ 600 million=0, ≥¥ 600 million=1)	.02	.240	.03	.122
Overweight at baseline (no=0, yes=1)	-.06	.003	.02	.271
Type of employment at baseline (non-regular=0, regular=1)	.09	<.001	.09	<.001
Engagement in physical work at baseline (no=0, yes=1)	-.03	.099	-.05	.004
Engagement in shift work at baseline (no=0, yes=1)	-.01	.632	-.01	.733
Weekly work time at baseline (hours)	.05	.018	.02	.202
Weekly exercise time at baseline (hours)	.15	<.001	.61	<.001
Exercise with others at baseline (no=0, yes=1)	.06	.001	.17	<.001
Exercise motivation at baseline (score, 1 to 6)	.17	<.001	.17	<.001

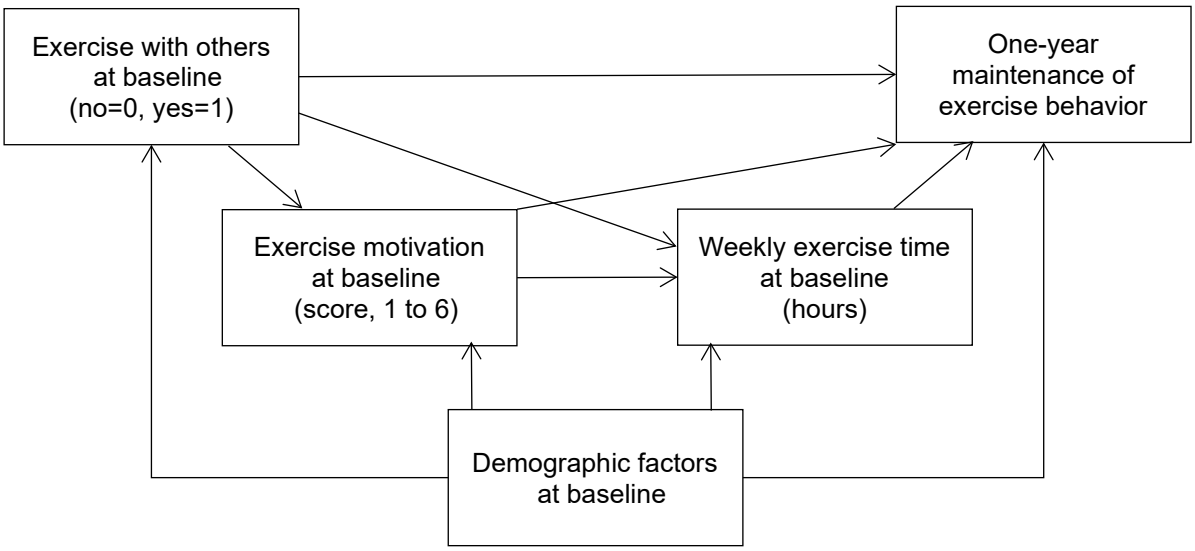
Table 3. Key results of standardized total and indirect associations in path analyses for predicting one-year maintenance of exercise behavior (main analyses).

	Estimated total association			Estimated indirect association		
	Unstandardized (95%CI)	Standardized (95%CI)	p-value	Unstandardized (95%CI)	Standardized (95%CI)	p-value
Model 1: predicting exercise participation after one year						
Weekly exercise time at baseline (hours)	0.01 (0.01, 0.02)	.13 (.09, .16)	<.001	—	—	
Exercise with others at baseline (no=0, yes=1)	0.07 (0.04, 0.11)	.07 (.04, .11)	<.001	0.06 (0.05, 0.07)	.06 (.05, .07)	<.001
Exercise motivation at baseline (score, 1 to 6)	0.05 (0.04, 0.06)	.14 (.10, .18)	.001	0.00 (0.00, 0.00)	.01 (.00, .01)	.004
Model 2: predicting weekly exercise time after one year						
Weekly exercise time at baseline (hours)	0.62 (0.53, 0.69)	.60 (.54, .65)	.001	—	—	
Exercise with others at baseline (no=0, yes=1)	1.66 (1.28, 2.06)	.18 (.14, .22)	<.001	1.62 (1.37, 1.90)	.18 (.15, .20)	<.001
Exercise motivation at baseline (score, 1 to 6)	0.41 (0.30, 0.52)	.13 (.09, .16)	.001	0.11 (0.04, 0.18)	.03 (.01, .05)	.006

Note. The one-year maintenance of exercise behavior was treated as exercise participation after one year in Model 1 and weekly exercise time after one year in Model 2. For clarity, this table does not display the standardized total and indirect associations of the demographic factors. Supplementary Table 1 displays the overall results including demographic factors. The standardized path coefficients in the path analyses are shown in Figure 2 for the main variables, and Supplementary Figure 1 and 2 for all variables. The model fit indices were TLI > .999, CFI > .999, and RMSEA = .001 for Model 1; and TLI = .996, CFI = .999, and RMSEA = .010 for Model 2.

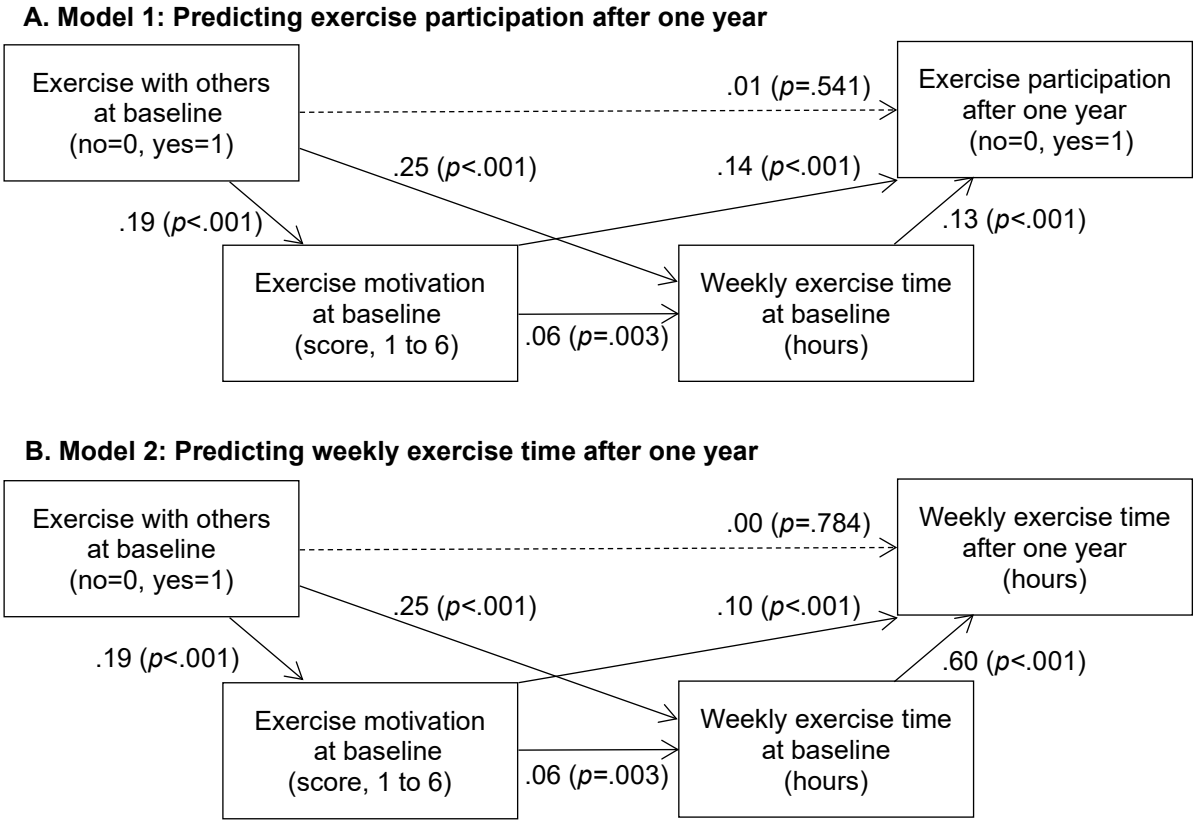
95%CI, 95% confidence interval.

Figure 1. Conceptual diagram of path analyses for predicting one-year maintenance of exercise behavior (main analyses).



Note. The one-year maintenance of exercise behavior was treated as exercise participation after one year in Model 1 and weekly exercise time after one year in Model 2. Demographic factors were age (years), gender (men = 0, women = 1), marital status (unmarried = 0, married = 1), education from 4 years college (no = 0, yes = 1), annual household income (under 6 million Japanese yen = 0, over 6 million Japanese yen = 1), overweight (no = 0, yes = 1), type of employment (non-regular = 0, regular = 1), engagement in physical work (no = 0, yes = 1), engagement in shift work (no = 0, yes = 1), and weekly work time (hours). Correlations within demographic factors were included in the model.

Figure 2. Key results of standardized path coefficients from path analyses for predicting one-year maintenance of exercise behavior (main analyses).



Note. The one-year maintenance of exercise behavior was treated as exercise participation after one year in Model 1 and weekly exercise time after one year in Model 2. Sold lines represent significant paths and dashed lines represent insignificant paths. While the actual models contain demographic factors, they are not displayed here for clarity. Supplementary Figure 1 and 2 display the overall results for Models 1 and 2, respectively, including the demographic factors. The standardized total and indirect associations in the path analyses are shown in Table 3 for the main variables and Supplementary Table 1 for all variables. The model fit indices were TLI > .999, CFI > .999, and RMSEA = .001 for Model 1; and TLI = .996, CFI = .999, and RMSEA = .010 for Model 2.