



# Effectiveness, Moderators and Mediators of Self-regulation Intervention on Older Adults' Exercise Behavior: a Randomized, Controlled Crossover Trial

Harada, Kazuhiro

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Table 1 | CONSORT checklist of information to include when reporting randomised crossover trials

| Section/topic   | Item No | Description   | Page No*       |
|---|---------|---|----------------|
| Title†  | 1a      | Identification as a randomised crossover trial in the title   | 1              |
| Abstract†   | 1b      | Specify a crossover design and report all information outlined in table 2   | 1              |
| Introduction:   |         |   |                |
| Background‡   | 2a      | Scientific background and explanation of rationale  | 2 to 6         |
| Objectives‡   | 2b      | Specific objectives or hypotheses   | 6              |
| Methods:  |         |   |                |
| Trial design†   | 3a      | Rationale for a crossover design. Description of the design features including allocation ratio, especially the number and duration of periods, duration of washout period, and consideration of carry over effect  | 6 to 7         |
| Change from protocol‡                                 | 3b      | Important changes to methods after trial commencement (such as eligibility criteria), with reasons  | 7              |
| Participants‡   | 4a      | Eligibility criteria for participants   | 8              |
| Settings and location‡                                | 4b      | Settings and locations where the data were collected  | 8              |
| Intervention†   | 5       | The interventions with sufficient details to allow replication, including how and when they were actually administered  | 9 to 11        |
| Outcomes†   | 6a      | Completely defined prespecified primary and secondary outcome measures, including how and when they were assessed   | 11             |
| Changes to outcomes‡                                  | 6b      | Any changes to trial outcomes after the trial commenced, with reasons   | 11             |
| Sample size†  | 7a      | How sample size was determined, accounting for within participant variability   | 7 to 8         |
| Interim analyses and stopping guidelines‡             | 7b      | When applicable, explanation of any interim analyses and stopping guidelines  | not applicable |
| Randomisation:  |         |   |                |
| Sequence generation‡                                  | 8a      | Method used to generate the random allocation sequence  | 7              |
| Sequence generation‡                                  | 8b      | Type of randomisation; details of any restriction (such as blocking and block size)   | 7              |
| Allocation concealment mechanism‡                     | 9       | Mechanism used to implement the random allocation sequence§ (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned  | 7              |
| Implementation†                                       | 10      | Who generated the random allocation sequence,§ who enrolled participants, and who assigned participants to the sequence of interventions  | 7              |
| Blinding‡   | 11a     | If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how  | 7              |
| Similarity of interventions‡                          | 11b     | If relevant, description of the similarity of interventions   | 24 to 25       |
| Statistical methods†                                  | 12a     | Statistical methods used to compare groups for primary and secondary outcomes which are appropriate for crossover design (that is, based on within participant comparison)  | 13 to 15       |
| Additional analyses‡                                  | 12b     | Methods for additional analyses, such as subgroup analyses and adjusted analyses  | 13 to 15       |
| Results   |         |   |                |
| Participant flow (a diagram is strongly recommended)† | 13a     | The numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome, separately for each sequence and period   | Figure1        |
| Losses and exclusions†                                | 13b     | No of participants excluded at each stage, with reasons, separately for each sequence and period  | Figure1        |
| Recruitment‡  | 14a     | Dates defining the periods of recruitment and follow-up   | 7, Figure1     |
| Trial end‡  | 14b     | Why the trial ended or was stopped  | 7              |
| Baseline data†  | 15      | A table showing baseline demographic and clinical characteristics by sequence and period  | Table1         |
| Numbers analysed†                                     | 16      | Number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups   | Figure1        |
| Outcomes and estimation†                              | 17a     | For each primary and secondary outcome, results including estimated effect size and its precision (such as 95% confidence interval) should be based on within participant comparisons.¶ In addition, results for each intervention in each period are recommended | Table2         |
| Binary outcomes‡                                      | 17b     | For binary outcomes, presentation of both absolute and relative effect sizes is recommended   | not applicable |
| Ancillary analyses‡                                   | 18      | Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing prespecified from exploratory  | 15 to 17       |
| Harms†  | 19      | Describe all important harms or unintended effects in a way that accounts for the design (for specific guidance, see CONSORT for harms <sup>32</sup> )  | 9              |
| Discussion:   |         |   |                |
| Limitations†  | 20      | Trial limitations, addressing sources of potential bias, imprecision, and if relevant, multiplicity of analyses. Consider potential carry over effects  | 25 to 26       |
| Generalisability‡                                     | 21      | Generalisability (external validity, applicability) of the trial findings   | 24             |
| Interpretation‡                                       | 22      | Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence   | 21 to 24       |
| Other information:                                    |         |   |                |
| Registration‡   | 23      | Registration number and name of trial registry  | 7, coverage    |
| Protocol‡   | 24      | Where the full trial protocol can be accessed, if available   | not applicable |
| Funding‡  | 25      | Sources of funding and other support (such as supply of drugs), role of funders   | coverage       |

CONSORT=Consolidated Standards of Reporting Trials.

\*Note: page numbers are optional depending on journal requirements.

†Modified original CONSORT item.

‡Unmodified CONSORT item.

§Random sequence here refers to a list of random orders, typically generated through a computer program. This should not be confused with the sequence of interventions in a randomised crossover trial, for example receiving intervention A before B for an individual trial participant.

¶A within participant comparison takes into account the correlation between measurements for each participant because they act as their own control, therefore measurements are not independent.

Electronic Supplementary Material 2.

*Components of Print-Based Intervention Materials*

| Week | Component 1:<br>Information about exercise and health promotion             | Component 2:<br>Information about tips for effective behavior change techniques | Component 3:<br>Fill-out forms for practice of self-regulatory strategies of exercise   |
|------|---|---|---|
| 1    | Recommended amounts and types of exercise for health promotion (four pages) | Tips for effective self-monitoring (two pages)                                  | Fill-out form for self-monitoring every day (one page)  |
| 2    | Key points of walking for health promotion (three pages)                    | Tips for effective goal settings and action planning (two pages)                | Fill-out form for goal setting and action planning<br>Fill-out form for self-monitoring<br>Fill-out form for review behavior goal achievement (two pages) |
| 3    | Key points of strength training for health promotion (three pages)          | Tips for creating and keeping desirable motivation (two pages)                  | Fill-out form for goal setting and action planning<br>Fill-out form for self-monitoring<br>Fill-out form for review behavior goal achievement (two pages) |
| 4    | Exercise and brain health (three pages)                                     | Tips for receiving social support effectively (two pages)                       | Fill-out form for goal setting and action planning<br>Fill-out form for self-monitoring<br>Fill-out form for review behavior goal achievement (two pages) |
| 5    | Exercise and mental health (two pages)                                      | Tips for preventing relapse and coping barriers (three pages)                   | Fill-out form for goal setting and action planning<br>Fill-out form for self-monitoring<br>Fill-out form for review behavior goal achievement (two pages) |
| 6    | Exercise, sedentary behavior, and health promotion (two pages)              | Tips for building self-confidence to maintain exercise behavior (three pages)   | Fill-out form for goal setting and action planning<br>Fill-out form for self-monitoring<br>Fill-out form for review behavior goal achievement (two pages) |
| 7    | Reviews of Week 1 to Week 6 (two pages)                                     | Reviews of Week 1 to Week 6 (three pages)                                       | Recommendations for further practices of self-regulatory strategies (two pages)   |

*Note.* Apart from the three components, the print material at each week had one front cover page. In the final week, in addition to the intervention material, the leaflets for health promotion policies and practices in the local community were also delivered to the participants.

Electronic Supplementary Material 3.

*Descriptive Statistics and Factor Structure for Items on Habit Strength of Exercise*

|   | M (SD)    | Coefficient in CFA |         |
|---|-----------|--------------------|---------|
|   |           | Model 1            | Model 2 |
| Item 1: I do automatically. (score, 1–7)                          | 4.7 (1.7) | 0.67               | 0.61    |
| Item 2: I do without having to consciously remember. (score, 1–7) | 4.1 (1.8) | 0.91               | 0.87    |
| Item 3: I do without thinking. (score, 1–7)                       | 3.8 (1.8) | 0.95               | 0.98    |
| Item 4: I start doing before I realize I'm doing it. (score, 1–7) | 3.4 (1.8) | 0.80               | 0.80    |

M, mean; SD, standard deviation, CFA, confirmatory factor analysis

A one-factor structure was examined using confirmatory factor analysis. Model 1 did not contain any correlated errors. Model 2 contained the correlated error between item 1 and item 2 (standardized coefficient of correlated error, 0.43 [p<0.001]).

Model fit indices of model 1 were  $\chi^2(2) = 60.7$  (p<0.001), CFI = 0.949, TLI = 0.847, and RMSEA = 0.275.

The model fit indices of model 2 were  $\chi^2(1) = 1.0$  (p = 0.307), CFI > 0.990, TFI > 0.999, and RMSEA = 0.011.

Electronic Supplementary Material 4.

*Descriptive Statistics for Perceived Adherence and Acceptance of intervention*

|  | n   | Total,<br>M (SD) | Delayed<br>intervention<br>group, M (SD) | Immediate<br>intervention<br>group, M (SD) | p-<br>value <sup>a</sup> |
|--|-----|------------------|--|--|--------------------------|
| Overall, how many pages on the materials did you actually read?                                  | 370 | 8.7 (2.0)        | 8.8 (1.9)                                | 8.6 (2.1)                                  | 0.282                    |
| Overall, how many fill-out forms on the materials did you actually fill out?                     | 366 | 7.2 (2.9)        | 7.1 (3.0)                                | 7.3 (2.9)                                  | 0.646                    |
| Overall, were the print materials easy to understand?  | 366 | 8.8 (1.5)        | 8.9 (1.4)                                | 8.7 (1.7)                                  | 0.151                    |
| Overall, was the participation in the intervention meaningful to promote your exercise behavior? | 366 | 8.2 (2.0)        | 8.3 (1.9)                                | 8.1 (2.0)                                  | 0.520                    |
| Overall, were you satisfied with the participation in the intervention?                          | 365 | 8.3 (1.8)        | 8.4 (1.7)                                | 8.2 (1.9)                                  | 0.358                    |

*Note.* <sup>a</sup>t-test

The participants responded to each item from “0” (not at all) to “10” (all).

## Electronic Supplementary Material 5.

*Fixed Effects in Mixed Models for Intervention Effects on Exercise Behavior*

|  | Model 1                 |             |                  | Model 2                    |              |                  |
|--|-------------------------|-------------|------------------|----------------------------|--------------|------------------|
|  | B (95%CI)               | $\beta$     | p-value          | B (95%CI)                  | $\beta$      | p-value          |
| Intervention group                           |                         |             |                  |                            |              |                  |
| Delayed                                      | (reference)             |             |                  | (reference)                |              |                  |
| Immediate                                    | -5.8 (-14, 2.4)         | -0.14       | 0.165            | -5.1 (-13.3, 3.1)          | -0.13        | 0.222            |
| Survey point                                 |                         |             |                  |                            |              |                  |
| T1   | (reference)             |             |                  | (reference)                |              |                  |
| T2   | 2.4 (-2.1, 6.8)         | 0.06        | 0.298            | 2.0 (-2.7, 6.7)            | 0.05         | 0.399            |
| T3   | <b>10.1 (5.5, 14.6)</b> | <b>0.25</b> | <b>&lt;0.001</b> | <b>9.5 (4.8, 14.3)</b>     | <b>0.24</b>  | <b>&lt;0.001</b> |
| Intervention group $\times$ survey point     |                         |             |                  |                            |              |                  |
| Immediate $\times$ T2                        | <b>9.4 (3.0, 15.9)</b>  | <b>0.24</b> | <b>0.004</b>     | <b>9.8 (3.1, 16.4)</b>     | <b>0.24</b>  | <b>0.004</b>     |
| Immediate $\times$ T3                        | 0.8 (-5.6, 7.3)         | 0.02        | 0.799            | 0.9 (-5.8, 7.6)            | 0.02         | 0.790            |
| Sex at T1                                    |                         |             |                  |                            |              |                  |
| Men  | —                       |             |                  | (reference)                |              |                  |
| Women  | —                       |             |                  | <b>-11.2 (-20.2, -2.1)</b> | <b>-0.14</b> | <b>0.016</b>     |
| Age (years) at T1                            |                         |             |                  | <b>0.8 (0.2, 1.3)</b>      | <b>0.12</b>  | <b>0.013</b>     |
| Educational background at T1                 |                         |             |                  |                            |              |                  |
| < 4-year college                             | —                       |             |                  | (reference)                |              |                  |
| $\geq$ 4-year college                        | —                       |             |                  | -0.9 (-9.4, 7.6)           | -0.01        | 0.841            |
| Marital status at T1                         |                         |             |                  |                            |              |                  |
| Single                                       | —                       |             |                  | (reference)                |              |                  |
| Married                                      | —                       |             |                  | 6.0 (-6.7, 18.7)           | 0.06         | 0.356            |
| Living arrangement at T1                     |                         |             |                  |                            |              |                  |
| Alone  | —                       |             |                  | (reference)                |              |                  |
| With others                                  | —                       |             |                  | 4.1 (-10.0, 18.3)          | 0.04         | 0.569            |
| Perceived economic status at T1 (score, 1–5) | —                       |             |                  | -1.2 (-6.6, 4.2)           | -0.02        | 0.663            |
| Frailty at T1 (score, 0–25)                  | —                       |             |                  | <b>-1.8 (-3.0, -0.5)</b>   | <b>-0.13</b> | <b>0.005</b>     |
| Enrollment with spouse                       |                         |             |                  |                            |              |                  |
| No   | —                       |             |                  | (reference)                |              |                  |
| Yes  | —                       |             |                  | 2.7 (-5.7, 11.1)           | 0.03         | 0.535            |

*Note.* B: unstandardized regression coefficient; 95%CI: 95% confidence interval;  $\beta$ : standardized regression coefficient; T1: baseline survey; T2: second survey; T3: third survey. Intercepts for individual differences (variance) were treated as random effects: B = 1196.6 (95% confidence interval; 1012.5, 1414.1) in Model 1, B for variance = 1090.4 (95% confidence interval; 915.4, 1298.9) in Model 2.

Electronic Supplementary Material 6.

*Fixed Effects in Mixed Models for Intervention Effects on Self-Regulation of Exercise*

|  | Model 1               |             |                  | Model 2                  |              |                  |
|--|-----------------------|-------------|------------------|--------------------------|--------------|------------------|
|  | B (95%CI)             | $\beta$     | p-value          | B (95%CI)                | $\beta$      | p-value          |
| Intervention group                           |                       |             |                  |                          |              |                  |
| Delayed                                      | (reference)           |             |                  | (reference)              |              |                  |
| Immediate                                    | -0.8 (-1.7, 0.1)      | -0.16       | 0.089            | -0.6 (-1.5, 0.3)         | -0.13        | 0.200            |
| Survey point                                 |                       |             |                  |                          |              |                  |
| T1   | (reference)           |             |                  | (reference)              |              |                  |
| T2   | -0.3 (-0.9, 0.3)      | -0.07       | 0.313            | -0.4 (-1.0, 0.3)         | -0.07        | 0.269            |
| T3   | <b>3.0 (2.4, 3.7)</b> | <b>0.64</b> | <b>&lt;0.001</b> | <b>3.0 (2.3, 3.6)</b>    | <b>0.62</b>  | <b>&lt;0.001</b> |
| Intervention group $\times$ survey point     |                       |             |                  |                          |              |                  |
| Immediate $\times$ T2                        | <b>4.0 (3.2, 4.9)</b> | <b>0.85</b> | <b>&lt;0.001</b> | <b>4.1 (3.2, 5.0)</b>    | <b>0.86</b>  | <b>&lt;0.001</b> |
| Immediate $\times$ T3                        | -0.9 (-1.7, 0.0)      | -0.18       | 0.054            | -0.8 (-1.6, 0.1)         | -0.16        | 0.095            |
| Sex at T1                                    |                       |             |                  |                          |              |                  |
| Men  | —                     |             |                  | (reference)              |              |                  |
| Women  | —                     |             |                  | -0.1 (-1.1, 0.8)         | -0.01        | 0.768            |
| Age (years) at T1                            |                       |             |                  | 0.0 (-0.1, 0.1)          | -0.01        | 0.754            |
| Educational background at T1                 |                       |             |                  |                          |              |                  |
| < 4-year college                             | —                     |             |                  | (reference)              |              |                  |
| $\geq$ 4-year college                        | —                     |             |                  | 0.0 (-0.9, 0.8)          | -0.01        | 0.916            |
| Marital status at T1                         |                       |             |                  |                          |              |                  |
| Single                                       | —                     |             |                  | (reference)              |              |                  |
| Married                                      | —                     |             |                  | 0.8 (-0.6, 2.1)          | 0.07         | 0.267            |
| Living arrangement at T1                     |                       |             |                  |                          |              |                  |
| Alone  | —                     |             |                  | (reference)              |              |                  |
| With others                                  | —                     |             |                  | -0.8 (-2.3, 0.6)         | -0.07        | 0.263            |
| Perceived economic status at T1 (score, 1–5) | —                     |             |                  | -0.1 (-0.7, 0.5)         | -0.02        | 0.689            |
| Frailty at T1 (score, 0–25)                  | —                     |             |                  | <b>-0.2 (-0.3, -0.1)</b> | <b>-0.13</b> | <b>0.003</b>     |
| Enrollment with spouse                       |                       |             |                  |                          |              |                  |
| No   | —                     |             |                  | (reference)              |              |                  |
| Yes  | —                     |             |                  | -0.1 (-0.1, 0.8)         | -0.01        | 0.774            |

*Note.* B: unstandardized regression coefficient; 95%CI: 95% confidence interval;  $\beta$ : standardized regression coefficient; T1: baseline survey; T2: second survey; T3: third survey. Intercepts for individual differences (variance) were treated as random effects: B = 11.2 (95% confidence interval; 9.3, 13.4) in Model 1, B for variance = 10.9 (95% confidence interval; 9.0, 13.2) in Model 2.

## Electronic Supplementary Material 7.

*Fixed Effects in Mixed Models for Intervention Effects on Habit Strength of Exercise*

|  | Model 1               |             |                  | Model 2                  |              |                  |
|--|-----------------------|-------------|------------------|--------------------------|--------------|------------------|
|  | B (95%CI)             | $\beta$     | p-value          | B (95%CI)                | $\beta$      | p-value          |
| Intervention group                           |                       |             |                  |                          |              |                  |
| Delayed                                      | (reference)           |             |                  | (reference)              |              |                  |
| Immediate                                    | -1.1 (-2.3, 0.1)      | -0.17       | 0.086            | -0.7 (-1.8, 0.5)         | -0.11        | 0.271            |
| Survey point                                 |                       |             |                  |                          |              |                  |
| T1   | (reference)           |             |                  | (reference)              |              |                  |
| T2   | -0.4 (-1.1, 0.3)      | -0.07       | 0.243            | -0.4 (-1.2, 0.3)         | -0.07        | 0.271            |
| T3   | <b>1.4 (0.7, 2.1)</b> | <b>0.23</b> | <b>&lt;0.001</b> | <b>1.5 (0.7, 2.2)</b>    | <b>0.24</b>  | <b>&lt;0.001</b> |
| Intervention group $\times$ survey point     |                       |             |                  |                          |              |                  |
| Immediate $\times$ T2                        | <b>1.9 (0.9, 3.0)</b> | <b>0.32</b> | <b>&lt;0.001</b> | <b>2.0 (0.9, 3.0)</b>    | <b>0.32</b>  | <b>&lt;0.001</b> |
| Immediate $\times$ T3                        | 0.4 (-0.7, 1.4)       | 0.06        | 0.483            | 0.3 (-0.7, 1.4)          | 0.05         | 0.559            |
| Sex at T1                                    |                       |             |                  |                          |              |                  |
| Men  | —                     |             |                  | (reference)              |              |                  |
| Women  | —                     |             |                  | 0.2 (-1.1, 1.5)          | 0.02         | 0.741            |
| Age (years) at T1                            |                       |             |                  | <b>0.2 (0.1, 0.2)</b>    | <b>0.17</b>  | <b>&lt;0.001</b> |
| Educational background at T1                 |                       |             |                  |                          |              |                  |
| < 4-year college                             | —                     |             |                  | (reference)              |              |                  |
| $\geq$ 4-year college                        | —                     |             |                  | -0.1 (-1.3, 1.1)         | -0.01        | 0.831            |
| Marital status at T1                         |                       |             |                  |                          |              |                  |
| Single                                       | —                     |             |                  | (reference)              |              |                  |
| Married                                      | —                     |             |                  | 0.5 (-1.3, 2.3)          | 0.04         | 0.585            |
| Living arrangement at T1                     |                       |             |                  |                          |              |                  |
| Alone  | —                     |             |                  | (reference)              |              |                  |
| With others                                  | —                     |             |                  | 0.8 (-1.1, 2.8)          | 0.05         | 0.416            |
| Perceived economic status at T1 (score, 1–5) | —                     |             |                  | <b>-1.0 (-1.8, -0.3)</b> | <b>-0.12</b> | <b>0.008</b>     |
| Frailty at T1 (score, 0–25)                  | —                     |             |                  | <b>-0.5 (-0.7, -0.3)</b> | <b>-0.26</b> | <b>&lt;0.001</b> |
| Enrollment with spouse                       |                       |             |                  |                          |              |                  |
| No   | —                     |             |                  | (reference)              |              |                  |
| Yes  | —                     |             |                  | 0.4 (-0.8, 1.5)          | 0.03         | 0.558            |

*Note.* B: unstandardized regression coefficient; 95%CI: 95% confidence interval;  $\beta$ : standardized regression coefficient; T1: baseline survey; T2: second survey; T3: third survey. Intercepts for individual differences (variance) were treated as random effects: B = 23.8 (95% confidence interval; 20.1, 28.2) in Model 1, B for variance = 20.3 (95% confidence interval; 17.0, 24.2) in Model 2.



Electronic Supplementary Material 8.

*Pearson's correlations of socio-demographic factors with exercise behavior, self-regulation, and habit strength*

|   | Changes from T1 to T2            |  |                                       | Changes from T2 to T3            |  |                                       |
|---|----------------------------------|--|---------------------------------------|----------------------------------|--|---------------------------------------|
|   | Changes in average exercise time | Changes in self-regulation of exercise | Changes in habit strength of exercise | Changes in average exercise time | Changes in self-regulation of exercise | Changes in habit strength of exercise |
| Age at T1 (years)   | 0.10<br>(p = 0.054)              | -0.03<br>(p = 0.592)                   | 0.02<br>(p = 0.680)                   | 0.02<br>(p = 0.730)              | -0.05<br>(p = 0.322)                   | <b>0.11</b><br><b>(p = 0.036)</b>     |
| Sex at T1 (men=0, women=1)  | -0.06<br>(p = 0.272)             | -0.02<br>(p = 0.723)                   | -0.03<br>(p = 0.572)                  | -0.03<br>(p = 0.541)             | 0.03<br>(p = 0.516)                    | 0.01<br>(p = 0.921)                   |
| Educational background at T<br>(<4-year college = 0, ≥4-year college=1) | -0.07<br>(p = 0.210)             | 0.01<br>(p = 0.785)                    | 0.01<br>(p = 0.845)                   | 0.05<br>(p = 0.328)              | -0.01<br>(p = 0.892)                   | -0.05<br>(p = 0.392)                  |
| Marital status at T1<br>(single = 0, married = 1)                       | 0.01<br>(p = 0.882)              | 0.00<br>(p = 0.992)                    | 0.06<br>(p = 0.284)                   | 0.06<br>(p = 0.298)              | -0.02<br>(p = 0.658)                   | 0.01<br>(p = 0.911)                   |
| Living arrangement at T1<br>(alone = 0, with others = 1)                | 0.02<br>(p = 0.732)              | 0.02<br>(p = 0.745)                    | 0.08<br>(p = 0.127)                   | 0.08<br>(p = 0.151)              | -0.07<br>(p = 0.206)                   | 0.07<br>(p = 0.186)                   |
| Perceived economic status at T1<br>(score, 1–5)                         | -0.02<br>(p = 0.759)             | 0.00<br>(p = 0.971)                    | 0.03<br>(p = 0.539)                   | -0.07<br>(p = 0.222)             | 0.04<br>(p = 0.506)                    | -0.02<br>(p = 0.722)                  |
| Frailty at T1 (score, 0–25)   | -0.10<br>(p = 0.081)             | -0.03<br>(p = 0.537)                   | <b>-0.12</b><br><b>(p = 0.027)</b>    | -0.05<br>(p = 0.417)             | <b>-0.27</b><br><b>(p = &lt;0.001)</b> | <b>-0.15</b><br><b>(p = 0.006)</b>    |
| Enrollment with spouse (no = 0, yes = 1)                                | -0.10<br>(p = 0.063)             | -0.04<br>(p = 0.414)                   | 0.01<br>(p = 0.846)                   | 0.10<br>(p = 0.061)              | 0.06<br>(p = 0.283)                    | 0.04<br>(p = 0.407)                   |

*Note.* T1: baseline survey; T2: second survey; T3: third survey.

Values represent Pearson's correlation coefficients.

Each change score represents residualized change score.

Electronic Supplementary Material 9.

*Total, Direct, and Indirect Effects of Path Analyses for Sequential Mediation Process of Intervention Effects on Exercise Behavior*

|   | Total effects                       |                                       |              | Direct effects                  |                                    |              | Indirect effects                   |                                       |              |
|---|-------------------------------------|---------------------------------------|--------------|---------------------------------|------------------------------------|--------------|------------------------------------|---------------------------------------|--------------|
|   | Unstandardized<br>(95%CI)           | Standardized<br>(95%CI)               | p-value      | Unstandardized<br>(95%CI)       | Standardized<br>(95%CI)            | p-value      | Unstandardized<br>(95%CI)          | Standardized<br>(95%CI)               | p-value      |
| Path model for changes in average exercise time from T1 to T2         |                                     |                                       |              |                                 |                                    |              |                                    |                                       |              |
| Intervention group<br>(delayed = 0, immediate = 1)                    | <b>6.8</b><br><b>(0.6, 12.7)</b>    | <b>0.12</b><br><b>(0.01, 0.22)</b>    | <b>0.033</b> | 1.4<br>(-5.4, 8.4)              | 0.03<br>(-0.10, 0.15)              | 0.686        | <b>5.4</b><br><b>(1.9, 9.3)</b>    | <b>0.10</b><br><b>(0.03, 0.17)</b>    | <b>0.002</b> |
| Changes in self-regulation of exercise<br>from T1 to T2 (score, 5–25) | <b>1.4</b><br><b>(0.5, 2.2)</b>     | <b>0.20</b><br><b>(0.07, 0.33)</b>    | <b>0.004</b> | <b>1.0</b><br><b>(0.0, 1.9)</b> | <b>0.14</b><br><b>(0.01, 0.28)</b> | <b>0.040</b> | <b>0.4</b><br><b>(0.2, 0.7)</b>    | <b>0.06</b><br><b>(0.02, 0.11)</b>    | <b>0.001</b> |
| Changes in habit strength of exercise<br>from T1 to T2 (score, 4–28)  | <b>1.0</b><br><b>(0.4, 1.7)</b>     | <b>0.18</b><br><b>(0.07, 0.28)</b>    | <b>0.001</b> | <b>1.0</b><br><b>(0.4, 1.7)</b> | <b>0.18</b><br><b>(0.07, 0.28)</b> | <b>0.001</b> | —                                  | —                                     |              |
| Frailty at T1 (score, 0–25)   | <b>-0.2</b><br><b>(-0.5, -0.0)</b>  | <b>-0.02</b><br><b>(-0.06, -0.01)</b> | <b>0.006</b> | —                               | —                                  |              | <b>-0.2</b><br><b>(-0.5, -0.0)</b> | <b>-0.02</b><br><b>(-0.06, -0.01)</b> | <b>0.006</b> |
| Path model for changes in average exercise time from T2 to T3         |                                     |                                       |              |                                 |                                    |              |                                    |                                       |              |
| Intervention group<br>(delayed = 0, immediate = 1)                    | <b>-6.9</b><br><b>(-12.7, -1.3)</b> | <b>-0.13</b><br><b>(-0.24, -0.03)</b> | <b>0.017</b> | -3.2<br>(-10.4, 3.3)            | -0.06<br>(-0.19, 0.06)             | 0.309        | <b>-3.6</b><br><b>(-6.7, -1.0)</b> | -0.07<br>(-0.13, -0.02)               | <b>0.005</b> |
| Changes in self-regulation of exercise<br>from T2 to T3 (score, 5–25) | <b>1.3</b><br><b>(0.4, 2.2)</b>     | <b>0.19</b><br><b>(0.05, 0.32)</b>    | <b>0.005</b> | <b>1.3</b><br><b>(0.4, 2.2)</b> | <b>0.19</b><br><b>(0.05, 0.31)</b> | <b>0.005</b> | 0.0<br>(-0.2, 0.2)                 | 0.00<br>(-0.02, 0.03)                 | 0.742        |
| Changes in habit strength of exercise<br>from T2 to T3 (score, 4–28)  | 0.1<br>(-0.5, 0.7)                  | 0.01<br>(-0.09, 0.11)                 | 0.791        | 0.1<br>(-0.5, 0.7)              | 0.01<br>(-0.09, 0.11)              | 0.791        | —                                  | —                                     |              |
| Age at T1 (years)   | 0.0<br>(-0.0, 0.1)                  | 0.00<br>(-0.01, 0.02)                 | 0.625        | —                               | —                                  |              | 0.0<br>(-0.0, 0.1)                 | 0.00<br>(-0.01, 0.02)                 | 0.625        |
| Frailty at T1 (score, 0–25)   | <b>-0.4</b><br><b>(-0.8, -0.1)</b>  | <b>-0.04</b><br><b>(-0.09, -0.01)</b> | <b>0.003</b> | —                               | —                                  |              | <b>-0.4</b><br><b>(-0.8, -0.1)</b> | <b>-0.04</b><br><b>(-0.09, -0.01)</b> | <b>0.003</b> |

*Note.* 95%CI: 95% confidence interval; T1: baseline survey; T2: second survey; T3: third survey

The values represent the total, direct, and indirect effects of each factor on the changes in the average exercise time.

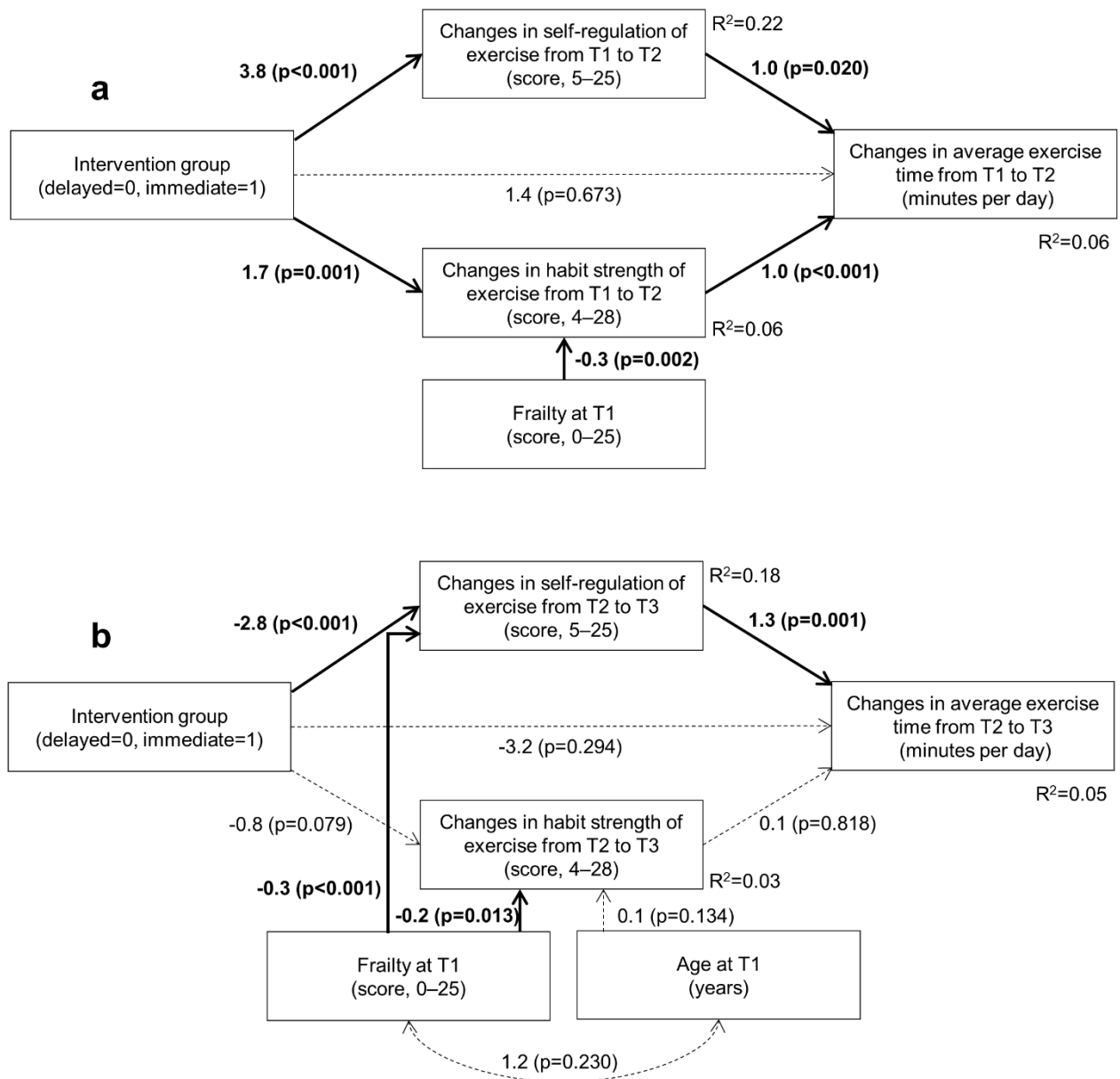
The path models are shown in Figure 3.

The bias-corrected method (5,000 bootstrap samples) was used to estimate the 95% confidence intervals and p-values.

Each change score represents residualized change score.

Electronic Supplementary Material 10.

Path models for parallel mediation process of intervention effects on exercise behavior.



Note. T1: baseline survey; T2: second survey; T3: third survey. Figure (a) represents the effects from the baseline to the second survey (a), and Figure (b) represents the effects from the second to third surveys. The bold and dashed lines represent statistically significant and non-significant paths, respectively. Each change score represents a residualized change score. The model-fit indices were  $\chi^2(4) = 36.1 (p<.001)$ , CFI = 0.787, TLI = 0.467, and RMSEA = 0.156 in the model for changes from the baseline to the second survey (a), and  $\chi^2(6) = 21.0 (p=.002)$ , CFI = 0.855, TLI = 0.638, and RMSEA = 0.088 in the model for changes from the second to third survey (b), respectively.

Electronic Supplementary Material 11.

*Total, Direct, and Indirect Effects of Path Analyses for Parallel Mediation Process of Intervention Effects on Exercise Behavior*

|   | Total effects                       |                                       |              | Direct effects                  |                                    |              | Indirect effects                   |                                       |              |
|---|-------------------------------------|---------------------------------------|--------------|---------------------------------|------------------------------------|--------------|------------------------------------|---------------------------------------|--------------|
|   | Unstandardized<br>(95%CI)           | Standardized<br>(95%CI)               | p-value      | Unstandardized<br>(95%CI)       | Standardized<br>(95%CI)            | p-value      | Unstandardized<br>(95%CI)          | Standardized<br>(95%CI)               | p-value      |
| Path model for changes in average exercise time from T1 to T2         |                                     |                                       |              |                                 |                                    |              |                                    |                                       |              |
| Intervention group<br>(delayed = 0, immediate = 1)                    | <b>6.8</b><br><b>(0.6, 12.7)</b>    | <b>0.12</b><br><b>(0.01, 0.23)</b>    | <b>0.032</b> | 1.4<br>(-5.4, 8.4)              | 0.03<br>(-0.10, 0.15)              | 0.686        | <b>5.4</b><br><b>(2.0, 9.3)</b>    | <b>0.10</b><br><b>(0.03, 0.17)</b>    | <b>0.002</b> |
| Changes in self-regulation of exercise<br>from T1 to T2 (score, 5–25) | <b>1.0</b><br><b>(0.0, 1.9)</b>     | <b>0.14</b><br><b>(0.01, 0.28)</b>    | <b>0.040</b> | 1.0<br>(0.0, 1.9)               | <b>0.14</b><br><b>(0.01, 0.28)</b> | <b>0.040</b> | —                                  | —                                     |              |
| Changes in habit strength of exercise<br>from T1 to T2 (score, 4–28)  | <b>1.0</b><br><b>(0.4, 1.7)</b>     | <b>0.18</b><br><b>(0.07, 0.28)</b>    | <b>0.001</b> | 1.0<br>(0.4, 1.7)               | <b>0.18</b><br><b>(0.07, 0.28)</b> | <b>0.001</b> | —                                  | —                                     |              |
| Frailty at T1 (score, 0–25)   | <b>-0.3</b><br><b>(-0.6, -0.1)</b>  | <b>-0.03</b><br><b>(-0.07, -0.01)</b> | <b>0.002</b> | —                               | —                                  |              | <b>-0.3</b><br><b>(-0.6, -0.1)</b> | <b>-0.03</b><br><b>(-0.07, -0.01)</b> | <b>0.002</b> |
| Path model for changes in average exercise time from T2 to T3         |                                     |                                       |              |                                 |                                    |              |                                    |                                       |              |
| Intervention group<br>(delayed = 0, immediate = 1)                    | <b>-6.9</b><br><b>(-12.7, -1.3)</b> | <b>-0.13</b><br><b>(-0.24, -0.03)</b> | <b>0.017</b> | -3.2<br>(-10.4, 3.3)            | -0.06<br>(-0.19, 0.06)             | 0.309        | <b>-3.6</b><br><b>(-6.6, -1.0)</b> | <b>-0.07</b><br><b>(-0.13, -0.02)</b> | <b>0.005</b> |
| Changes in self-regulation of exercise<br>from T2 to T3 (score, 5–25) | <b>1.3</b><br><b>(0.4, 2.2)</b>     | <b>0.19</b><br><b>(0.05, 0.31)</b>    | <b>0.005</b> | <b>1.3</b><br><b>(0.4, 2.2)</b> | <b>0.19</b><br><b>(0.05, 0.31)</b> | <b>0.005</b> | —                                  | —                                     |              |
| Changes in habit strength of exercise<br>from T2 to T3 (score, 4–28)  | 0.1<br>(-0.5, 0.7)                  | 0.01<br>(-0.09, 0.11)                 | 0.791        | 0.1<br>(-0.5, 0.7)              | 0.01<br>(-0.09, 0.11)              | 0.791        | —                                  | —                                     |              |
| Age at T1 (years)   | 0.0<br>(-0.0, 0.1)                  | 0.00<br>(-0.01, 0.02)                 | 0.587        | —                               | —                                  |              | 0.0<br>(-0.0, 0.1)                 | 0.00<br>(-0.01, 0.02)                 | 0.587        |
| Frailty at T1 (score, 0–25)   | <b>-0.4</b><br><b>(-0.8, -0.1)</b>  | <b>-0.04</b><br><b>(-0.09, -0.01)</b> | <b>0.003</b> | —                               | —                                  |              | <b>-0.4</b><br><b>(-0.8, -0.1)</b> | <b>-0.04</b><br><b>(-0.09, -0.01)</b> | <b>0.003</b> |

*Note.* 95%CI: 95% confidence interval; T1: baseline survey; T2: second survey; T3: third survey

The values represent the total, direct, and indirect effects of each factor on the changes in the average exercise time.

The path models are shown in Figure 3.

The bias-corrected method (5,000 bootstrap samples) was used to estimate the 95% confidence intervals and p-values.

Each change score represents a residualized change score.