Between- and Within-Couple Concordance for Health Behaviors Among Japanese Older Married Couples: Examining the Moderating Role of Working Time

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Between- and within-couple concordance for health behaviors among Japanese older married couples: examining the moderating role of working time

Abstract

Background: Although previous studies report spousal concordance for health behaviors at between-couple levels, concordance at within-couple levels remains unconfirmed. To clarify the behavioral mechanisms of spousal concordance for health behaviors among older couples at both levels, it is necessary to examine the moderators (effect modifiers) of spousal concordance. This study examined 1) whether spousal concordance for dietary variety, exercise behavior, and TV viewing behavior was observed at both the between-couple and the within-couple levels and 2) whether this spousal concordance was moderated by working time among older Japanese couples. ***Methods:*** This study analyzed data obtained from a questionnaire-based, three-wave longitudinal survey (baseline, one-year follow-up, three-year follow up) among 210 Japanese older couples. Each spouse's dietary variety, exercise time, TV viewing time, the couple's working time and demographic factors were investigated by multi-level analyses. ***Results***: One spouse's dietary variety and TV viewing time, but not exercise time, were significantly associated the other spouse's corresponding behaviors at both levels. The regressions of the wife's TV viewing time on the husband's TV viewing time were moderated by working time at the within-couple level; the regressive effect of wife's TV viewing time on husband's TV viewing time were more relevant as working time was lower. ***Conclusions***: This study found that spousal concordance for dietary variety and TV viewing was observed at within-couple and between-couple levels among older Japanese couples. In addition, shorter working time partly moderates the wife's influence on the husband's TV viewing among older couples at the within-couple level.

Keywords: Aged; Health Behavior; Marital Status; Social Interaction; Work

Introduction

Health behaviors would interact with each other within socially close groups, such as among married couples. Identifying the mechanisms of spousal concordance in health behaviors can illustrate how health behaviors can spread within groups. The present study investigated whether working time is involved in the mechanisms of spousal health behavior concordance among older Japanese couples. Regarding health behaviors, this study focused on dietary variety, exercise, and TV viewing. The importance of such behaviors for health promotion among older adults is well established. A lack of dietary variety, an essential aspect of diet quality, is associated with various health problems among older adults [1-3]. Exercise is a major component of physical activity performed in leisure time [4, 5]. Because older adults are likely to lose the opportunity to perform the physical activity in working and commuting due to retirement [6], physical activity during leisure time is especially important for them. Engaging in leisure-time physical activity, equivalent to exercise, is associated with lower mortality risk [7, 8]. TV viewing is one of the major domains of sedentary behavior [9]. Meta-analyses have confirmed that prolonged TV viewing is a risk factor for mortality [10, 11]. To develop effective strategies to promote health behaviors, identifying modifiable determinants of these behaviors is essential [12]. For physical activity and sedentary behavior, since modifiable determinants differ according to their settings, behavior-specific approaches are recommended [13, 14]. Thus, apart from overall indices of dietary habits, physical activity, and sedentary behavior, identifying the determinants of consuming a varied diet, exercising, and TV viewing is meaningful.

Spousal Concordances of Health Behaviors

One spouse's health behavior may be a modifiable determinant of the other spouse's

health behavior. For many older adults, their marital partner is one of the most important and closest people in their lives. The ecological model of health behavior [15] proposes that multi-level factors, such as individual-level, social-level, and environmental level factors, are correlated with health behaviors. Among the multi-level factors, an advantage of examining the health behaviors of close others, such as marital partners, as the determinants of one's health behaviors is that it indicates how positive changes in health behaviors could spread within socially close groups, such as married couples. For decades, previous studies have reported spousal concordance in dietary behavior [16-23], exercise or physical activity [16, 19-22, 24], and sedentary behaviors [25, 26] among the general population. Investigations have also been made into spousal health behavior concordance [26-31] among older couples.

However, evidence on spousal concordance for health behaviors has been predominantly obtained from a between-couple perspective; studies have examined whether the relatively better status of one spouse's health behaviors is associated with the relatively better status of the other spouse's health behavior compared with other couples [16-25, 27-30]. However, as indicated in spousal concordance for personality [32] and mental health [33], spousal concordance for health behaviors can also be captured from a within-couple perspective; one spouse's occasional changes in health behaviors are associated with the other spouse's occasional changes compared with behaviors at other times. Examinations of both between- and within-levels can strengthen evidence on spousal concordance for health behaviors and illustrate the process of one person changing their health behavior clearly. Only a few studies have examined the spousal concordance of health behavior at the within-couple level [26, 31], and one study [31] failed to show significant concordance for dietary behavior at this level. More examinations are thus necessary to confirm whether spousal concordance for health behaviors is observed at both levels. Furthermore, as previous studies have reported that the magnitudes of spousal concordance for the use of alternative tobacco

products [34] and depression [35] differ across countries and ethnicities, there might be cultural differences in the magnitudes of spousal concordances for health behaviors.

The Present Study

Clarifying the mechanisms of spousal health behavior concordance can illustrate how health behaviors may spread within socially close groups, such as married couples. Such illustrations could contribute to the development of effective strategies for promoting health behaviors via interpersonal networks. To clarify the behavioral mechanisms of spousal concordance for health behaviors among older couples at both levels, it is necessary to examine the moderators (effect modifiers) of spousal concordance. It is reasonable to assume that spouses' health behavioral interactions may be closer in certain types of couples than in other types (moderators at the between-couple level) and in certain situations than others within a couple (moderators at the within-couple level). One potential moderator of spousal concordance for health behaviors among older couples is working time. Reduced working time or retirement is a major life event for older couples as it usually gives them more spare time and opportunities to consume the same dishes, exercise, and view TV together. Meyler et al. [36] proposed four hypotheses to explain spousal concordance for health behaviors: assortative mating, shared resources, mood convergence or affective contagion, and social control. Among these, the shared resources hypothesis [36, 37] assumes spousal concordance occurs because spouses share the same resources. A previous study reported that spousal concordances for dietary behavior and physical activity [38] are more relevant among older couples than among younger ones. One potential reason for this might be that older couples would share more leisure time than younger couples. Reduced working time or retirement at an older age can indicate a remarkable increase of time resources, and retirement from work is associated with increased leisure activity engagement among older adults [39, 40]. One spouse's retirement is associated with another spouse's perceived health status [41]. Couples'

satisfaction with leisure time is associated with overall marital satisfaction [42]. Thus, age at retirement transition would be a good framework with which to examine whether shared time resources can explain spousal concordance of health behaviors. Pauly et al. [26] reported that a longer time spent together moderates spousal concordance for physical activity and sedentary behavior at the between-couple level. If the moderating role of working time on spousal concordance is confirmed, then the transmitting effects of health behavior change become more relevant among older couples with lower working time (between-couple level) and when working time occasionally decreases within a couple (within-couple level). However, apart from Pauly et al. [26], the moderating roles of time resources for spousal concordance for health behaviors have not been confirmed.

The purpose of the present study was to examine 1) spousal concordance for dietary variety, exercise behavior, and TV viewing behavior at the within- and between-couple levels among older Japanese couples, and 2) the moderating effect of couple's working time on spousal concordance for these behaviors. For the first purpose, the present study hypothesized that spousal concordance for these behaviors is observed at both the within-couple and the between-couple levels (Hypothesis 1). For the second purpose, the present study hypothesized that a shorter couple's working time strengthen spousal concordance for these behaviors at both the between-couple and the within-couple levels (Hypothesis 2).

Methods

Participants and Procedures (Figure 1)

Data obtained from a questionnaire survey of older adults living in Xxxx Ward of Xxxx City, Xxxx Prefecture, Japan were analyzed (deleted for the blind review process). Xxxx City is a major urban area in Japan and consists of X wards. The Xxxx Ward has approximately 137,000 residents. From the official register of residents of the Xxxx Ward, we

126 targeted all the men aged 64, 69, and 74 years on the first day of April 2017 (n = 2204) and
127 all the wives aged within 10 years of the men (n = 1516). Through a postal survey, we asked
128 these 3720 individuals to answer the baseline questionnaire, of whom 1784 (48.0%) did so.
129 The baseline survey was conducted from December 2017 to January 2018 (Wave 1). The
130 rationale for targeting this age group among men was that under Japanese employment
131 systems, employees often change their work status on the last day of a financial year when
132 they reach 60, 65, or 70 years old; therefore, a considerable number of male participants
133 would have reduced their working hours or retired from their work on March 31, 2018, the
134 last day of Japan's 2017 financial year.

135 Among the 1784 individuals, 1079 agreed to provide further contact with our
136 research group. From December 2018 to January 2019, we conducted a one-year follow-up
137 survey of 1079 individuals (Wave 2). Of these, 919 individuals completed the questionnaire.
138 From December 2020 to January 2021, we also conducted a three-year follow-up survey of
139 1079 individuals and 854 individuals answered this.

140 By matching these responses to the register, we identified 610 pairs of men and
141 women who answered together at the baseline. Among these 610 couples, 400 were excluded
142 because i) the husbands or wives did not respond to both Wave 2 and Wave 3 (n = 381), ii)
143 the husbands or wives were certified as requiring long-term care or support (n = 14), or iii)
144 they had missing data on demographic factors (n = 5). Thus, the present study analyzed data
145 from 210 couples.

146 Written informed consent was obtained from all the participants. Prior approval was
147 received from the Ethical Committee of the Graduate School of Xxxxx Xxxxxxxxx xxx
148 Xxxxxxxx, Xxxx University (deleted for the blind review process). All the procedures were
149 conducted in accordance with the principles of the Declaration of Helsinki.

150 This survey was implemented as a large research project from which we have

published two papers [43, 44], and we are submitting and preparing to submit several others. As none of these studies treat spousal concordance for health behavior, this manuscript is thoroughly different from the other papers from this project and provides unique scientific information.

Measures

Health behaviors. Consuming a varied diet was measured using the dietary variety score [45]. The dietary variety score represents the consumption frequencies of 10 components (meat, fish, eggs, milk, soy products, green and yellow vegetables, potatoes, fruit, seaweed, and fats and oils) for a typical week. The consumption frequencies of each component were assessed by four choices: "almost every day," "3 or 4 days a week," "1 or 2 days a week," and "almost never." We calculated the sum of the number of components to which a respondent answered "almost every day" as the dietary variety score (range 0–10) [45]. Higher scores indicated greater dietary variety. Japanese studies have commonly used this scale to measure dietary habits among older adults [2, 3, 46]. In terms of validity, a previous study [7] confirmed that higher scores are associated with increased intake of protein, micronutrients, and balanced meals.

For exercising, the participants were asked to report the number of days they exercised in a usual week (0–7 days). If they answered "1 to 7 days," they were also asked to indicate the average exercise time (hours and minutes) for the days on which they exercised. The weekly exercise time (hours per week) was calculated by multiplying the frequency by time. Japanese studies [48-50] and the Japan National Health and Nutrition Survey conducted by the Japanese government [51] have simply measured the frequency and duration of exercise in a typical week. Since the Japanese government [5] recommends all intensities of exercise, Japanese surveys [48-51] have included all intensities.

For TV viewing among workers, the time spent watching TV on typical non-working

176 days and typical working days as well as the weekly frequencies of working were measured.
177 Then, the present study calculated the average TV viewing time (hours per day) from the
178 answers of watching time and working frequencies. For non-workers, the present study asked
179 about the average TV viewing time (hours per day) on a typical day.

180 *Couples' working time*. For those who engaged in paid work, the present study asked
181 the weekly frequencies of working days (1 to 7 days) and the time spent on work and
182 commuting on a working day. The present study calculated the average of husbands' and
183 wives' working hours per day and treated this as one variable, couples' working time.

184 *Demographic factors.* The participants' ages, educational level (junior high or high
185 school, more than high school), frailty (no, yes), the couple's length of marriage (in years),
186 perceived household economic status (measured on a five-point Likert scale from 1 s= very
187 poor to 5 = very good), and living with non-spouse others (no, yes) were measured. Frailty
188 was measured using the Kihon Checklist [52, 53]. The respondents answered each of the 25
189 items as "yes" or "no" and the summed scores for the answers to all the items were
190 calculated. The individuals were subsequently dichotomized using the cut-off points for
191 frailty (7/8) [53]. Spearman's correlation coefficient between the score of the Kihon
192 Checklist and number of frailty phenotypes was 0.66 and that the sensitivity and specificity to
193 detect pre-frailty/frailty status by its cut-off point (7/8) were 89.5% and 80.7%, respectively
194 [53]. A couple's length of marriage (in years) and perceived household economic status were
195 created by calculating the average of the husband's and wife's responses.

196 ***Analyses***

197 The present study performed the analyses by couple using linear multi-level models to
198 set husbands' and wives' health behaviors as the dependent variables. Data from the present
199 study were nested. Based on the research trends on spousal health behavior concordance, the
200 present study justified that simultaneous examinations of spousal concordance at both

between- and within-couple levels are important. Multilevel models are suitable for examining both levels simultaneously. The multi-level models included two levels: the within-couple level (Level 1) and between-couple level (Level 2). In total, four models were examined for each dependent variable. The fixed effects of Model 1 were couple-mean-centered spouse's health behavior (Level 1), grand-mean-centered spouse's health behavior, age, educational background, and frailty (Level 2). In addition to the variables in Model 1, couple-mean-centered couple's working time, interaction term of the couple-mean-centered spouse's health behavior with the couple-mean-centered couple's working time (Level 1), grand-mean-centered couple's working time, and interaction term of the grand-mean-centered spouse's health behavior with the grand-mean-centered couple's working time were included as the fixed effects of Model 2. Similar to previous studies [56-58], the present study calculated the grand-mean-centered spouse's health behavior and couple's working time by subtracting all couples' mean scores in the three surveys from each couple's mean score in the three surveys. Grand-mean-centered variables represented the differences in one couple's usual status from other couples' usual status (i.e., between-couple differences). The present study calculated the couple-mean-centered spouse's health behavior and couple's working time by subtracting each couple's mean score in the three surveys from each couple's raw score in one survey. Couple-mean-centered variables represented the differences in each couple's occasional status from their usual status (i.e., within-couple differences). Survey time (reference, Wave 1), educational background (reference, junior high or high school), and frailty (reference, no) were treated as the dummy variables. The variance of intercept was set as a random effect. Maximum likelihood estimation was used to fit the model.

In Model 1, if regressions of couple-mean-centered and ground-mean-centered health behaviors were significant and positive, the present study regarded that Hypothesis 1 was supported. In Model 2, if the regressions of couple-mean-centered and ground-mean-centered

interaction terms were significant and negative, Hypothesis 2 was supported. If the interaction term(s) in Model 2 were significant, the present study created graph(s) by plotting the predicted health behavior from the model. Graphs included the effect of one spouse's health behavior on the spouse's health behavior at low (one standard deviation below the mean), middle (mean), and high (one standard deviation above mean) levels for each level of couples' working time (low, middle, and high).

Statistical significance was set at $p < 0.05$. Because multi-level analyses can estimate missing values, the present study did not use a missing value imputation method. For the patterns of missing values in the present study, Little's missing completely at random (MCAR) test supported the MCAR ($\chi^2(178)=196.1$, $p=0.167$). Stata v.14 (StataCorp LLC, College Station, Texas, USA) was used to perform the analyses.

Results

Characteristics of the Respondents

Table 1 shows the respondents' characteristics. The husbands included in the analyses were significantly more likely to be educated from more than high school compared with excluded husbands. The wives included in the analyses were significantly more likely to be younger and have a higher dietary variety score than excluded wives. The average husbands' working time was 2.8 hours (standard deviation, 3.4 hours) per day, and the wives' working time was 1.4 hours (standard deviation, 2.4 hours) per day (not shown in the table). Table 2 shows the longitudinal changes in health behaviors and couples' working time. Compared with Wave 1, husbands' TV viewing time in Wave 3 significantly increased, whereas couples' working time in Wave 3 significantly decreased.

Spousal Concordance for Health Behavior

The results of the multilevel analyses for spousal concordance of dietary variety,

exercise time, and TV viewing time are shown in Tables 3, 4, and 5, respectively.

In Model 1, significant and positive regressions of couple-mean-centered and ground-mean-centered spouses' behavior were observed for both husbands' and wives' dietary variety (Table 3) and TV viewing time (Table 5), which supported Hypothesis 1. However, regressions of couple-mean-centered and ground-mean-centered spouses' exercise time were insignificant for either husbands or wives (Table 4), indicating that Hypothesis 2 was not supported.

Moderating Effects of Couple's Working Time on Spousal Concordance for Health Behavior

In Model 2, the interaction term of couple-mean-centered spouse's TV viewing time with couple's working time was negatively significant for husband's TV viewing time (Table 5). No other interaction term was significant across behaviors and gender. Therefore, Hypothesis 2 was supported only for the regression of the wife's TV viewing time on the husband's TV viewing time at the within-couple level. Figure 2 shows the interactive effects of the couple-mean-centered wife's TV viewing time and the couple's working time on the husband's TV viewing time. As shown in Figure 2, the regressive effects of couple-mean-centered wife's TV viewing time were more relevant as the couple-mean-centered couple's working time was lower.

Discussion

Hypothesis 1 was supported for consuming a varied diet and TV viewing, but not for exercising. These findings indicate that the magnitudes of spousal concordance for health behaviors among older couples differ according to the types of health behaviors at both the between-couple and the within-couple levels; concordance for exercising is weaker than that for consuming a varied diet and TV viewing at both levels. For spousal concordance for

276 consuming a varied diet and TV viewing, the present study advances the body of knowledge
277 by adding evidence on concordance at the within-couple level. Most studies have revealed
278 spousal concordance for dietary habits [16-23] and sedentary behavior [25, 29, 30] only at the
279 between-couple level and few studies have found such concordance at the within-couple level
280 [26]. Although TV viewing is a major component of sedentary behavior [9] and behavior-
281 specific approaches are recommended when examining determinants [14], the current
282 evidence for spousal TV viewing concordance is limited. For exercise and physical activity,
283 similar to the present study, a Japanese cross-sectional study [29] failed to show clear spousal
284 concordance for objectively measured physical activity at the between-couple level among
285 older couples. The coefficients for the spousal concordances in the multilevel models were
286 0.03 to 0.08 for exercise, across all models and levels. The results indicate that a one-hour
287 increase in exercise time for one spouse was associated with a 0.03- to 0.08-hour increase in
288 exercise time for the other spouse. Thus, spousal exercise concordance would be weaker.
289 However, previous studies from Western countries have confirmed spousal concordance for
290 exercise and physical activity at both the within-couple level [26, 31] and the between-couple
291 level [16, 19-22, 24, 27, 28, 31]. The inconsistencies in concordance for exercise and physical
292 activity between Japanese [29] and other studies [16, 19-22, 24, 26-28, 31] can be partly
293 explained by cultural differences. Other factors such as self-motivation and attitude might
294 have more influence on the exercise behavior of older Japanese adults than the partner's
295 behaviors. Previous studies have reported that couples' general communication styles [54, 55]
296 and the magnitudes of spousal concordances for depression [35] and alternative tobacco
297 products use [34] differ across cultures. A couple's communication styles regarding exercise
298 would also be different across cultures; therefore, there might be cultural differences in the
299 spousal concordances for exercise behavior. However, based on the current research trends,
300 the present study cold not specificially indicate which cultural aspects between Japan [29]

301 and other countries [16, 19-22, 24, 26-28, 31] might cause inconsistencies in spousal
302 concordance for exercise.

303 For the moderating role of the couple's working time on spousal concordance, the
304 present study found that Hypothesis 2 was partially supported at the within-couple level only
305 for the wife's influence on the husband's behavior. These findings indicate that the behavioral
306 mechanisms of spousal concordance differ across types of health behaviors and that couple's
307 working time moderates only the wife's influence on the husband's TV viewing behavior at
308 the within-couple level, not the husband's influence on the wife's. Pauly et al. [26] reported
309 that longer time spent together moderates spousal concordance for sedentary behavior within
310 a couple, but they did not examine gender differences. The study advances previous findings
311 by investigating gender differences. As there are gender differences in the correlates of TV
312 viewing [59, 60], susceptibility to spousal influence may differ by gender. One potential
313 reason for the gender difference in the moderating effect of working time might be that the
314 magnitude of changes in leisure time at home, accompanied by changes in working time,
315 differ according to gender. It is reasonable to assume that when people experience increased
316 leisure time at home, they have more opportunities to join their spouses in watching TV.
317 Since husbands spend much less time on housework than wives among Japanese couples
318 [61], husbands' leisure time could increase to a greater extent than that of their wives after the
319 decreased working time. This study did not find a significant moderating effect of working
320 time on spousal dietary variety concordance, regardless of gender. One potential explanation
321 for this insignificant moderating effect might be that the majority of older couples eat the
322 same meals regardless of how much time they spend working. It is reasonable to assume that
323 when both spouses eat at home, they eat the same meals. In this study, as the average working
324 time was less than three hours per day, most couples would eat two to three meals at home on
325 a typical day. A recent study [62] assessed the joint health behavior of married couples, which

represented the extent of their joint engagement in health behavior (e.g., eating, exercising, and watching TV together), and examined their relationship with their health status. The concept of joint health behavior might be helpful in understanding the mechanism of spousal concordances in health behaviors. However, this study did not measure joint health behavior, and further studies examining spousal concordance should include it.

Regardless of gender, couples' working time did not moderate the spousal dietary variety and TV viewing concordance at the between-couple level. Temporal changes in working time might be more salient than overall volume in relation to the spousal concordance of TV viewing. Apart from the couple's working time being an index of shared time resources, other factors may explain the spousal concordance of TV viewing behavior at between-couple levels and dietary variety at both levels. From the shared resources hypothesis [36, 37], other resources such as financial, environmental, and social resources may explain such spousal concordance. The other three hypotheses of spousal concordance for health behaviors [36] assume that spousal concordance occurs 1) because spouses have close emotional relationships (the hypotheses of mood convergence or affective contagion [36]); 2) because one spouse tries to control the other spouse's health behaviors (the hypothesis of social control [36, 63]); and/or 3) because spouses tend to marry people with similar characteristics (the hypothesis of assortative mating [16, 64]). Among these, assortative mating is irrelevant among older couples because the majority have been married for decades. The other shared resources and the two remaining hypotheses are potential moderators of spousal concordance of health behaviors. However, their moderating roles are still unconfirmed. Further studies are necessary to examine their moderating roles.

Limitations and Directions for Future Research

This study has several limitations. First, owing to the low response rates, it had sampling bias. Participants who spend more time working would be less likely to respond to

the survey because they are busy. Thus, a low response rate might cause an underestimation of working time and may weaken the moderating effects of working time on spousal health behavior concordance. Second, health behaviors were assessed using self-reported questionnaires, for which the reliability was not established. Moreover, while the validity of the scale for dietary variety [47] was confirmed, the validity of the scales for exercise and TV viewing was not. Third, the measures of dietary variety and exercise time are based only on research trends in Japan. Especially, the present study did not limit the intensity of exercise to moderate to vigorous levels because the Japanese government [5] recommends exercising regardless of intensity. However, this recommendation is inconsistent with global research trends [4]. Fourth, the present study did not measure leisure time at home, frequency of eating at home, joint health behavior, or overlap of working time within a couple, although these factors would be helpful in more precisely understanding the moderating role of working time. Based on these limitations, further studies should increase the response rate, measure health behaviors by employing objective methods and globally validated and reliable questionnaires, and include data on the factors neglected in this study.

Practical Implications

According to our findings, dyadic interventions, which target both members of older couples, may be more effective than individual-based interventions in promoting dietary variety and reducing TV viewing because these behaviors interact with each other within older couples. Moreover, dyadic interventions might be especially effective in reducing TV viewing for older men who have retired or reduced their working time. However, dyadic interventions may not be superior to individual-based interventions for promoting exercise behaviors among older couples because the interactions regarding exercise behavior within the couples are weak or limited. The findings of the present study suggest that health promotion practitioners consider planning and implementing dyadic interventions when their

target behavior is older adults' dietary variety or TV viewing. However, when their target behavior is exercise, the priority of using dyadic interventions might be low.

Conclusions

The present study found that spousal concordance for dietary variety and TV viewing was observed at within-couple and between-couple levels among older Japanese couples. Also, a shorter couple's working time partly moderates the wife's influence on the husband's TV viewing among them at the within-couple level.

Informed consent: Informed consent was obtained from all individual participants included in the study.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Figure 1. Flowchart of the participants and procedure

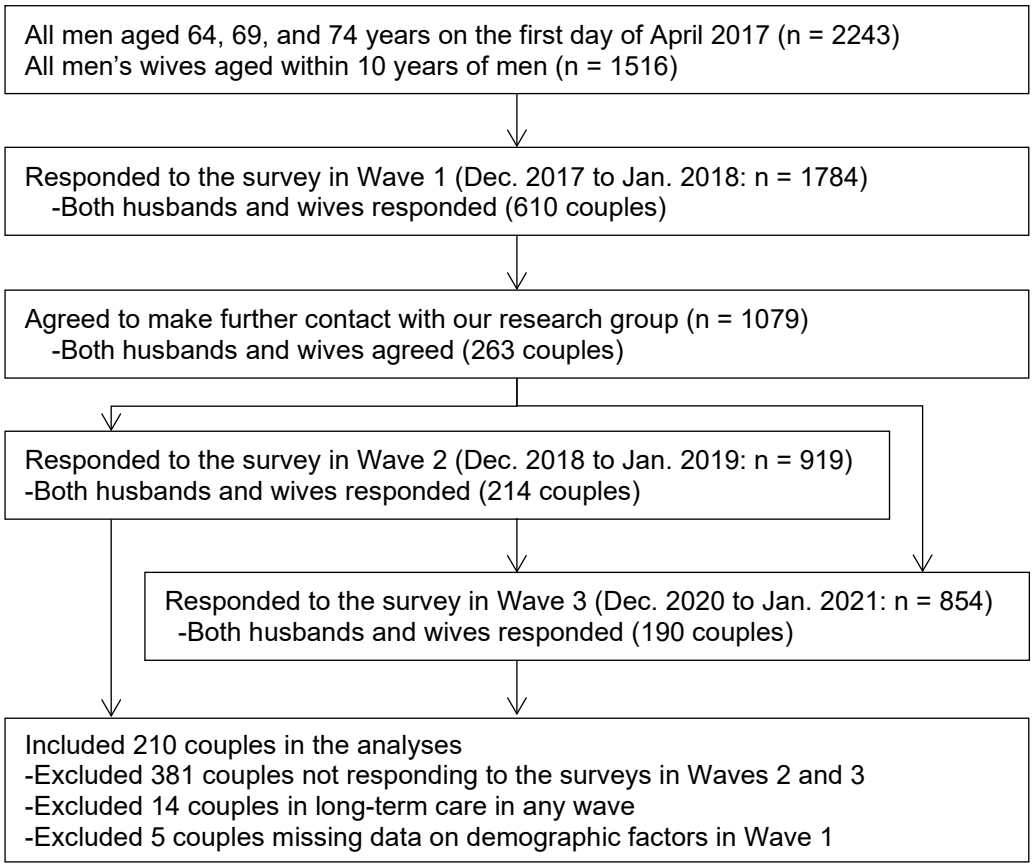


Table 1. Baseline characteristics of the participants

	Analyzed		Excluded		
	n	M or %	n	M or %	p-value
Husband's age (years), M (SD)	210	69.0 (3.8)	400	69.5 (3.7)	0.122[a]
Husband's educational background (> high school), %	210	**58.6%**	393	**47.1%**	**0.007[b]**
Husband's frailty (yes), %	210	12.9%	382	12.0%	0.773[b]
Husband's dietary variety (score), M (SD)	209	3.2 (2.1)	390	3.2 (2.2)	0.761[a]
Husband's exercise time (minutes/day), M (SD)	178	41.8 (38.8)	309	40.0 (46.0)	0.652[a]
Husband's TV viewing time (hours/day), M (SD)	205	3.9 (2.5)	364	4.0 (2.4)	0.533[a]
Wife's age (years), M (SD)	210	**65.9 (4.5)**	400	**66.8 (4.3)**	**0.013[a]**
Wife's educational background (> high school), %	210	48.1%	387	43.7%	0.299[b]
Wife's frailty (yes), %	210	5.7%	381	8.7%	0.196[b]
Wife's dietary variety (score), M (SD)	204	**4.4 (2.2)**	388	**4.0 (2.2)**	**0.047[a]**
Wife's exercise time (minutes/day), M (SD)	183	28.6 (33.8)	328	26.3(36.6)	0.495[a]
Wife's TV viewing time (hours/day), M (SD)	170	3.9 (2.2)	324	4.0 (2.5)	0.523[a]
Couple's working time (hours/day), M (SD)	171	2.2 (2.4)	385	2.2 (2.5)	0.926[a]
Couple's perceived household economic status (score), M (SD)	210	**3.1 (0.8)**	400	**2.9 (0.8)**	**0.013[a]**
Couple's length of marriage (years), M (SD)	210	**40.4 (7.4)**	400	**41.2 (6.8)**	**0.015[a]**
Couple's living status with non-spouse others (yes), %	210	39.9%	400	38.5%	0.895[b]

[a]t-test, [b]chi-squared test

The sample size for each variable varies due to missing values.

Table 2. Longitudinal changes in husbands' and wives' health behavior and couples' working time

	Wave 1		Wave 2			Wave 3		
	n	M (SD)	n	M (SD)	p-value[a]	n	M (SD)	p-value[a]
Husband's dietary variety (score)	209	3.2 (2.1)	201	3.3 (2.1)	0.364	185	3.3 (2.2)	0.266
Husband's exercise time (minutes/day)	178	41.8 (38.8)	197	44.9 (44.6)	0.691	183	44.1 (44.7)	0.636
Husband's TV viewing time (hours/day)	205	3.9 (2.5)	194	4.0 (2.2)	0.496	178	**4.2 (2.6)**	**0.023**
Wife's dietary variety (score)	204	4.4 (2.2)	197	4.4 (2.1)	0.766	179	4.6 (2.3)	0.611
Wife's exercise time (minutes/day)	183	28.6 (33.8)	190	28.3 (31.6)	0.549	173	**35.4 (36.7)**	**0.026**
Wife's TV viewing time (hours/day)	170	3.9 (2.2)	170	3.9 (2.2)	0.889	156	3.9 (2.2)	0.322
Couples' working time (hours/week)	171	2.2 (2.4)	162	1.9 (2.3)	0.186	150	**1.5 (2.0)**	**<0.001**

[a]Changes from Wave 1 estimated using the linear mixed model

The sample size for each variable varies due to missing values.

Table 3. Fixed effects of one spouse's dietary variety and couple's working time on the other spouse's dietary variety

	Husband's dietary variety				Wife's dietary variety			
	Model 1		Model 2		Model 1		Model 2	
	Estimated (95%CI)	p-value	Estimated (95%CI)	p-value	Estimated (95%CI)	p-value	Estimated (95%CI)	p-value
Intercept	0.25 (-4.44, 4.95)	0.916	-0.04 (-5.11, 5.02)	0.986	0.76 (-3.10, 4.62)	0.701	1.97 (-2.20, 6.14)	0.354
Level 1 (within-couple level)								
Survey time, wave 2 (ref. wave 1)	0.13 (-0.13, 0.40)	0.325	0.03 (-0.27, 0.34)	0.843	-0.08 (-0.35, 0.20)	0.579	-0.12 (-0.42, 0.19)	0.463
Survey time, wave 3 (ref. wave 1)	0.18 (-0.10, 0.45)	0.214	-0.07 (-0.40, 0.27)	0.692	0.04 (-0.25, 0.33)	0.798	0.08 (-0.25, 0.42)	0.620
Couple-mean-centered spouse's dietary variety	**0.19 (0.09, 0.29)**	**<0.001**	**0.20 (0.09, 0.31)**	**<0.001**	**0.21 (0.11, 0.31)**	**<0.001**	**0.22 (0.10, 0.33)**	**<0.001**
Couple-mean-centered couple's working time	—		-0.08 (-0.27, 0.11)	0.405	—		-0.17 (-0.35, 0.02)	0.077
Couple-mean-centered spouse's dietary variety × couple's working time	—		-0.18 (-0.40, 0.04)	0.118	—		0.09 (-0.11, 0.28)	0.377
Level 2 (between-couple level)								
Grand-mean-centered spouse's dietary variety	**0.38 (0.26, 0.51)**	**<0.001**	**0.42 (0.29, 0.55)**	**<0.001**	**0.39 (0.26, 0.51)**	**<0.001**	**0.41 (0.28, 0.54)**	**<0.001**
Grand-mean-centered couple's working time	—		0.03 (-0.09, 0.15)	0.613	—		-0.11 (-0.22, 0.01)	0.068
Grand-mean-centered spouse's dietary variety × couple's working time	—		0.05 (-0.02, 0.11)	0.153	—		0.06 (-0.01, 0.12)	0.078
Own age	0.06 (-0.01, 0.14)	0.093	0.07 (-0.01, 0.15)	0.080	0.02 (-0.04, 0.09)	0.477	0.01 (-0.06, 0.08)	0.746
Own educational background, > high school (ref. < high school)	0.14 (-0.32, 0.61)	0.543	0.09 (-0.39, 0.58)	0.703	0.11 (-0.37, 0.59)	0.663	-0.07 (-0.57, 0.44)	0.794
Own frailty, yes (ref. no)	-0.32 (-1.01, 0.37)	0.366	-0.27 (-0.98, 0.44)	0.457	-0.49 (-1.48, 0.51)	0.341	-0.59 (-1.68, 0.50)	0.286
Couple's perceived household economic status	**-0.37 (-0.67, -0.08)**	**0.013**	**-0.35 (-0.66, -0.03)**	**0.031**	**0.54 (0.25, 0.83)**	**<0.001**	**0.52 (0.21, 0.83)**	**0.001**
Couple's length of marriage	-0.01 (-0.05, 0.03)	0.625	-0.01 (-0.05, 0.03)	0.543	0.01 (-0.03, 0.05)	0.599	0.01 (-0.03, 0.05)	0.747
Couple's living status with non-spouse others, yes (ref. no)	-0.13 (-0.6, 0.34)	0.593	-0.19 (-0.68, 0.31)	0.457	-0.06 (-0.54, 0.41)	0.799	-0.21 (-0.71, 0.29)	0.408

95CI, 95% confidence interval

Table 4. Fixed effects of one spouse's exercise time and couple's working time on the other spouse's exercise time

	Husband's exercise time				Wife's exercise time			
	Model 1		Model 2		Model 1		Model 2	
	Estimated (95%CI)	p-value	Estimated (95%CI)	p-value	Estimated (95%CI)	p-value	Estimated (95%CI)	p-value
Intercept	**-124.00 (-228.86, -19.14)**	**0.020**	-93.70 (-203.55, 16.14)	0.095	-13.66 (-78.61, 51.3)	0.680	-3.05 (-73.19, 67.08)	0.932
Level 1 (within-couple level)								
Survey time, wave 2 (ref. wave 1)	2.08 (-3.78, 7.95)	0.486	2.34 (-4.14, 8.81)	0.480	-1.31 (-6.34, 3.71)	0.608	-3.00 (-8.61, 2.60)	0.294
Survey time, wave 3 (ref. wave 1)	0.32 (-5.76, 6.40)	0.918	0.5 (-6.49, 7.49)	0.889	4.77 (-0.42, 9.96)	0.072	2.86 (-3.19, 8.91)	0.354
Couple-mean-centered spouse's exercise time	0.08 (-0.05, 0.20)	0.256	0.06 (-0.08, 0.20)	0.419	0.06 (-0.03, 0.16)	0.206	0.03 (-0.09, 0.14)	0.658
Couple-mean-centered couple's working time	—		-2.48 (-6.28, 1.32)	0.200	—		1.07 (-2.26, 4.39)	0.529
Couple-mean-centered spouse's exercise time × couple's working time	—		-0.27 (-0.64, 0.10)	0.158	—		-0.17 (-0.36, 0.02)	0.086
Level 2 (between-couple level)								
Grand-mean-centered spouse's exercise time	0.07 (-0.10, 0.25)	0.412	0.07 (-0.13, 0.27)	0.493	0.04 (-0.06, 0.14)	0.457	0.04 (-0.08, 0.15)	0.554
Grand-mean-centered couple's working time	—		**-4.40 (-7.22, -1.58)**	**0.002**	—		**-2.60 (-4.71, -0.49)**	**0.016**
Ground-mean-centered spouse's exercise time × couple's working time	—		0.00 (-0.10, 0.10)	0.969	—		0.00 (-0.06, 0.06)	0.987
Own age	**2.22 (0.53, 3.91)**	**0.010**	**2.00 (0.23, 3.78)**	**0.027**	0.22 (-0.90, 1.35)	0.696	0.13 (-1.07, 1.34)	0.831
Own educational background,> high school (ref. < high school)	-3.33 (-13.77, 7.12)	0.533	-5.53 (-16.33, 5.27)	0.316	2.78 (-5.27, 10.83)	0.499	1.05 (-7.59, 9.69)	0.812
Own frailty, yes (ref. no)	-8.91 (-24.24, 6.43)	0.255	-12 (-27.96, 3.95)	0.140	-16.79 (-33.65, 0.07)	0.051	-18.59 (-37.25, 0.07)	0.051
Couple's perceived household economic status	2.81 (-3.63, 9.25)	0.392	1.92 (-4.93, 8.78)	0.582	3.12 (-1.68, 7.92)	0.203	3.05 (-2.18, 8.29)	0.253
Couple's length of marriage	0.26 (-0.61, 1.13)	0.555	-0.06 (-0.95, 0.83)	0.891	0.51 (-0.17, 1.19)	0.144	0.46 (-0.25, 1.17)	0.203
Couple's living status with non-spouse others, yes (ref. no)	-6.47 (-17.04, 4.09)	0.230	-3.95 (-14.81, 6.92)	0.476	-6.32 (-14.27, 1.63)	0.119	-4.04 (-12.43, 4.34)	0.345

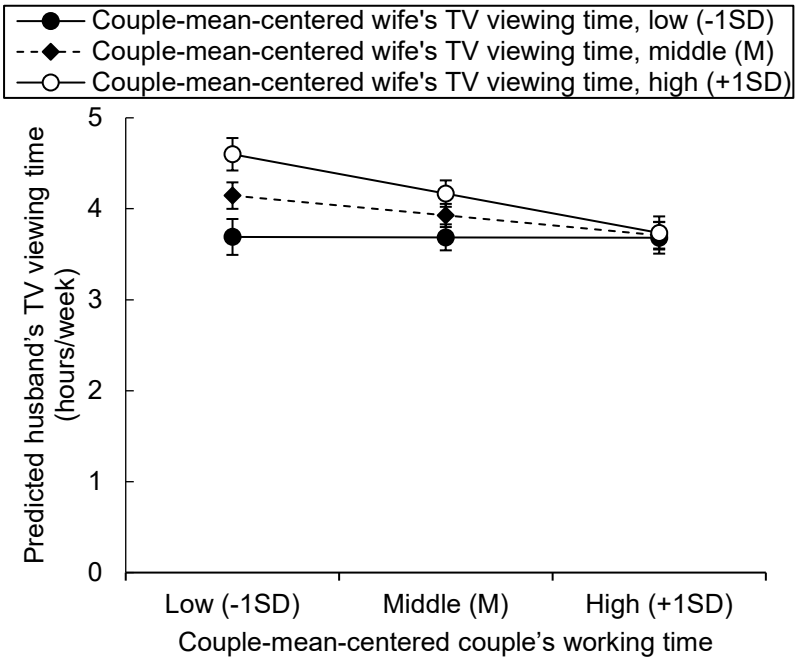
95CI, 95% confidence interval

Table 5. Fixed effects of one spouse's TV viewing time and couple's working time on the other spouse's TV viewing time

	Husband's TV viewing time				Wife's TV viewing time			
	Model 1		Model 2		Model 1		Model 2	
	Estimated (95%CI)	p-value	Estimated (95%CI)	p-value	Estimated (95%CI)	p-value	Estimated (95%CI)	p-value
Intercept	-0.97 (-6.16, 4.21)	0.713	0.96 (-4.31, 6.23)	0.722	3.24 (-0.92, 7.41)	0.127	**4.39 (0.20, 8.58)**	**0.040**
Level 1 (within-couple level)								
Survey time, wave 2 (ref. wave 1)	0.16 (-0.15, 0.47)	0.306	0.06 (-0.25, 0.38)	0.697	-0.02 (-0.26, 0.22)	0.867	-0.01 (-0.26, 0.25)	0.952
Survey time, wave 3 (ref. wave 1)	**0.41 (0.09, 0.73)**	**0.013**	0.18 (-0.16, 0.53)	0.299	-0.02 (-0.27, 0.24)	0.908	-0.04 (-0.32, 0.25)	0.805
Couple-mean-centered spouse's TV viewing time	**0.25 (0.11, 0.40)**	**0.001**	**0.27 (0.12, 0.42)**	**<0.001**	**0.15 (0.06, 0.24)**	**0.001**	**0.12 (0.03, 0.22)**	**0.011**
Couple-mean-centered couple's working time	—		**-0.31 (-0.50, -0.11)**	**0.002**	—		-0.02 (-0.19, 0.15)	0.814
Couple-mean-centered spouse's TV viewing time × couple's working time	—		**-0.34 (-0.61, -0.06)**	**0.016**	—		-0.09 (-0.22, 0.04)	0.182
Level 2 (between-couple level)								
Grand-mean-centered spouse's TV viewing time	**0.43 (0.30, 0.57)**	**<0.001**	**0.37 (0.23, 0.50)**	**<0.001**	**0.40 (0.28, 0.53)**	**<0.001**	**0.31 (0.17, 0.45)**	**<0.001**
Grand-mean-centered couple's working time	—		**-0.20 (-0.33, -0.06)**	**0.004**	—		**-0.22 (-0.36, -0.07)**	**0.003**
Grand-mean-centered spouse's TV viewing time × couple's working time	—		-0.05 (-0.11, 0.02)	0.161	—		-0.05 (-0.13, 0.02)	0.165
Own age	**1.14 (0.37, 1.90)**	**0.004**	0.08 (-0.00, 0.17)	0.054	0.02 (-0.05, 0.09)	0.608	0.00 (-0.07, 0.08)	0.904
Own educational background,> high school (ref. < high school)	**-0.37 (-0.70, -0.03)**	**0.033**	**-0.58 (-1.10, -0.05)**	**0.031**	-0.02 (-0.55, 0.51)	0.948	-0.17 (-0.70, 0.35)	0.515
Own frailty, yes (ref. no)	-0.03 (-0.08, 0.01)	0.143	**0.97 (0.21, 1.73)**	**0.012**	-0.37 (-1.50, 0.75)	0.517	-0.39 (-1.48, 0.70)	0.484
Couple's perceived household economic status	**-0.58 (-1.12, -0.05)**	**0.032**	-0.31 (-0.64, 0.02)	0.070	**0.35 (0.02, 0.67)**	**0.039**	**0.35 (0.03, 0.67)**	**0.032**
Couple's length of marriage	**0.43 (0.30, 0.57)**	**<0.001**	-0.04 (-0.08, 0.00)	0.080	-0.04 (-0.08, 0.00)	0.061	**-0.05 (-0.09, -0.00)**	**0.029**
Couple's living status with non-spouse others, yes (ref. no)	**0.11 (0.02, 0.19)**	**0.011**	-0.51 (-1.03, 0.02)	0.059	0.11 (-0.41, 0.63)	0.682	0.09 (-0.42, 0.59)	0.735

95CI, 95% confidence interval

Figure 2. Interaction of couple-mean-centered wife's TV viewing time with couple's working time on husband's TV viewing time.



Note. The error bars represent standard errors. (M) is mean and (SD) is the standard deviation.