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Harada, Kazuhiro ; Masumoto, Kouhei ; Katagiri, Keiko ; Fukuzawa, Ai ; Chogahara, Makoto ; Kondo, Narihiko ; Okada, Shuichi

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Title: Frequency of going outdoors and health-related quality of life among older adults: Examining the moderating role of living alone and employment status

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Authors: Kazuhiro Harada[1], Kouhei Masumoto[1], Keiko Katagiri[1], Ai Fukuzawa[1], Makoto Chogahawa[1], Narihiko Kondo[1], Shuichi Okada[1]

Institutions:

[1] Active Aging Research Hub, Graduate School of Human Development and Environment, Kobe University

Correspondence to:

Kazuhiro Harada, Ph.D.

Active Aging Research Hub, Graduate School of Human Development and Environment, Kobe University, 3–11 Tsurukabuto, Nada, Kobe, Hyogo 657-8501, Japan.

Tel: +81-78-803-7886; E-mail: harada@harbor.kobe-u.ac.jp

Abstract

Aims: Going outdoors more frequently is beneficial for maintaining and improving health-related quality of life (HRQOL) among older adults. However, individual differences may alter the effects of going outdoors. This study aimed to examine whether relationships between going outdoors and HRQOL were moderated by living alone and employment status.

Methods: This study was a secondary analysis of 14-month prospective data (n = 613). Variables used in this study were baseline data on frequency of going outdoors, HRQOL (physical and mental component summary scores assessed using the Japanese version of the Medical Outcomes study Short Form 8-Item Health Survey), living alone, employment status, potential confounders (gender, age, educational level, and instrumental activities of daily living), and follow-up data on HRQOL.

Results: Mixed models showed that the interaction term of going outdoors and currently living alone on both the physical and mental component summary and that of going outdoors and current employment status on the mental component were significant. Stratified analyses showed that going outdoors more frequently predicted the physical and mental component summary among those who lived with others and the mental component summary among those who were unemployed.

Conclusions: These results indicate that the influence of going outdoors on HRQOL was moderated by living alone and employment status. Going outdoors more frequently may be important for the maintenance of HRQOL, especially among unemployed older adults living with others.

Keywords: Effect Modifier; Homebound Persons; Mental Health; Prospective Study; Quality of Life

Introduction

Health-related quality of life (HRQOL) refers to perceptions about one's health status and is composed by multiple domains, such as physical, cognitive, emotional, and social health. Previous studies have revealed that HRQOL predicts mortality,[1,2] hospitalization,[1] and health care costs[3] among older adults. Thus, maintaining and improving HRQOL is recognized as one of the essential health outcomes in this population.

Going outdoors more frequently and preventing housebound status would be beneficial for maintaining and improving HRQOL among older adults. Going outdoors does not require any special knowledge, motivation, cost, or time. Therefore, it is easier for older adults to incorporate going outdoors into their daily lives compared to other behavioral predictors of quality of life, such as exercise[4] and/or smoking cessation.[5] Older adults go outdoors for various purposes such as shopping, walking for exercise, social visits, and running errands.[6] Regardless of the purpose, going outdoors usually involves certain levels of physical, cognitive, and/or social activities for older people. Previous studies have revealed that lower frequencies of going outdoors are associated with various health outcomes (including mortality,[7] instrumental activities of daily living [IADL],[7,8] urinary continence,[9] functional capacities,[9–15] cognitive impairments,[12,13,16] and psychological well-being[12,15,17]). The concept of frequency of going outdoors is similar to that of life space mobility but more simplified. One prospective study[9] has also reported that frequency of going outdoors is a predictor of self-related health status measured by a single item, a concept similar to HRQOL. Thus, although few prospective studies have directly examined HRQOL, it is reasonable to assume that HRQOL would also be associated with frequency of going outdoors among older adults in addition to these specific health outcomes.

The effects of frequency of going outdoors on HRQOL among older adults may be subject to individual differences. In other words, certain subgroups of older adults could gain

more benefits from going outdoors than others. Factors leading to such individual differences can be conceptualized as moderators (effect modifiers). To better understand the health benefits of going outdoors, examination of the moderators of the relationship is necessary. Unfortunately, most previous research in this field has not examined whether there are potential moderators of the relationship between frequency of going outdoors and health outcomes. Only a few studies have examined the moderators and have shown a stronger relationship between going outdoors and health outcomes among men,[14] those with limited physical function,[13] and those with lower external control beliefs.[16]

In addition to these variables, the relationships between frequency of going outdoors and HRQOL might be also relevant among those who demographically had fewer opportunities for social interaction (i.e., living alone, not having work) than among those who had more such opportunities (i.e., living with other people, having current work). According to previous studies about the relationship between going outdoors and social interactions[18] and between social interactions and psychological status,[19] going outdoors would provide psychological benefits through increasing social interactions. Thus, going outdoors might be more influential on psychological status among those who demographically had fewer opportunities for social interaction. Nevertheless, as far as we know, no previous studies have examined such factors as potential mediators of the relationships between going outdoors and HRQOL.

The purpose of the present study was to examine whether prospective relationships between going outdoors and HRQOL were moderated by living alone and employment status among older adults. Specifically, we assumed that these relationships were more salient among those who lived alone and did not currently work compared with those who lived with other people and currently worked.

Methods

Participants and Procedures

The present study conducted a secondary analysis of 14-month prospective data from the Tsurukabuto Active Aging Project. The primary purpose of this project was to examine whether social participation could increase social network size; it was entirely different from the purpose of the present study. The project targeted the Tsurukabuto community in the Nada ward, Kobe city, Japan. Among all people living in this community, 1,769 were aged 60 years or more at baseline. The questionnaire survey was distributed to all of these individuals through the mail. Among them, 1,068 (61.6%) responded to the questionnaire. Fourteen months following baseline, we conducted a follow-up survey by mailing a questionnaire. Among the baseline respondents, 768 (71.9%) responded to the follow-up survey. Among the 768 respondents, individuals with missing data were excluded, resulting in the analysis of 613 individuals in the present study (Figure 1).

Informed consent was obtained from all participants. The Tsurukabuto Active Aging Project received prior approval from the Ethical Committee in the Graduate School of Human Development and Environment, Kobe University. All procedures were carried out in accordance with the Helsinki Declaration.

Measures

Frequency of going outdoors.

The present study asked respondents at baseline, "*Usually, how many days do you go out of the house (e.g., shopping for daily necessities and groceries, walking for leisure, and commuting)*?" The respondents answered by selecting 1 from 5 choices: *almost every day*, *4 to 5 days, 2 to 3 days, 1 day,* or *less than 1 day*. To treat this item as a continuous variable, the choices were coded as follows: *almost every day* = 6.5, *4 to 5 days* = 4.5, *2 to 3 days* = 2.5, *1 day* = 1, and *less than 1 day* = 0.

Previous Japanese studies[8,10,11,13,18,20] have also measured frequency of going outdoors using single items. However, the details of instructions and choices differed among these studies, and no method to measure frequency of going outdoors has been standardized. Most of them[8,10,11,18] have found that higher frequencies of going outdoors are associated with better health outcomes. The trend tests (Jonckheere-Terpstra Test) for our baseline data indicated that higher frequencies of going outdoors were associated with higher physical component summary (p-for-trend < 0.001) and with higher mental component summary at a marginal significant level (p-for-trend = 0.052). Thus, it would be reasonable to consider the linear relationships between frequency of going outdoors and HRQOL.

Health-related quality of life.

To assess the HRQOL, the Japanese version of the Medical Outcomes Study Short Form 8-Item Health Survey (SF-8)[21] was utilized. The SF-8 consists of 8 items. From the answer of each item, summary scores for the physical and mental components of health were calculated using a standardized calculation formula[21]. Each score ranged from 0 to 100, and the mean and standard deviations were 50 and 10, respectively, in a national sample.[21] Its reliability an alternate-forms method was adequate (r_s = 0.70–0.88), and the correlation coefficient of each 8-domain scale score between the SF-8 and SF-36 was appropriate (r_s = 0.56–0.87) .[21]

The present study analyzed the scores of physical and mental components summary at baseline and follow-up.

Living alone and employment status.

Living alone (yes, no) and current employment status (yes, no) were measured at baseline. Current employment included all paid work such as full-time jobs, part-time or temporary jobs, self-employed work, and family business.

Potential confounders.

Gender (male, female), age, education level (junior high school or high school, beyond high school), and IADL in baseline were included as potential confounders. Declines in IADL were measured with a 5-item subscale of the Tokyo Metropolitan Institute of Gerontology Index of Competence.[22] This index has sufficient reliability and validity.[23] The respondents answered each item with "yes" or "no." A "no" response on at least one item is considered indicative of decline in IADL, and responding "yes" to all items is considered indicative of absence of decline.

Analyses

The baseline characteristics of those who were included in (n = 613) and excluded from (n = 455) the present study were examined using chi-squared tests (gender, educational level, living alone, employment status, and decline in IADL) and t-tests (age, going outdoors, and physical and mental components summary scores).

Then, multiple linear mixed models were performed with physical and mental component summary scores as the dependent variables. For longitudinal data, ordinal regression models are not recommended[24] because the significance level could be biased. Alternatively, mixed-random and fixed-effect regression models (also called mixed models) are useful[24] to analyze longitudinal data. One advantage of mixed models is that they can consider individual differences for longitudinal changes. The present study treated individual differences as random effects and other factors as fixed effects. A variance component was selected for covariance structure. The present study included two models. In Model 1, independent variables included going outdoors, living alone, employment status, and potential covariates as well as the intercept and the time of measurements. These variables were examined simultaneously. Next, in Model 2, two interaction terms (the interaction term of going outdoors with living alone and the interaction term of going outdoors with employment status) were added. Two interaction terms were added at the same time. If the interaction

terms were significant, stratified analyses were conducted.

Statistical significance was set at $p < 0.05$. The Statistical Package for the Social Sciences (SPSS) for Windows 21.0 was used to perform all analyses.

Results

Baseline Characteristics of Participants

Participant characteristics at baseline are summarized in Table 1. The mean for the frequency of going outdoors was 4.9 days per week.

The results of chi-squared tests and t-tests revealed that the individuals included in the present study were significantly more highly educated, were younger, went outdoors more frequently, and had better HRQOL than those who were excluded.

Basic characteristics by living alone and employment status are shown in Supporting Information. Compared with those who lived with others, those who lived alone were more likely to be female, older, and unemployed; maintain IADL; go out less frequently; and have lower physical component scores at follow-up (Appendix Table 1). Those who were currently employed were more likely to be male, younger, and highly educated; live with others; and have higher physical component scores at both baseline and follow-up (Appendix Table 2).

Association of Frequency of Going Outdoors, Living Alone, and Employment Status with HRQOL

The results of the mixed models are shown in Table 2. In Model 1, frequency of going outdoors was significantly associated with both physical and mental component summaries (Table 2). In Model 2, the interaction term of going outdoors and currently living alone on both physical and mental components and the interaction term of going outdoors with current employment status on the mental component were significant.

Stratified by living status (Table 3, Table 4), while the frequency of going outdoors

did not significantly predict both physical and mental component summary scores among those who lived alone, it predicted both scores among those who lived with others. Stratified by current employment status (Table 4), the frequency of going outdoors significantly predicted the mental component summary score only among those who were currently unemployed.

Discussion

To our knowledge, this is the first prospective study examining if the relationships between frequency of going outdoors and health outcomes, including HRQOL, were moderated by living alone and employment status. Since the baseline characteristics differed by living alone and employment status (Supporting Information), the present study examined their moderating role after statistically adjusting for other baseline variables. Previous studies have considered that going outdoors comprehensively includes physical, cognitive, and/or social involvement and that it has positive effects on going outdoors in various health outcomes.[7–17] To better understanding of health benefits of going outdoors among older adults, examinations of potential moderators are necessary. Most previous studies have not examined moderators of such relationships. A few previous studies have shown the moderating role of gender,[14] physical function,[13] and control beliefs.[16] However, other possible moderators remain unknown.

The major finding of the present study was that the influence of going outdoors on the mental aspect of HRQOL was moderated by current employment status (i.e., the influence was observed only among those who were unemployed). This finding indicates that going outdoors more frequently would be important to keep and maintain mental health, especially among older adults not currently employed. Previous studies have shown that going outdoors is associated with psychological well-being.[12,15,17] The present study suggests that there are

individual differences that affect the impact of going outdoors on mental health. A potential reason for the moderating role of current employment status might be that unemployed people would have fewer opportunities to have social interactions than would those who are currently employed. Although the degrees of social interaction would vary according to the purpose of going outdoors, in many cases, going outdoors accompanies some social interaction, as indicated in a previous study.[18] Social interactions can reduce the risk of depression.[19] Thus, going outdoors might influence mental health through social interactions. For older adults, paid work can be regarded as a social activity. Continued working in older age is associated with better mental health.[25] Thus, older adults that are currently employed would have more opportunities to interact with others, and relative influences of going outdoors might be weaker. In contrast, for those not currently employed, going outdoors would provide important opportunities to interact with others, and the loss of going outdoors might result in a more serious influence on mental health.

The present study assumed that the relationships between going outdoors and HRQOL were more relevant among those who lived alone. However, contrary to the assumption, the results of the present study showed that, while significant association of going outdoors with HRQOL was observed among those who lived with others, a significant association was not observed among those who lived alone. One potential reason for these unexpected results might be that the purposes of going outdoors among those who lived alone differed from the purposes of those who lived with others. While older adults go outdoors for various purposes, the degrees of activity levels in going outdoors differ by the purposes of going outdoors.[6,26] Despite the lack of available current evidence, it would be reasonable to consider that going outdoors for daily necessities, such as shopping for groceries and running errands, might have lower impact on HRQOL than going outdoors for social and enjoyable purposes such as social visits, exercise for leisure, and entertainment. Those who live alone

usually have to acquire groceries and run their errands by themselves. Thus, going outdoors for daily necessities would be more common among those who live alone than among those who live with others, and then the impact on HRQOL of going outdoors might be weaker among them. However, the present study did not measure the purposes of going outdoors, and no previous studies have examined the health effects of different purposes of going outdoors by living status among older adults. Further examinations are necessary to determine the mechanisms of the moderating role of living status on the relationships between going outdoors and HRQOL.

A strength of the present study is the employment of a prospective design. However, the present study includes some limitation. First, data were acquired from one small community. Neighborhood factors might influence the frequency of going outdoors among older adults.[20] However, as the present sample was selected only from one community, the external validity of the findings may be weak. Second, going outdoors was measured by a single self-reported item. Except for the frequency, this study but did not measure other aspects of going outdoors, including purpose, duration, interactions with other people, and mode of transportation. Third, as shown in Table 1, characteristics of those included in the present study differed from those excluded. Compared with the excluded participants, the included participants were likely to be younger; more highly educated; and in better status for IADL, HRQOL, and going outdoors. This indicates that there is a selection bias for the included participants and weakens the internal validity of the findings. Fourth, the present study did not measure the types and frequency of working. Thus, further examination using objective and detailed data about going outdoors, differentiating types and frequencies of work, and from more diverse communities are needed. Nevertheless, the present study can contribute to a better understanding of the influences of going outdoors on HRQOL among older adults.

In conclusion, the present study found that the frequency of going outdoors predicted HRQOL among older adults not currently employed and living with others. Encouraging older adults who do not work and who live with others to go outdoors might be effective in preventing a decline in their HRQOL. Further research examining the individual differences of the effects of going outdoors on health promotion is recommended.

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Disclosure statement

There are no potential conflicts of interest to disclose.

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Table 1. Baseline Characteristics of Respondents

	Analysis of the present study		
	Excluded[a]	Included	
	n or mean	*n* or mean	p-value
Gender, *n* (%)			0.541[b]
Male	181 (40.9)	262 (42.7)	
Female	262 (59.1)	351 (57.3)	
Educational level, *n* (%)			0.003[b]
Junior high school/high school	278 (63.0)	330 (53.8)	
Higher than high school	163 (37.0)	283 (46.2)	
Decline in instrumental activities of daily living, *n* (%)			<0.001[b]
No	336 (80.2)	554 (90.4)	
Yes	83 (19.8)	59 (9.6)	
Living alone, *n* (%)			0.247[b]
No	348 (77.5)	493 (80.4)	
Yes	101 (22.5)	120 (19.6)	
Current employment status, *n* (%)			0.566[b]
No	338 (75.6)	454 (74.1)	
Yes	109 (24.4)	159 (25.9)	
Age, mean (SD)	73.9 (9.0)	72.4 (7.2)	0.005[c]
Frequency of going outdoors, mean (SD)	4.6 (2.0)	4.9 (1.8)	0.017[c]
PCS at baseline, mean (SD)	45.9 (8.6)	47.7 (6.7)	<0.001[c]
MCS at baseline, mean (SD)	48.6 (7.8)	50.0 (6.3)	0.003[c]
PCS at follow-up, mean (SD)	—	44.8 (8.8)	—
MCS at follow-up, mean (SD)	—	48.6 (7.3)	—

SD, standard deviation

PCS, physical component summary

MCS, mental component summary

[a]Sample sizes in the excluded group vary due to missing data.

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

Table 2. Fixed effects in linear mixed models for association between going outdoors, living alone, and current employment status with HRQOL

	Physical component summary						Mental component summary					
	Model 1			Model 2			Model 1			Model 2		
	Estimate	SE	*p* value	Estimate	SE	*p* value	Estimate	SE	*p* value	Estimate	SE	*p* value
Intercept	56.52	2.38	<0.001	55.51	2.42	<0.001	50.06	2.33	<0.001	48.78	2.36	<0.001
Time (follow-up)	−0.53	0.37	0.152	−0.53	0.37	0.152	0.19	0.36	0.605	0.19	0.36	0.604
Gender (female)	0.26	0.41	0.530	0.24	0.41	0.556	0.40	0.40	0.314	0.40	0.40	0.322
Age (year)	−0.16	0.03	<0.001	−0.16	0.03	<0.001	−0.03	0.03	0.353	−0.03	0.03	0.373
Education (beyond high school)	1.41	0.38	<0.001	1.42	0.38	<0.001	0.62	0.37	0.091	0.64	0.37	0.082
Decline in IADL (yes)	−4.03	0.66	<0.001	−3.96	0.66	<0.001	−0.54	0.65	0.403	−0.46	0.64	0.480
Living alone (yes)	−0.82	0.49	0.094	1.57	1.24	0.207	−0.19	0.48	0.699	2.49	1.21	0.040
Current employment status (yes)	0.82	0.48	0.083	2.83	1.58	0.073	−0.49	0.47	0.294	2.36	1.54	0.126
Frequency of going outdoors (day/week)	0.44	0.11	<0.001	0.64	0.14	<0.001	0.31	0.11	0.004	0.56	0.14	<0.001
Living alone × going outdoors				−0.52	0.24	0.034				−0.58	0.24	0.015
Employment status × going outdoors				−0.38	0.28	0.164				−0.54	0.27	0.045

SE, standard error

IADL, instrumental activities of daily living

Table 3. Fixed effects in linear mixed models for association between going outdoors and physical component scores stratified by living alone

	Living alone					
	No			Yes		
	Estimate	SE	*p* value	Estimate	SE	*p* value
Intercept	54.06	2.62	<0.001	65.16	5.84	<0.001
Time (follow-up)	−0.38	0.40	0.348	−1.14	0.89	0.204
Gender (female)	0.12	0.44	0.777	1.16	1.23	0.348
Age (year)	−0.13	0.03	<0.001	−0.27	0.07	<0.001
Education (beyond high school)	1.32	0.41	0.001	1.51	0.94	0.109
Decline in IADL (yes)	−4.11	0.68	<0.001	−3.60	2.33	0.123
Current employment status (yes)	0.97	0.51	0.057	−0.61	1.32	0.645
Frequency of going outdoors (day/week)	0.56	0.12	<0.001	0.09	0.24	0.714

Dependent variable was physical component summary.

SE, standard error

IADL, instrumental activities of daily living

Table 4. Fixed effects in linear mixed models for association between going outdoors with mental component scores stratified by living alone and employment status

	Living alone						Current employment status					
	No			Yes			No			Yes		
	Estimate	SE	*p* value	Estimate	SE	*p* value	Estimate	SE	*p* value	Estimate	SE	*p* value
Intercept	49.48	2.57	<0.001	51.69	5.60	<0.001	48.83	2.81	<0.001	53.16	4.69	<0.001
Time (follow-up)	0.06	0.39	0.884	0.71	0.86	0.406	0.28	0.43	0.515	−0.08	0.66	0.909
Gender (female)	0.05	0.43	0.910	2.06	1.18	0.082	0.69	0.48	0.146	−0.20	0.74	0.789
Age (year)	−0.02	0.03	0.502	−0.06	0.07	0.380	−0.02	0.03	0.570	−0.06	0.06	0.337
Education (beyond high school)	0.33	0.41	0.411	1.40	0.90	0.121	0.45	0.44	0.305	1.16	0.68	0.091
Decline in IADL (yes)	−0.83	0.67	0.214	1.55	2.23	0.489	−1.15	0.77	0.133	1.05	1.19	0.376
Living alone (yes)	—	—	—	—	—	—	0.16	0.54	0.771	0.70	1.05	0.504
Current employment status (yes)	−0.51	0.50	0.311	−1.29	1.26	0.308	—	—	—	—	—	—
Frequency of going outdoors (day/week)	0.44	0.12	<0.001	0.02	0.23	0.918	0.39	0.12	0.001	−0.05	0.23	0.814

Dependent variable was mental component summary.

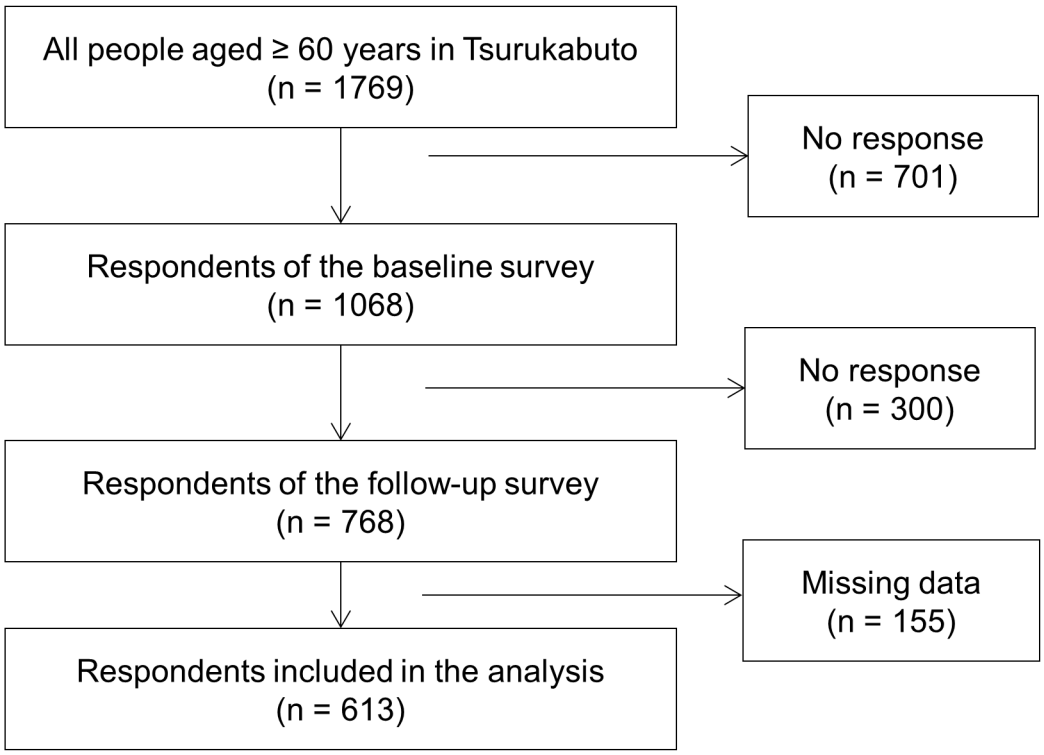
SE, standard error

IADL, instrumental activities of daily living

Figure Legend

Figure 1. Study process from the baseline survey to study completion.

Tsurukabuto community is located in Nada Ward, Kobe City, Japan.


All people aged ≥ 60 years in Tsurukabuto
(n = 1769)
No response
(n = 701)
Respondents of the baseline survey
(n = 1068)
No response
(n = 300)
Respondents of the follow-up survey
(n = 768)
Missing data
(n = 155)
Respondents included in the analysis
(n = 613)

Supporting Information

Appendix Table 1. Association of Baseline Characteristics by Living Status

Appendix Table 2. Association of Baseline Characteristics by Current Employment Status

Appendix Table 1. Association of Baseline Characteristics by Living Status

	Living alone		
	No	Yes	
	n or mean	*n* or mean	p-value
Gender, *n* (%)			<0.001[a]
Male	241 (48.9)	21 (17.5)	
Female	252 (51.1)	99 (82.5)	
Educational level, *n* (%)			0.935[a]
Junior high school/high school	265 (53.8)	65 (54.2)	
Higher than high school	228 (46.2)	55 (45.8)	
Decline in instrumental activities of daily living, *n* (%)			0.024[a]
No	439 (89.0)	115 (95.8)	
Yes	54 (11.0)	5 (4.2)	
Current employment status, *n* (%)			0.019[a]
No	355 (72.0)	99 (82.5)	
Yes	138 (28.0)	21 (17.5)	
Age, mean (SD)	71.8 (7.0)	75.1 (7.3)	<0.001[b]
Frequency of going outdoors, mean (SD)	5.0 (1.7)	4.6 (2.0)	0.026[b]
PCS at baseline, mean (SD)	47.9 (6.6)	47.0 (7.2)	0.192[b]
MCS at baseline, mean (SD)	50.1 (6.2)	49.6 (6.8)	0.423[b]
PCS at follow-up, mean (SD)	47.5 (6.9)	45.8 (7.2)	0.021[b]
MCS at follow-up, mean (SD)	50.1 (6.2)	50.3 (6.6)	0.827[b]

SD, standard deviation

PCS, physical component summary

MCS, mental component summary

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

Appendix Table 2. Association of Baseline Characteristics by Current Employment Status

	Current employment status		
	No	Yes	
	n or mean	*n* or mean	p-value
Gender, *n* (%)			<0.001[a]
Male	174 (38.3)	88 (55.3)	
Female	280 (61.7)	71 (44.7)	
Educational level, *n* (%)			0.032[a]
Junior high school/high school	256 (56.4)	74 (46.5)	
Higher than high school	198 (43.6)	85 (53.5)	
Decline in instrumental activities of daily living, *n* (%)			0.924[a]
No	410 (90.3)	144 (90.6)	
Yes	44 (9.7)	15 (9.4)	
Living alone, *n* (%)			0.019[a]
No	355 (78.2)	138 (86.8)	
Yes	99 (21.8)	21 (13.2)	
Age, mean (SD)	74.2 (6.9)	67.3 (5.5)	<0.001[b]
Frequency of going outdoors, mean (SD)	4.6 (1.8)	5.6 (1.5)	<0.001[b]
PCS at baseline, mean (SD)	47.0 (6.9)	49.6 (5.7)	<0.001[b]
MCS at baseline, mean (SD)	49.9 (6.5)	50.1 (5.7)	0.733[b]
PCS at follow-up, mean (SD)	46.5 (7.1)	49.0 (6.3)	<0.001[b]
MCS at follow-up, mean (SD)	50.2 (6.4)	50.0 (6.1)	0.791[b]

SD, standard deviation

PCS, physical component summary

MCS, mental component summary

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