Acta Med. Okayama, 2018
Vol. 72, No. 1, pp. 31–37

Acta Medica Okayama
http://escholarship.lib.okayama-u.ac.jp/amo/

Original Article

Relationship between Social Participation, Physical Activity and Psychological Distress in Apparently Healthy Elderly People: A Pilot Study

Yutaka Owari[a,b]*, Nobuyuki Miyatake[b], and Hiroaki Kataoka[b]

[a]*Shikoku Medical College, Utazu, Kagawa 769-0205, Japan,*
[b]*Department of Hygiene, Faculty of Medicine, Kagawa University, Miki, Kagawa 761-0793, Japan*

Few studies examined the relationship between social participation, physical activity and psychological distress in elderly people. Here we examined these relationships in apparently healthy elderly people. After exclusion of subjects who dropped out or did not meet enrollment criteria, the data of 86 subjects (apparently healthy elderly embers at a college health club; 25 males, 61 females) from July 20 to September 10, 2016 were used. We evaluated each subject's psychological distress using the K6 questionnaire, social participation by a self-completed questionnaire, and physical activity level by a triaxial accelerometer (7 consecutive days). The K6 scores were significantly correlated with social participation in the total series and the women. The K6 scores of the subjects who had engaged in social participation (1.847 ± 2.231) were significantly lower (better) than those of the subjects who had not (6.714 ± 5.014). Both exercise limitation and social participation were significant predictors of the K6 scores. Our findings indicate that psychological distress in apparently healthy elderly people is not associated with physical activity, but is associated with social participation. Our results demonstrate that in healthy elderly people, participating in a social activity can help improve psychological distress.

Key words: elderly people, physical activity, psychological distress, social participation

In Japan, the number of individuals with mood and anxiety disorders (including depression) in 2014 was reported to be 1,116,000 [1], and 340,000 (30%) of these individuals were elderly people (≥65 years old) [1]. With the continuing increase in the numbers and proportions of elderly people in Japan, the number of patients with mood and anxiety disorders (including depression) is predicted to increase. Therefore, the effective prevention and improvement of mental health in the elderly is urgently required.

The associations between physical activity and mental health have been evaluated [2-9], but the results of these studies are not definitive and remain controversial [10,11]. Moreover, there are few studies on the relationship between physical activity depending on exercise intensity and mental health (including psychological distress) in the elderly, and this relationship is not well established in Japan [12,13]. It is also possible that factors other than physical activity may be more effective for improving mental health in the elderly. One of these factors was suggested to be social participation [14]. Although the definition of social participation had not been established and varies greatly among researchers, Japan's Ministry of Health, Labor and Welfare (MHLW) has described efforts to identify social participation-related items "the investigation of items an elderly person needs in everyday life" (http://www8.

Received April 18, 2017; accepted August 22, 2017.
*Corresponding author. Phone: +81-87-891-2465; Fax: +81-87-891-2134
E-mail: owari@med.kagawa-u.ac.jp (Y. Owari)

Conflict of Interest Disclosures: No potential conflict of interest relevant to this article was reported.

cao.go.jp/kourei/whitepaper/w-2014/zenbun/pdf/1s2s_5.pdf [in Japanese] accessed 8, 2017). We used these MHLW-identified items as those of social participation in the present study. We conducted this investigation to elucidate the relationships between social participation, physical activities and psychological distress in apparently healthy elderly people.

Methods

Study design. We performed an observational (cross-sectional) study. In order to define our purpose, we adopted two hypotheses: (1) elderly people engaging in social participation would show lower levels of psychological distress, and (2) psychological distress in elderly people would be alleviated by increasing their physical activity. The subjects targeted for this study were 96 individuals who offered their cooperation in this study among the apparently healthy elderly people who were members at the health club of college A in Utazu, Japan (population approx. 18,450). We carried out the study from July 20 to September 10, 2016. Three of the 96 volunteers canceled and 7 did not meet the criteria used for the standard measurements of physical activity; we excluded these 10 individuals from the analysis. The final subject population was 25 men (aged 71.5 ± 5.4 years) and 61 women (71.9 ± 5.5 years) in the present pilot study. We received approval from the Shikoku Medical College Ethics Screening Committee (approval no.: H27-3), and written informed consent to participate in the study was also obtained from each subject.

Clinical parameters and measurements. We evaluated anthropometric and body composition based on the following parameters as confounding factors: age (years), height (cm), body weight (kg), body mass index (BMI) (kg/m^2), and working hours (h/day). We determined each subject's health behavior included sleeping time (h/day), spouse (presence/absence) (%), and exercise limitation (presence/absence) (%) (this depended on the diagnosis of the subject's physician), pain in limbs (presence/absence) (%), smoking habit (%), and drinking habit (%) (for the definition of smoking and drinking habits, we used the definition in the specific medical checkup question provided by the MHLW (http://www.mhlw.go.jp/bunya/kenkou/seikatsu/pdf/02b.pdf [in Japanese] accessed 8, 2017).

Psychological distress. We measured each subject's level of psychological distress, an objective variable. In a previous study [15], psychological distress was assessed using 6 items of the Japanese edition of the Kessler Psychological Distress Scale (K6) scale [16]. The K6 is a self-completed questionnaire developed by R.C. Kessler as a screening test for psychological distress that can effectively discriminate psychological distress [17]: it is valid and reliable. Our subjects answered the following six K6 questions on a 5-point Likert scale, and the response to each item was transformed into scores ranging from 0 to 4 points. Each of the 6 questions begins with the wording "Over the last month, about how often did you feel:" (1) nervous, (2) hopeless, (3) restless or fidgety, (4) so sad that nothing could cheer you up, (5) that everything was an effort, (6) worthless? The subjects were asked to respond by choosing from the following: "all of the time" (4 points), "most of the time" (3 points), "some of the time" (2 points), "a little of the time" (1 point), and "none of the time" (0 points), and we used the sum of the subject's points on the 6 questions as the evaluation level [18]. Thus, the score range was 0-24. A higher total score corresponds to higher psychological distress.

Social participation. We determined the level of each subject's social participation, as an explanatory variable. We evaluated social participation as established by Haeuchi *et al.* [19]. The subjects were asked whether they participated in each of 8 types of social activities within the 1-year before the date of the survey: (1) local events and festivals, (2) a resident or neighborhood association, (3) a circle activity; *i.e.*, a group activity based on a hobby or an interest such as history, (4) a golden-age club, (5) volunteer activity, (6) religious activity, (7) paid work, and (8) learning in a social environment, within the past year from the date of the survey. The subjects were requested to respond by choosing from the following: "participated in this social activity (or more than one activity) within the past month, one or more times per week" (1 point), "participate in no activities" (0 points). Thus, the score range was 0-8.

Physical activity. To measure the level of each subject's physical activity (an explanatory variable), we recorded the activity using a triaxle accelerometer (Active Style Pro HJA-750C, Omron Healthcare, Kyoto, Japan) for 14 consecutive days. The subjects were asked to wear the accelerometer at all times except when it was not possible, such as while bathing and swimming. The

standard deviation of the data of each 10-sec interval recorded by the accelerometer was used as the average value of acceleration. We asked the subjects to wear the accelerometer ≥ 10 h/day for 7 consecutive days including a Saturday or a Sunday. Physical activity was evaluated by Σ[metabolic equivalents × h per week (Mets • h/w)], daily step counts (steps/day), daily step hours (h/day), walking time (min/day) and physical activity (≤ 1.5 Mets, 1.6-2.9 Mets, 3-5.9 Mets) (min/day). As the physical active mass did not exhibit a normal distribution, we adopted the median.

Statistical analysis. Continuous variables are presented as the mean ± standard deviation (SD), and categorical variables are shown as percentages. To assess the relationships among psychological distress, social participation, and physical activity factors, we used simple correlations and the Mann-Whitney *U*-test, and *p*-values <0.05 were considered significant. We also performed a multiple regression analysis with the K6 scores as the purpose variable and with BMI, exercise limitation (presence), physical activity level (≤ 1.5 Mets), and social participation (model 1) as the four explanatory variables to clarify the relationships among psychological distress, social participation, and level of physical activity. We selected these 4 explanatory variables in reference to many precedent studies. We also performed a stepwise multiple regression analysis on all variable factors that might affect the K6 scores (model 2) to inspect the robustness of model 1. A variance inflation factor (VIF) was used to check for multicollinearity.

All calculations were performed using the STATA program, ver. 14 (Stata, College Station, TX, USA).

Results

We obtained the following results. The clinical profiles of the 86 enrolled elderly subjects (25 men and 51 women) are summarized in Table 1. The results of our analyses of the relationships between the K6 scores and the clinical parameters are summarized in Table 2. In the series of all subjects, the K6 scores were significantly correlated with social participation ($p<0.05$). However, no clear correlations between the K6 scores and other clinical parameters were noted. The multiple regression analysis with K6 scores as the purpose variable and BMI, exercise limitation, social participation, and physical activity level (≤ 1.5 Mets) as explanatory variables to adjust for confounding factors (model 1) revealed that both exercise limitation and social participation were significant predictors of K6 scores (adjusted $R^2=0.3008$, $F=10.1422$, $p<0.001$) (Table 3). We also performed a stepwise regression analysis using the K6 scores as the purpose variable, and sex, age, BMI, working hours, exercise, number of steps/day, minutes/day of walking, physical activity level, social

Table 1 Clinical characteristics of enrolled subjects

	Total			Men			Women		
	Mean ± SD	Minimum	Maximum	Mean ± SD	Minimum	Maximum	Mean ± SD	Minimum	Maximum
Number of subjects	86			25			61		
Age (year)	71.7 ± 5.5	65	85	71.5 ± 5.4	65	85	71.9 ± 5.5	65	85
Height (cm)	157.1 ± 9.2	138.3	178.4	167.2 ± 6.1	155.3	178.4	152.8 ± 6.2	138.3	166.4
Body weight (kg)	55.9 ± 9.6	40.3	86.2	65.7 ± 8.7	50.4	86.2	51.9 ± 6.7	40.3	65.4
BMI (kg/m^2)	22.6 ± 2.8	14.9	29.1	23.5 ± 2.7	17.6	29.1	22.2 ± 2.7	14.9	28.8
Working hours (h/day)	1.8 ± 2.9	0	10	3.3 ± 3.6	0	10	1.2 ± 2.4	0	10
Exercise (MeTs · h/w)	5.2 ± 2.2	0.4	9.7	4.7 ± 2.1	1.6	9.3	5.4 ± 2.1	0.4	9.7
Number of steps (steps/day)	5,692.8 ± 2,527.2	569.9	12,230.1	5,881.5 ± 2,413.8	1,585.4	11,049.1	5,615.5 ± 2,587.7	569.9	12,230.1
Walking time (min/day)	85.1 ± 32.2	20.9	177.7	88.8 ± 34.1	31.3	177.7	83.6 ± 31.6	20.9	177.0
≤1.5 Mets (%/day)	55.0 ± 9.9	35.4	79.9	59.4 ± 11.4	36.8	79.9	53.2 ± 8.7	35.4	75.5
1.6～2.9 Mets (%/day)	35.3 ± 7.8	16.9	52.3	31.6 ± 8.6	16.9	45.3	36.8 ± 6.9	19.4	52.3
3～5.9 Mets (%/day)	9.1 ± 3.8	0.8	17.0	8.7 ± 4.4	2.8	17.0	9.3 ± 3.5	0.8	15.6
K6 scores	2.6 ± 3.4	0	14	2.9 ± 3.6	0	13	2.5 ± 3.3	0	14
Sleep time (h/day)	6.5 ± 1.1	4	10	6.7 ± 0.9	5	9	6.5 ± 1.1	4	10
Social participation (Presence) (%)	83.7			84.0			81.8		
Spouse (Presence) (%)	75.5			96.0			67.2		
Exercise limitation (Presence) (%)	10.4			12.0			9.8		
Pain in limbs (Presence) (%)	75.5			60.0				81.9	
Smoking status (Smoker) (%)	4.6			12.0			1.6		
Alcohol drinking status (Drinker) (%)	29.0			52.0			19.6		

BMI, body mass index (kg/m^2); Mets, Metabolic equivalents.

Table 2 Simple correlation and Mann-Whitney *U* test analysis between K6 scores and clinical parameters

	Total		Men		Women	
Simple correlation	r	*p*	r	*p*	r	*p*
BMI (kg/m^2)	−0.098	0.369	0.200	0.338	−0.188	0.147
Working hours (h/day)	−0.055	0.618	−0.146	0.486	−0.212	0.100
Exercise (Mets・h/w)	−0.165	0.129	−0.106	0.613	−0.136	0.297
Number of steps (steps/day)	−0.132	0.226	−0.075	0.722	−0.107	0.413
Walking time (min/day)	−0.095	0.386	0.142	0.498	−0.093	0.476
≤1.5 Mets (%/day)	0.031	0.778	0.152	0.467	−0.020	0.881
1.6〜2.9 Mets (%/day)	0.016	0.882	−0.086	0.682	0.086	0.511
3〜5.9 Mets (%/day)	−0.106	0.332	−0.194	0.354	−0.111	0.394
Sleep time (h/day)	0.027	0.804	−0.018	0.932	−0.011	0.933
	Total		Men		Women	
Mann–Whitney U test	Mean ± SD	*p*	Mean ± SD	*p*	Mean ± SD	*p*
Social participation (Presence)	1.847 ± 2.231	**<0.001**	2.190 ± 2.542	0.167	1.706 ± 2.100	**0.002**
(none)	6.714 ± 5.014		6.750 ± 6.238		6.700 ± 4.832	
Spouse (Presence)	2.677 ± 3.341	0.802	3.042 ± 3.653	none	2.463 ± 3.171	0.867
(none)	2.524 ± 3.487		none ±		2.650 ± 3.528	
Exercise limitation (Presence)	4.778 ± 4.577	0.085	4.000 ± 3.464	0.462	5.167 ± 5.307	0.116
(none)	2.390 ± 3.129		2.773 ± 3.702		2.236 ± 2.893	
Pain in limbs (Presence)	3.046 ± 3.642	0.081	3.800 ± 4.195	0.196	2.820 ± 3.474	0.182
(none)	1.381 ± 1.802		1.600 ± 2.119		1.182 ± 1.537	
Smoking habits (Smoker)	4.750 ± 5.679	0.377	3.046 ± 3.823	0.829	2.350 ± 2.991	none
(none)	2.537 ± 3.225		2.000 ± 1.732		none ±	
Drinking habits (Drinker)	2.200 ± 3.000	0.615	1.923 ± 1.935	0.573	2.531 ± 3.130	0.631
(none)	2.820 ± 3.500		4.000 ± 4.710		2.500 ± 3.920	

Bold values are significant ($p < 0.05$).
BMI, body mass index (kg/m^2); EX, Mets * h, M, Mets (Metabolic equivalents).
none, unmeasurable for few samples.

Table 3 Multiple regression analysis to identify the association between K6 and performance in daily life (model 1)

Objective variable	Explanatory variables	*β*	95% CI	*p*	VIF
K6 scores					
	BMI (kg/m^2)	−0.104	−0.335〜 0.126	0.371	1.096
	≤1.5 Mets (%/day)	0.020	−0.045〜 0.084	0.544	1.109
	Social participation (Presence)	−4.751	−6.388〜−3.113	**<0.001**	1.008
	Exercise limitation (Presence)	2.089	0.091〜 4.088	**0.041**	1.032

Bold values are significant ($p < 0.05$).
$R^2 = 0.3525$, Adjusted $R^2 = 0.3288$.
VIF: Multicollinearity Variance Inflation Factor.
Multiple regression equation $F = 14.8774$, $p < 0.001$.

participation, sleeping time, spouse, exercise limitation, pain in limbs, smoking and drinking as explanatory variables to adjust for confounding factors. Among all subjects, exercise limitation and social participation were determinant factors of the K6 scores (adjusted $R^2 = 0.3247$, $F = 11.2188$, $p < 0.001$) (model 2) (Table 4). The mean VIF values of models 1 and 2 were < 1.2, suggesting that multicollinearity did not exist between these variables. Even when continuous variables were used instead of binary variables for social participation, K6 and social participation showed a significant correlation (data not shown).

Table 4 Multiple regression analysis to identify the association between K6 and performance in daily life (model 2)

Objective variable	Explanatory variables	β	95% CI	p	VIF
K6 scores					
	Social participation (Presence)	−4.558	−6.190 ～ −2.927	<0.001	1.036
	Spouse (Presence)	1.065	−0.410 ～ 2.540	0.155	1.146
	Exercise limitation (Presence)	2.426	0.425 ～ 4.428	0.018	1.071
	Pain in limbs (Presence)	1.217	−0.234 ～ 2.668	0.099	1.109

Bold values are significant ($p < 0.05$).
$R^2 = 0.3565$, Adjusted $R^2 = 0.3247$.
VIF: Multicollinearity Variance Inflation Factor.
Multiple regression equation $F = 11.2188$, $p < 0.001$.

Discussion

In this cross-sectional study of apparently healthy elderly people (≥65 years old), we first evaluated the relationship between the K6 scores (a measure of psychological distress) and social participation measured by a self-completed questionnaire. The results demonstrated a significant association between the K6 scores and social participation (by Mann-Whitney *U*-test) in these elderly adults, especially in the women.

In Japan, Jindo *et al.* [12] indicated that among elderly people in a city in Japan, good psychological condition was related to exercising together with others than by oneself. Takeda *et al.* [20] also supported that result in studies of middle-aged people. Mechakra-Tahiri *et al.* [14] reported that "volunteer work (for older adults) may be beneficial for mental health, particularly for men." Takagi *et al.* [21] also reported that "higher social participation and performing key roles in an organization had protective effects on depressive symptoms for women. However, there were no main effects of these variables on the mental health of men." According to these precedent studies, the significant differences of these relationships varied between men and women.

In the present study, we observed that the K6 scores were significantly correlated with social participation in the total series and among the women, but there was no corresponding significant correlation in the men. We suspect that this lack of a correlation in the males is due to the small sample size (n = 25). Cohen [22] explained that the sample size required was n = 84 for α = 0.05, power = 0.80 and r = 0.3; n = 28 for α = 0.05, power = 0.80 and r = 0.5. We thus feel that the sample number was sufficient for all of our subjects (n = 86) and the women (n = 61), but not the men.

We also evaluated the relationship between the K6 scores and the intensity of physical activity measured over a 7-day period by a triaxial accelerometer. The results demonstrated no significant association between K6 scores and physical activity level. Many studies reported that the correlation in elderly people between psychological distress and physical activity were statistically significant [2-9]. In addition, physical activity (≤1.5 Mets) was associated with psychological distress in elderly people [23,24]. In the present study, we found no clear relationship between the K6 scores and physical activity stratified by intensity. Sallis and Owen [25] reported that subjects without psychological problems would not be expected to achieve further improvements in psychological status by exercise. We speculated that elderly people who frequented a health club as a target group were more health-conscious than the average population. Moreover, the K6 scores of our target group were lower than those in other studies (http://ikiru.ncnp.go.jp/ikiru-hp/report/ueda16/ueda16-8.pdf [in Japanese] accessed August, 2017). These factors would appear to explain why a significant relationship between the K6 scores and physical activity stratified by intensity was not noted in this study.

We conducted a multiple regression analysis with the K6 scores as the purpose variable and BMI, exercise limitation, social participation, and physical activity level (≤1.5 Mets) as explanatory variables to adjust for confounding factors (model 1). We selected four explanatory variables: physical activity level (≤1.5 Mets) and social participation for the inspection of our hypothesis, and BMI and exercise limitation in light of previous studies [26,27]. Model 1 included exercise limitation and social participation as dummy variables which took a value of 0 or 1. The value 0 indicates the absence of the attributes of the category, and the value

1 indicates the presence of the attributes of category. We also conducted a stepwise multiple regression analysis on all variable factors that may affect the K6 scores (model 2) to inspect the robustness of model 1. The result was that both exercise limitation and social participation were significant predictors of the K6 scores. In detail, when other factors were assumed to be uniform, the K6 scores lowered to 4.75 in comparison with no social participation. In contrast, the K6 scores were 2.09 for both with and without exercise limitation, but the relationship between the K6 scores and exercise limitation was not significant using Mann-Whitney *U*-test. Overall, our findings are in accord with many previous studies.

Our study has several potential limitations. First, the study design was cross-sectional, not longitudinal. Second, the small sample sizes, especially of the men, make it difficult to validate our findings. We could not prove the relationship between the K6 scores and social participation. Third, we chose apparently healthy elderly people as subjects; we thus could not make conclusions about a relationship between the K6 scores and physical activity. To confirm these results, further prospective investigations, large sample-size studies, and random sampling from the elderly population are urgently required.

In conclusion, it seems reasonable to suggest that social participation may result in improvement in psychological distress among apparently healthy elderly people.

References

1. Ministry of Health, Labor and Welfare: Patient investigation (kannjya chousa [in Japanese]) (2014).
2. Lampinen P, Heikkinen RL, Kauppinen M and Heikkinen E: Activity as a predictor of mental well-being among older adults. Aging Ment Health (2006) 10: 454–466.
3. Strawbridge WJ, Deleger S, Roberts RE and Kaplan GA: Physical activity reduce the risk of subsequent depression for older adults. Am J Epidemiol (2002) 156: 328–334.
4. Blumenthal JA, Emery CF, Madden DJ, Schniebolk S, Walsh-Riddle M, George LK, Mckee DC, Higginbotham MB, Cobb FR and Coleman RE: Long-term effects of exercise on psychological functioning in older men and women. J Gerontol (1991) 46: 352–361.
5. Harris AH, Cronkite R and Moos R: Physical activity, exercise coping, and depression in a 10-year cohort study of depressed patients. J Affect Disord (2006) 93: 79–85.
6. Kawakami N, Ido M and Shimizu H: Prevalence and correlates of major depressive episode among the elderly in a community in Japan. Japan Society of Public Health (1995) 42: 792–798 (in Japanese).
7. Osada H, Shibata H, Haga H and Yasumura S: Relationship of physical condition and functional capacity to depressive status in person aged 75 years. Japan Society of Public Health (1995) 42: 897–909 (in Japanese).
8. Oida Y, Arao T, Nishijima Y and Kitabatake Y: Relationship among Functional Fitness, Activities in Daily Life, and Emotional Status in Aged People. Bulletin of the Physical Fitness Research Institute (1996) 90: 7–16 (in Japanese).
9. Ide K, Hatayama T, Nagano M, Une H and Kumagai S: Relationship between physical fitness and mental health in the community dwelling elderly. Bulletin of the Physical Fitness Research Institute (2010) special issue; 11–19 (in Japanese).
10. Koyano W, Shibata H, Haga H and Suyama Y: Measurement of competence in the elderly living at home: development of an index of competence. Japan Society of Public Health, (1987) 34: 109–114 (in Japanese).
11. Kritz-Silverstein D, Barrett-Connor E and Corbeau C: Cross-sectional and Prospective Study of Exercise and Depressed Mood in the Elderly. Am J Epidemiol (2001) 153: 596–603.
12. Jindo T and Okura T: Association between the presence of exercise buddy and depression in community-dwelling older adults. Bulletin of the Physical Fitness Research Institute (2016) special issue: 37–42 (in Japanese).
13. Imahori M, Shirase Y and Noguchi H: Effects of preventive long-term care on physical and psychological health status for the elderly: Evidence from a "Salon for the Elderly" in Abashiri City. Japan Society of Public Health (2016) 63: 675–681 (in Japanese).
14. Mechakra-Tahiri S, Zunzunequi MV, Preville M and Dube M: Social relationships and depression among people 65 years and over living in rural and urban areas of Quebec. Int J Geriatr Psychiatry (2009) 24: 1226–1236.
15. Sakano N, Suzue T, Miyatake N, Yoda T, Yoshioka A, Nagatomi T, Shiraki W and Hirano T: Factors associated with psychological distress of Public Health Nurse in Kagawa prefecture, Japan: a pilot study. Open J Nurs (2012) 2: 23–30.
16. Furukawa TA, Kawakami N, Saitoh M, Ono Y, Nakane Y, Nakamura Y, Tachimori H, Iwata N, Uda H, Nakane H, Watanabe M, Naganuma Y, Hata Y, Kobayashi M, Miyake T, Takeshima T and Kikkawa T: The performance of the Japanese version of the K6 and K10 in the World Mental Health Survey Japan. Int J Methods Psychiatr Res (2008) 17: 152–158.
17. Kessler RC, Andrews G, Colpe LJ, Hiripi E, Mroczek DK, Normand SL, Walters EE and Zasiavsky AM: Short Screening Scales to Monitor Population Prevalences and Trends in Non-Specific Psychological Distress. Psychol Med (2002) 32: 959–976.
18. Katayama A, Miyatake N, Nishi H, Uzike K, Sakano N, Hashimoto H and Koumoto K: Evaluation of physical activity and its relationship to health-related quality of life in patients on chronic hemodialysis. Environ Health Prev Med (2014) 19: 220–225.
19. Haeuchi Y, Honda T, Chen T, Narazaki K, Chen S and Kumagai S: Association between participation in social activity and physical fitness in community-dwelling older Japanese adults. Japan Society of Public Health (2016) 63: 727–737 (in Japanese).
20. Takeda F, Noguchi H, Monma T and Tamiya N: How possibly do leisure and social activities impact mental health of middle-aged adults in Japan?: An evidence from a national longitudinal survey. PLoS One (2015) 2 October: 10.
21. Takagi D, Kondo K and Kawachi I: Social participation and mental health: moderating effects of gender, social role and rurality.

BMC Public Health (2013) 13/701: 8.
22. Cohen J: A Power Primer. Psychological Bulletin (1992) 112: 155–159.
23. Lee H, Lee J-Ah, Brar JS, Rush EB and Jolley CJ: Physical activity and depressive symptoms in older adults. Geriatric Nursing (2014) 35: 37–41.
24. Ishihara T, Tou K, Takizawa K and Mizuno M: Effects of Daily Exercises on Executive Function and Mental Health in Elderly Individuals: Comparison between Low Intensity and Moderate/Vigorous Intensity Exercise. Japan Society of Physiological Anthropology (2015) 20: 127–133 (in Japanese).
25. Sallis JF and Owen N: Physical Activity, Psychological Health, and Quality of Life; in Physical Activity and Behavioral Medicine, 1st Ed, Sage Publications, Thousand Oaks, CA (1998) pp41–52.
26. Kuriyama S. Nakaya N and Ohmori-Matsuda K: Factors Associated with Psychological Distress in a Community-Dwelling Japanese Population: The Ohsaki Cohort 2006 Study. J Epidemiol (2009) 19: 294–302.
27. Weyerer S: Physical inactivity and depression in the community: Evidence from the Upper Bavarian Field Study. Int J Sports Med (1992) 13: 492–496.