The association of daily activities with motor and cognitive functions in community living older adults

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日常活動が認知・運動機能に与える影響――地域高齢者における検討――

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要約

高齢者が認知症や寝たきりにならずにできるだけ長く健康寿命を保つために、厚生労働省は早期診断と早期治療に加え、栄養・運動・活動への参加など健康的な行動による予防政策を打ち出している。本研究の目的は、地域在住の高齢者 229 名を対象に、日常活動への参加状況が運動機能や認知機能と関連があるかを検討することである。10 種類の活動への参加頻度を 5 件法にて質問紙で調査し、運動機能（10 メートル歩行速度・重心動揺・最大一歩幅・背筋力）と認知機能（3 数字抹消検査・言語流暢性検査・散文の記憶再生）は個別に測定した。因子分析と相関分析の結果より、社会的活動・仕事・公共交通機関の利用や運転を高頻度で行っている者は認知機能も運動機能も良好であった。一方、家事・テレビ・親しい人との交流など主に家庭内での活動に取り組んでいる者は、高齢期に低下すると言われている注意機能や記憶機能には良い影響を示さなかった。高齢者は家に閉じこもらず、交通機関を利用して外出し、社会参加に努めることが機能維持につながると考える。

Key words

daily activities, work, social activity, cognitive and motor function, older adults

1. Introduction

Population aging is a remarkable demographic trend, especially in developed countries where life expectancy has increased and fertility rates have declined, due in part to improved public health and medicine (United Nations, 2011). Japan is considered the most aged society (elderly proportion is 23.1 % at 2011) and its course of aging has been very rapid compared to other countries (Japanese cabinet office, 2011). In aged societies, expenditures on social support for older people, such as pension, medical and welfare services are increasing; therefore, social participation among the elderly is an important issue because their participation is beneficial for the society. The Japanese government has set a goal of increasing the time that people can live a healthy life without suffering dementia or becoming bedridden by increasing prevention efforts, early detection and early treatment of behavioural health issues (Japanese ministry of Health, Labor and Welfare, 2012). Participation in activities, exercise and good nutrition habits in daily life support well-being.

Declines in motor and cognitive functions are common in old age (Gaugler et al., 2007; Buchman et al., 2007). Numerous studies related to gate found that age influenced maximum walking speed (Bohannon, 1997; Forrest et al., 2006; García-Ruiz et al., 2007; Samson et al., 2001; Shkuratova et al., 2004). Mild loss of muscle strength and bulk, balance and dexterity are common among the elderly (Baumgartner et al., 1998; Fried et al., 2001; Louis et al., 2005). Memory dysfunction is a common complaint of cognitive decline in aged people (Salthouse & Pink, 2008). In addition, there is evidence of a negative relationship between age and cognitive functions such as processing speed, explicit memory and verbal fluency (Brickman et al.,

2005; Davidson et al., 2003; Park et al., 2002; Park & Gutchess, 2002). Several studies have found an association between cognitive functions and motor performance among community dwelling elderly people (Fitzpatric et al., 2007; Rossano et al., 2005; Soumare et al., 2009). Research suggests that executive function and attention are associated with walking speed and risk of falls (Ble et al., 2005; Holtzer et al., 2006).

Preservation of these motor and cognitive functions through participation in activities is essential for the elderly because some functional deficits result in dependence on others or lower quality of life (Gaugler et al., 2007). Participation in leisure activities (cognitive and physical) has been associated with a decreased risk of poor cognition and early cognitive decline (Clocombe & Kramer, 2003; Verghese et al., 2003; Lin et al., 2012). Physical activity is associated with the rate of declining motor function in community-dwelling elders (Visser et al., 2002; Brach et al., 2003; Warburton et al., 2006; Buchman et al., 2007). In addition, accumulating evidence suggests that physical activity may reduce the risk of poor cognition and early cognitive decline (Yaffe et al., 2001 Weuve et al., 2004; Sumic et al., 2007; Etgen et al., 2010; Sofi, et al., 2010), and the frequency of participation in social activities is associated with motor functions (Buchman, et al., 2009) and cognitive functions (James, et al., 2011).

Although evidence of the relationship between some specific activities and functioning has been revealed separately, little is known about the effects of participation in daily activities on functioning comprehensively in older people. The purpose of this study was to examine the relationship between daily activities and both motor and cognitive functions simultaneously in the same cohort.

2. Subjects and Method

2.1 Procedures

We used a cross sectional survey design to collect data from a sample of older people living in a rural area. The study protocol was approved by the medical division review board of Nagoya University and the department of health and welfare in Yakumo town autonomy. This study was conducted in 2009 at a Yakumo town community centre for the elderly during the annual health checkup period.

Approximately one month before the checkup, we sent the questionnaire, which included demographic information and participation in activities, and the informed consent form to the elderly individual who registered for the annual health checkup through city administrative offices. We asked them to read the explanations and instructions of the study, answer the questions and bring the answered questionnaire and written consent on the day of their annual health checkup appointment.

On the appointed day, the subjects participated in motor and cognitive functional tests voluntarily while at the health checkup. These tests were administered individually and subjects could withdraw from participation at any time.

2.2 Participants

The subjects were recruited from those enrolled in the 2009 municipal health checkup. Inclusion criteria included living in Yakumo town, being 65 years of age or older, being able to read and write, walking independently, having no fatal illnesses and no significant cognitive impairment. Initially, 241 elderly people aged from 65 to 89 voluntarily applied to the study. Twelve participants were excluded because of the screening test of cognitive function (MMSE score ≦ 23; Folstein et al., 1975); therefore, 229 elderly people participated in the study. The characteristics of the participants are shown in Table 1.

Table 1: Characteristics of the participants (n = 229)

Parameters		%
Age		
	65-74	67.7
	Over 75	32.3
Gender		
	male	40.6
	female	59.4
Education		
	4- 9 years	50.6
	10-12 years	33.6
	Over 13 years	11.3
	unknown	4.4
Medical service		
	Yes	53.7
	No	30.6
	unknown	15.7

2.3 Measures

An anonymous questionnaire created by the authors was used to collect demographic data regarding gender, age, education and frequencies of participation in 10 groups of activities (domestic activities, work activities, social activities, reading and writing activities, contact with friends and families, using transport or driving, physical activities, handicrafts, artistic activity, watching TV or listening to music) with 5 alternatives . These activities were chosen based on the concept of Activity and Participation in International Classification of Functioning, Disability and Health (ICF: World Health Organization, 2001) which were categorized into the following groups: learning and applying knowledge, general tasks and demands, communication, mobility, self-care, domestic life, interpersonal interactions and relationships. We added some leisure activities based on a previous study (Ito et al., 2003; Taniguchi, 2006) because the activities are very important for well-being and can replace some of the lost occupation, especially after retirement (Silverstein & Park-

er, 2002).

Cognitive functions were assessed by a 3-digit cancellation task (Hatta, Ito & Yoshizaki 2001), verbal fluency tasks (Ito et al., 2004) and a memory task from the Japanese version of the Rivermead Behavioral Memory Test (Wilson 1985; Watamori et al., 2002). In the cancellation task, the subjects were given an A4 sized sheet of paper with lines of numbers printed at random and asked to cross out as many of the designated numbers (8/3/9) as they could for one minute. The number of crossed out numbers was applied as an index. The participants completed 2 verbal fluency tasks for one minute each. First, the participants were asked to generate as many words as possible beginning with A or Ka as letter fluency tasks. Second, they were asked to generate words related to Animal or Sport as category fluency tasks. We tallied the number of words generated except for repeated words. For the memory task, we asked the participants to memorize a short story consisting of 25 words read to them and then recall it immediately. The number of the words remembered was adopted as an index. Cancellation tasks are considered measures of selective attention, alternative attention and intensive attention. Verbal fluency tasks assess word knowledge, access to semantic memory, speed of information processing, working memory, inhibition and executive functions (Lezak, 1995; Ruff et al., 1996; Crowe, 1998). Immediate recall of a short story gauges an aspect of short-term logical memory (Sugishita, 2001; Wilson, 1985) from neuropsychological viewpoints. Deterioration of these functions is common in old age (Park et al., 1996; Baltes & Lindenberger, 1997).

Additionally, indices of motor functions, including static standing balance, back muscle strength, gate speed and maximum step-width, were measured. The static standing balance was measured by the stabile meter (GP-7; Anima Co.; Tokyo, Japan) individually and used the size of envelope surface with eyes open condition for 30 seconds as an index in this study. Back strength was measured twice by the digital back muscle meter (T.K.K.5402; Takei Scientific Instruments Co.; Niigata, Japan), and we then used a better index. We assessed gate speed using the time required for full-powered walking in 10 meters and maximum step length of the right leg. These functions are related to age-related declines and their changes related to fallings (Ferrandez et al., 1990; Lord et al., 1996; Shimada et al., 2003; Shumway-Cook et al., 1997).

2.4 Analysis

The Statistics Package for the Social Sciences (SPSS), version 19.0, was used for data analysis. Descriptive analysis and the Mann-Whitney Test were used to study the level of engagement in activities. Factor analysis with maximum likelihood estimation method and Promax rotation was conducted to extract common factors of participation in activities. We then examined the relationship between the factorial scores of activities and several administered functions using Pearson's correlation coefficient.

3. Results

Most of the participants engaged in housework, watching TV or listening to music and reading newspapers or books regularly. Half of them never work; however, three-quarters of them engaged in social and physical activities frequently. They also often had interaction with close friends or family members from whom they lived apart. Half of them were seldom involved in handicraft and artistic activities (Figure 1). There were some differences in engagement in activities by gender. Women participated in housework (U = 2548.5, p <.01) and interactive activities (U = 4170.5, p < .01) more often than men, while men were involved in work activities (U = 3881.0, p < .01) and driving or using transportations (U = 2382.5, p < .01) more often than women (Figure 1).

The factor analysis determined 3 factors of activities based

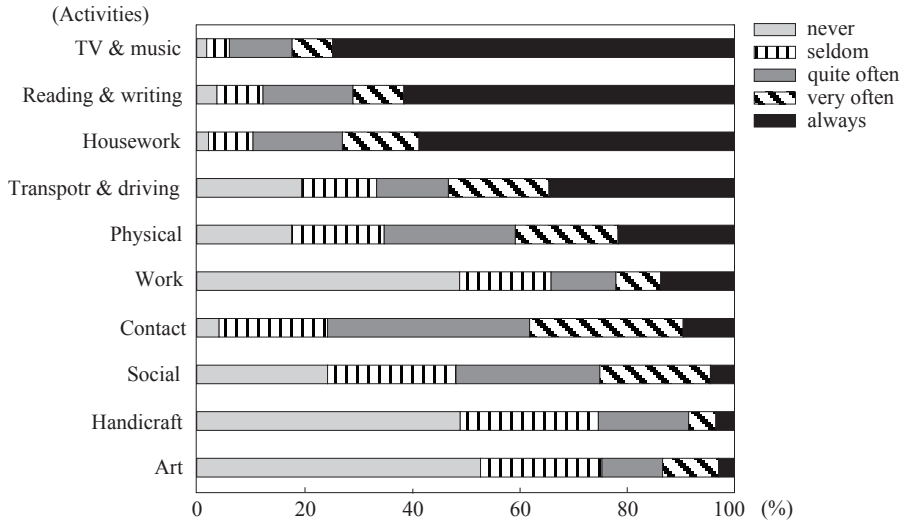

Figure 1: State of participation in activities

Table 2: Factorial pattern and sum of factor loadings

Activities	Factor 1	Factor 2	Factor 3
Factor 1: Transport &Productive Activity			
Transport	.750	-.220	-.057
Social	.450	.351	-.038
Work	.427	.115	-.026
Factor 2: Hand work & Artistic Activity			
Handicraft	-.084	.709	-.028
Art	.267	.634	-.050
Factor 3: Domestic Activity			
Housework	-.255	.231	.530
TV	.029	-.154	.495
Contact	.145	.063	.436
Squared factor loadings	1.339	1.442	1.227
Proportion of variance explained	24.992	15.198	12.528
Cumulative proportion of variance explained	24.992	40.190	52.718

on the eigenvalue (χ^2 = 13.540, *df*: 18, p = .037). These factors were labeled as 1) Transport and Productive activity, 2) Hand work & Artistic activity, and 3) Domestic activity (Table 2). Cumulative proportion of variance of these activities explained was 52.7 %.

Correlation analyses confirmed that factorial scores of "Transport and Productive Activities" (full time job, part time job, volunteer activities, community event, women's club, old people's club, religious activities, driving and using transportations) related to both motor and cognitive functions positively while "Hand work and Artistic Activity" (movie, museum, photography, musical instrument, chorus, tea ceremony, flower arranging, knitting, sewing, paper crafts) were not related to either functions except for balance ability.

Engaging in "Domestic Activities" (washing, cleaning, shopping, repair house, gardening, caring, visiting friends or relatives, talking on the phone, e-mail, watching TV)" influenced some functioning in verbal fluency, maximum step and balance, however there was no relation to attention and memory aspects. (Table 3).

Table 3: Correlation between activities and motor, cognitive functions (correlation coefficients)

Functions \ Factors	Factor 1	Factor 2	Factor 3
3 digit cancellation	.168*		
Immediate recall	.257**		
Letter fluency (Ka)	.274**		.202*
Category fluency (S)	.386**		.275**
Maximum step (R)	.409**		.173*
Walking speed			
Strength of B.M.	.520**		
Balance		-.183*	-.173*

Note: S: sports, R: right, B.M.: back muscle
*: $p < .005$, **: $p < .001$

4. Discussion

Most older people who retire from their jobs must change their lifestyle, including work and domestic, social, leisure, and other activities. In this study, participants reported participating in housework, watching TV, reading newspapers or books frequently and sometimes have communication with close friends or family members. These findings are comparable to the data of time allotment released by the Japanese Ministry of Internal Affairs and Communications (2006) that found older adults spend time doing house work, working, watching TV, listening to radio, reading newspaper or books and resting (not including sleeping) and self-care activities in a day. These common activities are very important for older people to share their roles as a family member, to maintain intimacy with friends or relatives and to easily be involved in solitary activities without constraint. However, according to the results of this analysis of the relationship between activities and functions, if older people are engaged only in the above routine activities, their physical and psychological functions may deteriorate during the natural aging process.

We demonstrated that engaging in productive activities relates positively to both motor and cognitive functions in the identical subjects. Previous research showed that less frequent participation in social activities was associated with a more rapid rate of motor function decline (Buchaman et al., 2009) and frequent participation was associated with a decrease in the rate of decline in global cognitive functions, such as episodic memory, semantic memory, working memory, perceptual speed and visual-spatial abilities in old age (James et al., 2011). There are numerous opportunities during work and social activities to modify plans, manage sudden incidents, and cooperate with other people as well as other physical actions. Numerous theories suggest that social activities challenge older adults to participate in complex interpersonal exchanges, which could promote or maintain neural network efficiency (Hultsch, 1999). Social activities may also provide meaningful social roles and a sense of purpose in old age (Berkman, 2000), which could have direct neurohormonal influences on the brain (Fratiglioni et al., 2004).

In addition, driving is necessary to commute to remote places to complete tasks or roles, which may also compensate for deficits in motor functions in lower extremities of older adults, particularly for those in rural areas. The driving process involves

visuospatial perception, divided, focused, and sustained attention, executive function, muscle strength and a range of motion in extremities and neck, motor coordination and psychomotor speed with sound judgment (Reger et al., 2004; Whelihan et al., 2005; McCarthy et al., 2006; Ott et al., 2008; Carr & Ott, 2010). By engaging in work and social activities using transportations, there are numerous opportunities to utilize and maintain several motor and cognitive functions. This theory is supported by results from the study that show increased memory, word fluency, step width, and muscle strength in the subjects who were highly involved in work, social activities and driving or public transports. Previous studies indicated that memory, reasoning and processing speed were significantly associated with life space (Sartori et al., 2011) and subjects who had faster walking speed and capability for 1 km walk had better life space scores than those with poor motor functions (Abe et al., 2009). Mobility in older adults is one of the essential factors for higher-level functioning.

Although "Domestic Activity" had positive relation to slite cognitive and motor functions, these activities were not associated with memory and attention which were considered to deteriorate in older age. Doing domestic work, contact with friends or relatives and watching TV seem to be house bound and monotonous. The previous studies revealed that watching television was associated with an increased risk of cognitive impairment (Wang et al., 2006) and the risk of Alzheimer's disease (Lindstrom et al., 2005) for middle and older people. The results of the study supported a part of these findings. It is necessary for older people to go out, meet new people and engage in varied activities, and not to watch television in their home to maintain or improve their muscle strength, attention and memory functions.

Some elderly people have difficulties in going out by themselves due to illnesses and disabilities or others live in institutions. This result could be applicable to elderly services, such as care homes or day care program, to maintain their functions and abilities. It is important for older adults to expand from ordinary to enlarged activities to maintain or improve their several functions in their active life as much as possible.

The study's limitations include the number of subjects and places of recruitment. Given that there are some variations in participation in activities depending on age, sex, and environmental or personal factors among older adults, we should examine effects of these factors among subjects in various regions in future studies. Since in this study hardly any covariate were collected, such as depression hypertention, hyperlipidemia, diabetes mellitus, alcoholic consumption and smoking which may influence cognitive functions, the cumulative proportion of variance explained for daily activities might be lower and some other factors have impact on both motor and cognitive functions either. In addition, this is a cross-sectional study and longitudinal analyses are necessary to investigate causality between activities and functions so that the results can be utilized for health promotion or preventive medicine in communities and clinical settings.

This study found that certain activities had a slight positive relation on motor and cognitive functions. This research suggests that to be healthy it is important to go out for work and social activities using public transport or driving, rather than being house-bound. In an aged society, social participation and inclusion among older people is valuable not only for the elderly but also for society because a large amount of financial resources are spent on medical care, care services and pension plans. Well-being must be maintained as long as possible through participation in daily activities in the community.

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