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The Applicability of the Activities of Daily Living Age Scale in Japanese Community-Dwelling Adults Aged 75 Years or Older

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Abstract

Our aim is to investigate the applicability of the activities of daily living age scale (ADLA) through the examination of the degree to which physical functionality is enhanced by habitual exercise in older Japanese aged 75 years and older. Participants comprised 598 community-dwellings older Japanese (386 women 79.0 ± 3.5 and 212 men 79.1 ± 3.8), who were divided in 2 groups of a non-exercise (NE) and an active group (A). The ADLA equation is an instrument that estimates participants' physical functioning regarding ADL using data obtained previously from 1006 subjects. All participants completed a comprehensive battery of 3 physical performance items that formed the basis for the ADLA equation. The developed equations are as follow: ADLA for women = 0.447 (chronological age: CA) – 5.49 (ADL scoreADLS) + 44.17; and ADLA for men = 0.519CA – 4.27ADLS + 38.26. In women the mean of ADLA of NE group (78.9 ± 4.3 years) were significantly lower than their mean of CA (79.4 ± 3.5 years, $p<0.05$). Meanwhile there were no significant difference among the mean of ADLA of the NE group in men (80.0 ± 5.1 years) and their mean of CA (79.7 ± 4.2). The ADLA mean of A group in women (76.3 ± 3.7 years) and in men (77.3±3.4 years) were significantly lower than their mean of CA (78.6 ± 3.5 and 78.4 ± 3.3 years, $p<0.01$) respectively. The result indicates that ADLA scale has validity application. Through the responsiveness of the ADLA scale we conclude that exercise habituation affects overall physical function even on people over 75 years and older, possessing significantly higher level of physical fitness than those who do not exercise regularly. They showed a remarkably older ADLA.

Keywords: Physical function; 75 years and older; Exercise habituation; ADL age scale

Introduction

With the rapidly aging population increasing attention has been raised focusing on the development strategies and preventive medicine designed to help individuals age in a healthfully, actively, satisfactorily and successfully way for a better quality of life. Recent decades have seen dramatic change in social research. Science and policy turned toward health issues of the older population, specially focused on mortality, morbidity and frailty [1,2].

Frailty has been defined as a state of increased vulnerability from age-associated decline in reserve and function resulting in reduced ability to cope with every day or acute stressors [3,4]. In the current study we used the term frail from a physical weakness perspective, older adults who experience an age-related decrements in their ability to perform activities of daily living (ADL). There is emerging evidence that risks associated with frailty might be improved with interventions such as comprehensive assessment [5,6] and exercise training. Therapeutic exercise has been shown to increase gait speed and improve performance in activities of daily living [7-9]; however, the degree of benefit in some studies has been modest [10,11]. Further research should be directed at determining the extent to which frailty can be reversed or postponed, and the boundary between tractable and intractable stages in the progression of frailty. In fact Cooper et al. have mentioned the necessity of investigating whether a derived composite score representing overall lower or upper body functioning [12] Performance-based measures of physical function predict future incidence of disability, dependence in ADL, institutionalization and death in initially non-disabled older people [13-21]. As an example in Japan every year 10% of people over 75 years old adults are institutionalized [22]; therefore, we support the idea that every individual's functional fitness depends of their life style. In part, time-related deteriorations may be inherited although may also be modified by the environmental conditions such as stress, physical inactivity (Hypokinetic disease), and nutrition [23-25]. We believe that exercise as a part of our life style provides many benefits that can affect our ageing. Nakamura et al. in 1989 proved that there are considerable individual variations in the relationship between biological condition and physical fitness. People who are in a state of high physical fitness maintained a relatively good biological condition. This might suggest that in older individuals regular physical activity may provide physiological improvements which in turn reduce "the rate of aging" [25]. A number of reports from large epidemiological studies have shown that increasing habitual physical activity prevents the decline in mobility-related physical performance in older adults [26-31]. These studies assessed habitual physical activity using subjective reports (i.e., questionnaires) [32]. Performance-based measures of physical function not only represent a decline of functional status (e.g., functional limitation and disability), but also predict other adverse-health outcomes [33,34].

The present authors have developed the concept of activities of daily living age (ADLA) for the assessment of the functional status of Japanese people over 75 years and older. The current study aims to investigate the applicability of the ADLA through the examination of the degree to which physical functionality is enhanced by habitual exercise in a comparison between older people who are relative active and people who have not exercise habits in Japanese aged 75 years and older.

Methods

Study design and participants

Participants included in this investigation were 640 Japanese community dwellers 75 years and older. The participants were recruited through poster advertisement and flyers that were displayed in senior centres, leisure centres and residential retirement communities. Participants were recruited from 3 prefectures located north east of Tokyo (Fukushima, Ibaraki, and Chiba) Japan from 2011 to 2014. Inclusion criteria were that the participants were community dwellers aged 75 years and older. Exclusion criteria were as follow: (1) participants unable to perform the physical test (n=33, (5.2%)); and (2) those unable to understand the instructions for the test and questionnaires (n=9, 1.4 %)). The remaining 598 participants (93.4%; 386 women aged 79.0 ± 3.5 years and 212 males aged 79.1 ± 3.8 years) were included in the current study. Prior to the test recruited individuals who required nursing care, prevention programs or day-care service read and signed the informed consent form, which was approved by the institutional review board (IRB approval no.:696) this study was conducted in accordance with the guidelines proposed in the declaration of Helsinki and the study protocol was reviewed and approved by the ethics committee, University of Tsukuba, Japan.

Participants were dividing into 2 groups according to the "frequency of exercise and timeof use" by a self-report questionnaire. Non-exercise (NE) group (n=140) women and (n=65) men and active (A) group (n=246) women and (n=147) men.

Physical activity assessment

The status was assessed through self-reported responses which consists information about habitual physical activity, such as: (a) types of exercise or activities, (b) frequency of exercises / physical activities per week, (c) time per session, (d) practice time, including activities that require a physical effort such as agriculture, cleaning house, shopping, etc.

The assessment was used to determine a baseline level of exercise or fitness, assessing how many exercises and time they are spending and how long they are continuing doing those activities. According to researchers at Pennington Biomedical Research Centre in Baton Rouge, Louisiana, reported findings from a study involving 464 women who weren't exercisers. After six months, a group who walked an average of 72 minutes a week at two to three mph—that is about 10 minutes per mile-pace striding a day—had significantly improved heart strength and general fitness, with this in mind we constructed 2 groups: The NE group that was determined by the people who spend less than 10 minutes a day of exercise. Moreover, the A group that was those who spend more than 10 minutes a day of physical activities [35].

Demographic and health-related information

Participants were interviewed to obtain demographic information, which included age and living conditions, medication use, pain sites, co-morbidities and health-related information. Body height and weight were measured with minimal clothing and no shoes. Participants were asked to rate their current health status as poor, good, or very good.

Physical performance items

The following 3 physical performance items were selected according to further research that recognizes them as significantly related to ADL [36-46]. These are the same items that were used in the developed ADLA equation in previous study.

Hand-grip strength: Participants in the standing position holding the dynamometer in their hand to be tested, with the arm at right angles and the elbow by the side of the body. The handle of the dynamometer was adjusted if was required - the base rested on first metacarpal (heel of palm), while the handle rested on middle of four fingers. When the participants were ready they squeezes the dynamometer with maximum isometric effort, which was maintained for about 3 seconds. No other body movement was allowed. The subject was strongly encouraged to give a maximum effort to obtain a high record, we also recommend to do it with good respiration, while they were expulsing the air they grip the handgrip strongly. The test was performed twice for each hand alternatively. The average of the sum of the scores of the all trials, in kilograms, was used in the analysis. Hand-grip dynamometer was a GRIP-D, T.K.K 5401; Takei Scientific Instruments, Tokyo Japan [47].

Five-chair sit to stand test (SST): The 5-chair SST test measured the time that takes from the sitting position to the stand during five times repetition without using the arms. Participants were asked to stand up and sit down on a standard-height chair as quickly as possible. Specifically, the start position was seated with the knee joint angle at 90 degrees and the soles of the feet completely on the floor. The time was measured from the initial sitting position to the final fully erect position at the end of the fifth stand. The average time recorded in the two trials rounded to the nearest 0.01 seconds was used for analysis [36].

Timed up and go (TUG): Participants were asked sit down on a standard-height chair, after a signal they rise from that chair and walk forward as quickly as possible without running to a distance of 3m where a red cone, turn 180 degrees at the cone, and walk back to the chair and sit down. Participants were allowed to use canes or walkers. This test has been found to be reliable and valid test for a quantifying functional mobility. The average time recorded that was nearest to 0.01 s during two trials was used in the analysis [48].

With the physical test we obtain the activities of daily living score (ADLS) necessary to obtain the ADLA.

For women, ADLS = 0.077X1 -0.080X2 -0.067X3 +0.072

For men, ADLS = 0.051X1 -0.105X2 -0.099X3 +0.249

Where X1 = hand-grip strength, (kg), X2= five-chair SST (s), X3= TUG (s)

After the extraction of the ADLS, the following ADLA scale, obtained from 1006 subjects in previous study were applied to both groups in the current study [49].

ADLA women = 0.447 CA − 5.49ADLS + 44.17; ADLA men = 0.519CA − 4.27ADLS + 38.26.

Variables	Mean ± standard deviation or n (%)					
	Women (n = 386)			men (n =212)		
	NE (n= 140)	A (n= 246)	p value	NE (n= 65)	A (n= 147)	p value
Age, years	79.4 ± 3.5	78.6 ± 3.5	*0.018	79.7± 4.2	78.4 ± 3.3	*0.011
Geographic area, n (%)			0.107			0.107
FUKUSHIMA	15 (10.7)	57 (23.2)		14 (21.5)	31 (21.1)	
IBARAKI	81 (57.9)	82 (33.3)		34 (52.3)	48 (32.7)	
CHIBA	44 (31.4)	107 (43.5)		17 (26.2)	68 (46.3)	
Height, cm	145.5 ± 5.7	146.4 ± 5.3	0.066	158.7 ± 6.1	160.9 ± 6.6	*0.011
Weight, kg	50.7 ± 9.2	50.1 ± 7.7	0.267	60.8 ± 9.7	62 ± 8.2	0.187
Body mass index, kg/m^2	23.9 ± 3.9	23.4 ± 3.4	0.089	24.1 ± 3.5	23.9 ± 2.9	0.349
Chronic disease, n (%)						
Hypertension	82 (58.6)	116 (47.2)	*0.015	22 (33.8)	74 (50.3)	*0.022
Stroke	8 (5.7)	3 (1.2)	*0.005	5 (7.7)	12 (8.2)	0.454
Heart disease	22 (15.7)	23 (9.3)	0.031	13 (20.0)	21 (14.3)	0.149
Diabetes mellitus	10 (7.1)	24 (9.8)	0.053	13 (20.0)	19 (12.9)	0.174
Self-rated health, n (%)			0.081			0.335
Excellent to good	132 (94.3)	239 (97.2)		62 (95.4)	142 (96.6)	
Fair to poor	8 (5.7)	7 (2.8)		3 (4.6)	5 (3.4)	
Alcohol drinking status, n (%)			*0.043			0.291
Current	59 (42.1)	110 (44.7)		41 (63.1)	99 (67.3)	
No drink	81 (57.9)	136 (55.3)		24 (36.9)	48 (32.7)	
Smoking status, n (%)			*0.045			**0.0005
Current	10 (7.1)	7 (2.8)		18 (27.7)	4 (2.7)	
No smoke	41 (92.9)	23 (48.9)		47 (72.3)	143 (97.3)	
Body pain, n (%)						
Waist	47 (33.6)	70 (28.5)	0.147	12 (18.5)	27 (18.4)	0.494
Shoulder joint	19 (13.6)	26 (10.6)	0.189	5 (7.7)	23 (15.6)	0.058
Elbow joint	2 (1.3)	5 (2.0)	0.335	0-	4 (2.7)	0.091
Hip joint	8 (5.7)	6 (2.4)	0.049	4 (6.2)	4 (2.7)	0.114
Knee joint	51 (36.4)	72 (29.3)	*0.074	8 (12.3)	23 (15.6)	0.264
Feet	15 (10.7)	14 (5.7)	0.036	1 (1.5)	4 (2.7)	0.301

Table 1: Characteristics of the study participants (n =598); (NE: Non-exercise group; A: Active group; *P< 0.05, **P< 0.01)

Results

Table 1 shows the characteristics of the participants. In women between NE and A group, age, some chronic disease as hypertension, stroke, alcohol consumption and knee joint pain were significant different. In men, age, height, and hypertension present a significant difference.

Variables	Mean ± standard deviation or n (%)					
	women (n = 386)			men (n =212)		
	NE (n= 140)	A (n= 246)	p value	NE (n= 65)	A (n= 147)	p value
Types of exercises, n (%)						
Walking	5(3.6)	74(30.1)		0-	52 (35.4)	
Golf	0-	44 (17.9)		0-	48 (32.7)	
Gymnastics exercise	17(12.1)	30 (12.2)		0-	12 (8.2)	
Yoga	0-	8 (3.3)		0-	0-	
Gatebal	0-	7 (2.8)		0-	4 (2.7)	
Taichi	0-	7 (2.8)		0-	4 (2.7)	
Cycling	1(0.7)	6 (2.4)		0-	1 (0.7)	
Japanese dance	0-	5 (2.0)		0-	0-	
Singing	0-	5 (2.0)		0-	0-	
Agriculture	0-	5 (2.0)		0-	3 (2.0)	
Stretching	1(0.7)	4 (1.6)		0-	3 (2.0)	
Muscle training	0-	4 (1.6)		0-	4 (2.7)	
Swimming	0-	4 (1.6)		0-	2 (1.4)	
Pool exercise	0-	3 (1.2)		0-	1 (0.7)	
Dance	0-	2 (0.8)		0-	0-	
Aqua fitness	0-	1 (0.4)		0-	0-	
Tennis	0-	0-		0-	3(2.0)	
Bowling	0-	0-		0-	2 (1.4)	
Mountain climbing	0-	1(0.4)		0-	1 (0.7)	
Other	0-	36(14.6)		1-	7 (4.8)	
Frequency of exercise per week, t	1.1 ± 2.6	5 ± 4.3	**	± 0.9	6 ± 3.8	**
Time of activity per week, m	0.8 ± 1.9	146.6 ± 110.3	**	0 ± 0.1	171.7 ± 123.7	**
Activities or exercise, n (%)			**			**
Zero	116 (82.9)	0-		63 (98.4)	0-	
One	21 (15.0)	127 (51.6)		1 (1.6)	67 (45.6)	
Two	3 (2.1)	82 (33.3)		0-	57 (38.8)	
Three	0-	32 (13.0)		0-	18 (12.2)	
Four	0-	5 (2.1)		0-	4 (2.7)	
Five	0-	0-		0-	1 (0.7)	
Descriptive statistic for the 3 ADL performances test						
Hand-grip strength, kg	19.0 ± 4.2	20.4 ± 3.8	**	28.8 ± 6.7	31.8 ± 5.8	**
5-Chair SST, s	10.7 ± 4.4	8.2 ± 3.1	**	9.3 ± 4.2	7.7 ± 2.6	**

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Timed up and go, s	8.7 ± 2.0	7.3 ± 2.1	**	8.2 ± 2.7	6.8 ± 1.9	**

Table 2: Descriptive statistics (n =598) (NE: Non-exercise group; A: Active Group; **p<0.01)

The data showed that more participants in the NE group have poorer health than those in the A group including some body pains and a bad habit such as consuming alcohol. Table 2 shows the mean and percentage of the types of exercise, the highest percentage of women in A group was walking follow by golf with the 30.1 and 17.9 percent respectively. As in men the data shows similarity where the highest were walking and golf with 35.4 and 32.7 percent respectively of the all men participants. The frequency of exercise (times), time of activity (minutes) and number of exercise and/or activities per week shown significance difference (p<0.01) between NE and A group of both genders. A group in both genders present a high presence of exercise from five to six days a week, where women spend an average of 146.6 minutes and men 171.7 minutes per week. All the ADL performance test scores in both genders were significantly differed among NE and A groups (p<0.01). The difference between women ADLA in NE group (78.9 ± 4.3 years) and A group (76.3 ± 3.7 years) were significantly higher (p<0.01) by a difference of 2.6 years. The mean of ADLA in NE group and compared with their mean of CA was significantly younger (p<0.05) and (p<0.01) respectively (Table 3).

The mean ADLA men in NE group (80.0 ± 5.1 years) was statistical significant higher (p<0.01), by 2.7 years than their ADLA mean in A group (77.3 ± 3.4 years), also the mean of ADLA in A group was significantly lower (younger) at the 0.01 level than the mean of CA, by 1.1 years, although there were no statistical difference between the mean of ADLA and CA in NE group (Table 3). Thus, indicating that participants in the A group are in a significantly higher state of physical fitness than NE participants.

Women (n=386)						**Men (n=212)**			
Group	**Variables**	**n**		**Differences**		**n**		**Differences**	
NE	CA, years	140	79.4 ± 3.5	*		65	79.7 ± 4.2	NS	
	ADLA		78.9 ± 4.3	*	**		80.0 ± 5.1	NS	**
A	CA	246	78.6 ± 3.5	**		147	78.4 ± 3.3	**	
	ADLA		76.3 ± 3.7	**			77.3 ± 3.4	**	

Table 3: The mean of ADLA in NE group and compared with their mean of CA (NE: Non -exercise; A: Active; CA: Chronological age; ADLA: Activities of daily living age; NS: No significance diference; *p<0.05; **p<0.01)

Discussion

To the best of our knowledge, this is the first ADLA assessment for Japanese people aged 75 years and older. The primary strength of our study was the objective measurement of habitual physical activity by ADLA scale to identify cut-off values of physical function. Moreover, this study found further evidence that the ADLA is not only a reliable and valid tool for the assessment of ADL, our results have shown that the physical performance assessed by ADLA can indicate with high confidence the physical function status in older subjects. The results suggest that the ADLA have shown that is high clinic applicability as the assessment of ADL in older Japanese aged 75 years and older.

As several previous investigations has reported significant dose-response relationship between objectively measured habitual physical activity and mobility-related physical performance in older adults. After the application of the ADLA scale we found that less habitual physical activity is high associated with limitation in mobility for ADL [50]. Our data suggests that NE groups in both sexes, the presence of some chronic disease as hypertension, stroke, and alcohol consumption and knee joint pain were significantly different than those who are involved in an active life-style. The data showed that more participants in the NE group have poor health and bad habits. This means that the lack of exercise can accelerate the rate of decline in physical function and vice versa. Our results coincide with further researches, Terkelsen et al., found that people who remain inactive fall into a state in which it is easy to fell joint pain and mobility limitation, losing the independence to realize ADL [51]. This might suggest that regular physical activity may provide physical functionality improvements in Japanese people over 75 years and older community-dwellers which in turn might reduce the dependence on somebody or nurse care. With this the health benefits will helps in reduce the rate of aging [25]. Our findings suggest that the ADLA can be used with confidence providing evidence of the applicability to discriminate the physical function status of older Japanese over 75 years and older. This corresponds well also with others previous findings: In 2003 Tanaka et al., [52] through the "vital age" in middle aged and patient's ischemic heart disease found that those people who do not exercise regularly in their daily lives have remarkably older ages than similarly aged people with exercise habituation.

In conclusion ADLA scale showed positive responsiveness for detecting the degree to which physical functionality is enhanced by habitual exercise in older Japanese aged 75 years and older. In addition findings indicate that people who engage in a regular exercise with a not large amount of exercise might possess significantly higher levels of physical function and consequently physiological improvements. The current ADLA scale could be a useful tool to recognize people who are becoming frail, helping physicians to provide appropriate counseling to patients and family members about the risk of nursing care, in addition this tool could allow for exercise interventions to reduce the risk of fall into a dependent person and the opportunity to optimize management of coexisting physical weak conditions. Therefore physicians could use the tool as scanner to prescribe an exercise program.

It is also important to recognize that this study has some limitations. First, our sample of the population might not be representative of the entire Japanese older population. Second the sample consisted only in relatively healthier older Japanese over 75 years and older that had a sufficiently mobile to commute to our study centre, limiting participation in our study to these centres' visitors, thus, tend to participate with a positive effect in the strata. Third the lack of information about the real intensity of the exercise, could effect on the results, differing with other studies. Therefore it is necessary to apply the ADLA scale under intervention programs where the intensity, amount of exercise and all regimens must been controlled by professional instructors to obtain a more accurate result of the degree of the health benefits of the exercise in terms of physical functionality for older Japanese over 75 years and older.

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