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Original Article

Characteristics of Physical Functions in Elderly People Requiring Support

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Abstract

Objective: We assessed the physical functions of independent elderly subjects compared to those requiring support of day care services to clarify the differences in the characteristics of their physical functions.

Methods: We conducted Anti-Aging checkups for 31 elderly subjects (18 males, 13 females, age 77.8±7.2 years old) requiring support routinely visiting "Day Service Dandan", a day care center, and 44 independent elderly subjects (17 males, 27 females, age 68.9±6.2 years old) living in the Yurin district of Kyoto. The following factors were evaluated: muscle age, bone age, blood vessel age, neural age and Δage (functional age - chronological age). For the calculation of functional age we used the Age Management Check (without compensation interview). Process analysis was conducted using SPSS; the differences between the two groups were analyzed by chi-square test. This study was approved by the ethics committee.

Results: In the comparison of background factors, chronological age [independent group (IND): 68.9±6.3 years; group requiring support (SUP): 77.8±7.2 years, $p<0.01$], bone age (IND: 61.5± 15.4 years; SUP: 81.0±12.0 years, $p<0.01$), and blood vessel age (IND: 65.6±8.4 years; SUP: 75.5±12.6 years, $p<0.01$) were higher in the SUP. In contrast, muscle age (IND: 58.8±3.3 years; SUP: 55.7±6.9 years, $p=0.020$) was higher in the IND group. Δmuscle age (IND: −13.2±6.9 years; SUP: −19.0±3.3 years, $p<0.01$) was lower in SUP, however Δbone age (IND:−7.4±15.4 years old; SUP: 15.2±8.3 years old, $p<0.01$) and Δneural age (IND: −4.8±15.2years old; SUP: 6.7±8.3 years old, $p<0.01$) were younger in IND. Δblood vessel age (IND: 3.3±8.4years; SUP: −2.3±12.6 years old, $p=0.596$) showed no significant difference between the groups.

Conclusion: Elderly requiring support showed improved muscle age, likely as a result of the exercise programs conducted by day care services, however bone age and nerve age have been suggested to be a concern. In the future, preventive care programs focusing on the correction of the weaknesses of functional age are desirable.

KEY WORDS: elderly people requiring support, Anti-Aging health exams in Japan, functional age, aging

Introduction

In Japan, the current (2010) elderly population aged 65 and over totals 29,580,000 people; the percentage of elderly people in the overall population reached 23.1% [1)]. Moreover, the cost of social security has reached about 94 trillion yen, which is the highest amount on record. The proportion of this amount spent on elderly people has reached about 70 percent [2)], and nursing-care-insurance services covered 4 million people in fiscal 2008 year [3)].

From fiscal year 2005, preventive health care services have been carried out to provide support; the intended purpose was to prevent elderly people from requiring care and adding burden to the government. About 800,000 elderly people are using this service as of 2011.

Seven years have passed since the inception of the service [4)]. For improvement in function, movement assistance devices and other equipment are offered from the start of the service to the user in many of the day care facilities. Despite the 7-year history of the service, verification of the effect of the service has not been studied thoroughly. Moreover, although the primary analysis of physical action for the support of middle-aged and elderly people requires research to assess activities of daily living [5-7)], analysis of the physical action of the whole body has not been undertaken. Such analysis is necessary to verify the effects for future preventive measures for health and to clarify the features of the physical actions achieved by middle and old age people requiring support.

Therefore, in this study, Anti-Aging medical checkups for elderly people requiring support were carried out with the aim of clarifying the characteristics of physical function of middle-aged and elderly people requiring support compared with the medical checkup results of elderly people leading independent lives [8)].

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Methods

Subjects

The subjects were 44 healthy middle-aged and elderly persons (17 men and 27 women, 68.9±6.2 years old), living in the Yurin area (Shimogyo-ku, Kyoto) and 31 middle-aged and elderly persons requiring support (18 men and 13 women, 77.8±7.2 years old), regularly attending a day care center (Dandan) in Kyoto City. Middle aged and elderly persons independently living in the Yurin area (IND group) were recruited from a meeting held to show respect for the aged. Middle-aged and elderly persons requiring support (SUP group), going to the day care center in question, were recruited as notified by the staff of the day care center. Before starting this study, the terms, place, aims, and methods, and also the advantages and disadvantages that were expected by participating in this study were explained. Prior written informed consent was obtained from all subjects.

Health diagnosis

Diagnostic evaluation was conducted for the IND group (December 2008) and for the SUP group (September 2011). Subjects were prohibited from performing strenuous exercises on the day before the diagnosis. As previously reported [8-10], evaluation methods were anthropometry, blood pressure after resting, Anti-Aging medical checkup (5 functional age evaluations: muscle, blood vessel, nervous system, hormone, and bone ages), and subjective symptom evaluations based on the Anti-Aging QOL Common Questionnaire (AAQol) were conducted. Blood chemistry analysis was conducted for independent elderly subjects and urine analysis for middle-aged and elderly people requiring support.

The age Management Check system (Ginga Kobo, Naka-ku, Nagoya, Aichi, Japan) was used to calculate functional age, and relative functional age was determined using a database [8-10]. To evaluate muscle age, muscle mass was determined with a bioelectrical impedance analyzer for muscle mass (Physion MD, Physion Co., Ltd., Shimogyo-ku, Kyoto, Japan). The degree of atherosclerosis was evaluated by acceleration plethysmography (SDP-100, Fukuda Denshi Co., Ltd., Bunkyo-ku, Tokyo, Japan). Evaluation was conducted in the sitting position after at least a 1-minute of rest. Executive brain function was evaluated by Wisconsin card sorting test (WCST), and bone age was evaluated from the value of stiffness of the calcaneus bone as determined by ultrasonography (A-1000, GE Yokogawa Medical Systems, Ltd., Hino, Tokyo, Japan).

Subjective symptoms were divided into two categories for evaluation purposes: “physical symptoms” and “mental symptoms”. As mentioned above, the Anti-Aging QOL Common Questionnaire (AAQol) was used to rate individual symptoms according to a 5-grade scale ranging from 1 to 5 points [8-10] with 1 meaning “Not at all”, 2, “Almost none”, 3 “A little”, 4, “Moderate degree”, and 5, “High degree”.

Health promotion program

In the program for the SUP group, each physical strength and movement volition is considered individually. Specifically, the program involved a combination of use of a training machine, such as an exercise bike and activities such as "nordic walking" and "step well" exercises. Quantity of motion was adjusted according to conditions on the day. Therefore, statements regarding the details of individual programs were difficult to generalize.

On the other hand, although the IND group lacked exercise routines, the group’s average daily number of steps was 8,435.9±3,561.4 steps; this number of steps was notably high compared with the subjects in Kyoto (subjects between 60and 70 years of age; 6,796 steps for males, 6,222 steps for females [8]. Therefore, the IND group can be considered to have been a group with a high level of body activity.

Ethical Considerations

The study was conducted in accordance with the principles of the Declaration of Helsinki and the Act on the Protection of Personal Information. Further, it was conducted referring to “Ethical Guidelines for Epidemiological Research” of the Ministry of Health, Labour and Welfare and the Ministry of Education, Culture, Sports, Science and Technology. The study protocol was approved by the ethics committee of Doshisha University Ethical Review Board.

Statistical Analysis

All data were expressed as Δage (real age−functional age) ± SD, and $p<0.05$ was considered as statistically significant. Statistics were calculated with SPSS for Windows Ver.15.0 (SPSS Inc., Chicago, IL, USA). Differences within groups were tested by unpaired *t*-test.

Results

Anthropometry

Results of anthropometry are presented in ***Table 1***. No significant change was seen in height, body weight or BMI between the two groups, IND and SUP. As for systolic and diastolic blood pressure, there was a significant difference between the two groups, with higher blood pressure in IND.

Table 1 Anthropometry

		Independent Group (IND)		Group Requiring Support (SUP)		*p* value
		mean	SD	mean	SD	
Height	cm	158.56	7.46	158.65	10.17	0.369
Weight	kg	57.55	10.52	57.44	10.38	0.818
BMI	kg/m²	22.77	2.98	22.80	3.21	0.882
Systolic blood pressure	nmHg	143.8	24.4	116.9	8.8	<0.001**
Diastolic blood pressure	nmHg	78.6	16.2	64.8	7.4	<0.001**

IND: n=44; SUP: n=31. SD: standard deviation, independent *t*-test.

Functional age and Δage

Functional age is presented in ***Fig. 1***. Chronological age (IND: 68.9±6.3 years old; SUP: 77.8±7.2 years old, $p<0.01$), bone age (IND: 61.5±15.4 years old; SUP: 81.0±12.0 years old,

p<0.01), and blood vessel age (IND: 65.6±8.4 years old; SUP: 75.5±12.6 years old, p<0.01) were significantly higher in SUP, while muscle age (IND: 55.7±6.9 years old; SUP: 58.8±3.3 years old, p=0.020) was significantly higher in IND.

Δage is presented in ***Fig. 2***. Δmuscle age (IND: −13.2±6.9 years old; SUP: −19.0±3.3 years old, p<0.01) was significantly lower in SUP, while Δbone age (IND: −7.4±15.4 years old; SUP: +3.11±1.9 years old, p<0.01) and Δneural age (IND: −4.8±15.2 years old; SUP: 6.7±8.3 years old, p<0.01) were significantly lower in IND. There was no significant difference in Δblood vessel age (IND: −3.3±8.4 years old; SUP: −2.3±12.6 years old, p=0.596).

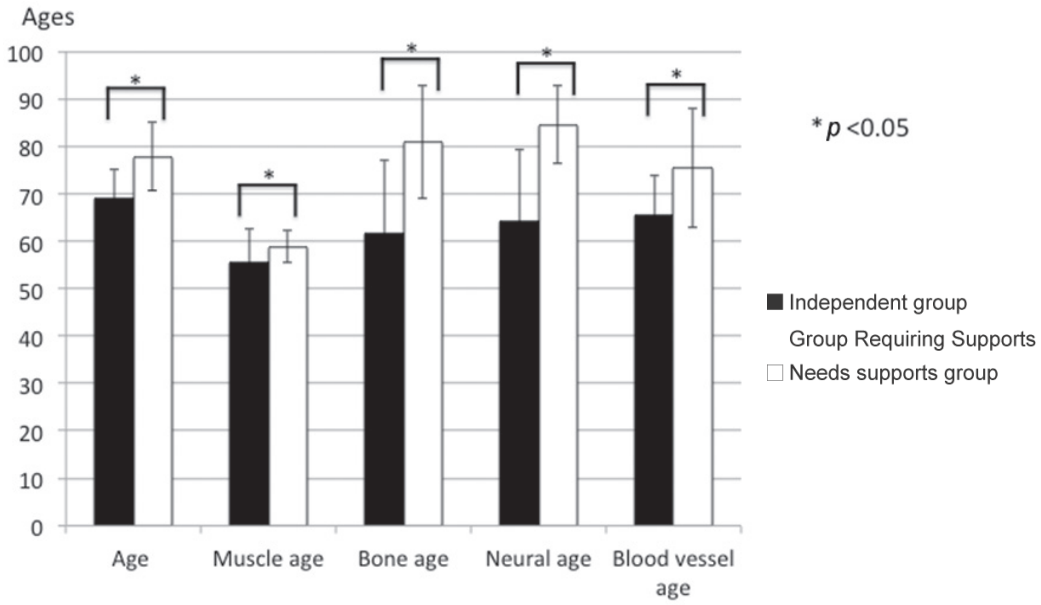

Fig. 1. **Functional age**
Independent group; n=44, group requiring support; n=31. Bars indicate standard deviation. * p<0.05 by independent t-test.

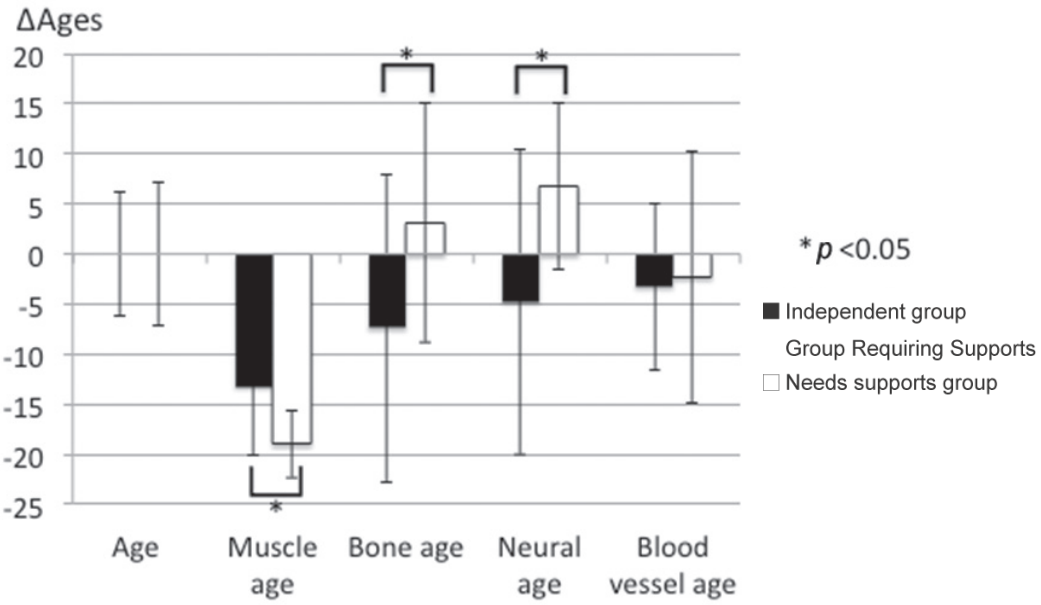

Fig. 2. **Δ Functional age**
Independent group: n=44; group requiring support: n=31. Bars indicate standard deviation. * p<0.05 by independent t-test.

Subjective Symptoms Resulting from Common Questionnaire

Of the 34 physical symptoms, 11 symptoms (eye pain, stiff shoulders, muscular pains/stiffness, early satiety, epigastralgia, liability to catch cold, hair loss, headache, tinnitus, arthralgia, hot flashes) showed significant differences between the two groups (***Table 2***). Of the 21 mental symptoms, 6 symptoms (easily angered, depressed, inability to sleep due to worries, feeling tense, feeling tense for no particular reason, vague feeling of fear) showed significant differences between the two groups (***Table 3***). Of 6 lifestyle-related behaviors, 2 behaviors, smoking and visual display terminal (VDT) watching hours, showed significant differences between the two groups (***Table 3***).

Table 2 Physical symptoms

	Independent Group (IND)		Group Requiring Support (SUP)		
Physical symptoms	**mean**	**SD**	**mean**	**SD**	***p* value**
Tired eyes	2.7	1.0	2.5	1.2	0.393
Blurry eyes	2.6	1.0	2.1	1.2	0.062
Eye pain	1.8	0.9	1.5	1.0	0.035*
Stiff shoulders	3.0	1.2	2.2	1.2	0.012*
Muscular pains/stiffness	2.9	1.1	2.0	1.1	0.002**
Palpitations	2.0	1.0	1.5	0.8	0.061
Shortness of breath	2.1	1.0	1.7	1.0	0.129
Tendency to gain weight	2.8	1.3	2.3	1.5	0.149
Weight loss; thin	1.5	0.9	1.7	1.2	0.775
Lethargy	1.9	0.8	2.4	1.4	0.160
Lack of sense of wellness	2.2	0.9	2.3	1.3	0.806
Thirst	2.4	1.1	2.0	1.1	0.148
Skin problems	2.2	0.9	2.2	1.5	0.497
Anorexia	1.6	0.8	2.0	1.4	0.757
Early satiety	2.0	1.0	1.3	0.7	0.003**
Epigastralgia	1.9	0.9	1.5	1.0	0.008**
Liability to catch colds	2.4	1.1	1.4	0.9	0.000**
Coughing and sputum	2.4	1.1	2.1	1.3	0.190
Diarrhea	1.9	0.8	1.7	1.3	0.060
Constipation	2.1	1.2	2.0	1.4	0.375
Hair loss	3.8	1.0	2.2	1.6	0.000**
Gray hair	3.0	1.0	3.0	1.6	0.883
Headache	2.0	1.0	1.6	1.1	0.030*
Dizziness	2.0	1.0	2.0	1.5	0.407
Tinnitus	2.4	1.3	1.7	1.3	0.015*
Lumbago	3.0	1.2	2.9	1.6	0.804
Arthralgia	3.0	1.1	2.2	1.4	0.010*
Edematous	1.8	0.9	1.7	1.2	0.269
Easily breaking into a sweat	2.8	1.2	2.3	1.4	0.105
Frequent urination	2.7	1.1	3.0	1.2	0.207
Hot flashes	2.2	1.1	1.5	1.0	0.004**
Cold skin	2.6	1.1	2.4	1.5	0.297

IND: n=44; SUP: n=31. SD: standard deviation,
* $p<0.05$, ** $p<0.01$, by independent *t*-test.

Table 3 Mental symptoms and lifestyle-related behaviors

	Independent Group (IND)		Group Requiring Support (SUP)		
Mental Symptoms	**mean**	**SD**	**mean**	**SD**	***p* value**
Irritability	2.3	0.9	2.1	1.3	0.384
Easily angered	2.3	1.0	1.7	1.0	0.017*
Loss of motivation	1.9	0.8	2.2	1.1	0.333
Unhappy	1.9	1.0	1.5	0.9	0.076
Nothing to look forward to in my life	1.9	1.0	1.8	1.1	0.385
Daily life is not enjoyable	2.0	1.2	1.8	1.0	0.462
No confidence	1.9	0.8	1.8	1.0	0.57
Reluctance to talk with others	1.7	0.9	1.8	1.0	0.835
Depressed	1.7	0.7	1.6	1.1	0.15 *
Feeling useless	2.1	0.9	2.0	1.2	0.377
Shallow sleep	2.6	1.2	2.4	1.5	0.355
Difficulty falling asleep	2.5	1.3	2.0	1.5	0.052
Pessimism	2.3	1.0	2.0	1.2	0.188
Memory lapse	3.0	1.0	3.1	1.3	0.722
Inability to concentrate	2.3	0.8	2.1	1.1	0.313
Inability to solve problems	2.1	0.7	2.0	1.2	0.144
Inability to readily make judgments	2.3	0.8	2.1	1.3	0.220
Inability to sleep due to worries	2.4	0.9	1.7	1.3	0.001**
Feeling tense	2.5	0.8	2.0	1.3	0.012*
Feeling anxious for no particular reason	2.0	0.8	1.7	1.1	0.029*
Vague feeling of fear	1.9	0.8	1.8	1.2	0.160*

		IND		SUP		
Lifestyle-related behaviors		**mean**	**SD**	**mean**	**SD**	***p* value**
Smoking	Cigarettes/day	0.0	0.0	1.5	4.8	0.025*
Frequency of alcohol drinking	times/week	1.2	2.3	1.0	2.0	0.355
Exercise	days/week	3.0	2.8	3.4	2.1	0.214
Sleeping hours	hours/day	6.6	1.0	7.5	1.7	0.044
Water consumption	L/day	1.5	0.7	1.3	0.5	0.421
VDT watching hours	hours/day	3.0	1.6	5.0	2.9	0.006**

VDT; visual display terminal. IND; n=44, SUP; n=31. SD; standard deviation,
* $p<0.05$, ** $p<0.01$, by independent *t*-test.

Discussion

For the purposes of this Anti-Aging checkup, we evaluated the results by Δage, yielded by subtracting functional age from true age, because the difference in age between the two groups was large. We could not regard the results as characteristic of general physical functions in elderly persons requiring support, as most of the people in the SUP group participated in the day care service's exercise program for 1-3 years and improved their physical function as a result of exercise. Unfortunately, other factors in the subject's backgrounds, such as eating habits, current medical history, or medication, were not examined. In the future, we wish to further clarify features of physical function of general elderly persons requiring support further by carrying out Anti-Aging checkups for older adults who do not yet participate in exercise programs run by institutions. Here, the Δmuscle age values for both groups were lower than actual age, and that of the SUP group was significantly lower than that of the IND group. The muscle age of the SUP group was lower than that of the IND group due to the efficacy of the exercise program conducted by the care establishment attended by subjects of the group in question. The day care service

is carrying out individualized exercise programs designed by physical therapists and occupational therapists based on consideration for specific users. The program is mainly based on training through nordic walking or step well exercises or by using a Motorcize training machine. Moreover, the users' whole body muscle mass is measured by a high-precision muscle mass meter (Physion MD) once every three months, in order to obtain progress updates. It is thought that these measurements raise incentive to participate in the exercise program by demonstrating that users are keeping their muscle age below actual age.

On the other hand, Δbone age and Δneural age were higher than their corresponding actual age values. As for Anti-Aging medicine, the five functional ages (muscle, bone, nervous system, vascular, and hormone) should represent well-balanced aging [11]. The present study suggested that bone age and neural age are weak points in elderly adults requiring support. Bone aging will bring on increasing risk of fracture and require intense care. A decrease in higher cerebral function exerts a significant influence on communication skills and many other aspects of the lifestyle of elderly persons. In implementing preventative care services, the development of useful services for bones and the nervous system will be needed in order to obtain a good balance of aging body functions.

This original research evaluated and analyzed the degree of aging by means of assessment of functional age elderly requiring support. Although former reports have analyzed the functional age of elderly persons moving into a medical care facility [9], elderly persons leading independent lives [8], and elderly company workers judged by a specific medical examination to require lifestyle guidance [10,12], this is the first study of elderly requiring support. The purpose of this research was to investigate the validity of health programs offering preventive measures for elderly requiring support in Japan.

With regard to study limitations, although this research focused on smoking, drinking, movement, sleeping hours, fluid intake, and TV monitor watching duration as survey items for lifestyle, background information of subjects regarding clinical history, medication information, and eating habits was unfortunately not included. Therefore, differences between the two groups in terms of the rate of occurrence of chronic diseases such as diabetes, high blood pressure, hyperlipemia, and osteoporosis, was not analyzed. We would like to consider this point as a future subject.

Conclusions

Differences in physical function for bone age and neural age were seen between independent elderly and those requiring support. Muscle age, however, did not show significant differences between the two groups. This result suggested that muscle age of long-term care elderly adults was improved by the active programs provided at the day care center. However, the day care center exercise program did not demonstrate improvement in the body functions of bone age and neural age, etc., with the exception of muscle age. In the future, development of care prevention programs that continue to follow and correct the weak points of the functional age in long-term care elderly adults will be necessary.

Acknowledgements

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Conflict of interest staetment

The authors declare no financial or other conflicts of interest in the writing of this paper.

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