博士論文

Age scale for assessing activities of daily living for older adults aged 75 years or older
（後期高齢者の ADL（日常生活動作）評価における ADL 年齢算出式の開発）

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Age scale for assessing activities of daily living for older adults aged 75 years or older

By

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LIST OF ABBREVIATIONS

A: active group

ADL: activities of daily living

ADLA: activities of daily living age

ADLS: activities of daily living score

BADL: basic activities of daily living

BI: Barthel index

BMI: body mass index

CA: chronological age

ICC: intraclass coefficient correlation

NE: non-exercise group

TUG: timed up and go

WHO: World Health Organization

5SST: five-chair sit to stand test

RESEARCH OUTCOME

[Original papers]

1. **Figueroa R**, Seino S, Yabushita N, Okubo Y, Osuka Y, Nemoto M, Songee Jung, Tanaka K. Age scale for assessing activities of daily living. *International Journal of Statistics in Medical Research* 4: 48-56, 2015.
2. **Figueroa R**, Seino S, Yabushita N, Okubo Y, Osuka Y, Nemoto M, Songee Jung, Tanaka K. Cross-validity and reliability of the age scale for assessing activities of daily living among Japanese community-dwelling adults aged 75 years or older. *Journal of Aging and Gerontology.* (in press)
3. **Figueroa R**, Seino S, Yabushita N, Osuka Y, Okubo Y, Nemoto M, Songee Jung, Tanaka K. The applicability of the activities of daily living age scale in Japanese community-dwelling adults aged 75 years or older. Family Medicine & Medical Science Research 4: 167, 2015.

CHAPTER 1

GENERAL INTRODUCTION

The aging is a process that begins at the moment we are born. All our bodies, minds, start to change and develop and mature for special targets according to our activities of daily living. This development is influenced by many factors including our personal characteristics, our family background, how we are raised, where we grow up and who raises with us. Similarly, this development throughout our adulthood continues to be influenced by our health, attitude, behaviors, and our interactions with family, friends and environment around us. Therefore aging is a complex process influenced by many personal and social factors. Those associated with old age and aging that affect how we age are broad in scope and diverse: biological factors include genetic background and physical health. Psychological influences include level of cognition, mental health status, and general well-being; and sociological factors range from personal relationships to the cultures policies and infrastructure that organize society (Brossoie N and Walter C, 2013). Gerontologists have recognized the very different conditions that people experience as they grow older within the years defined as old age. In the United States, most people in their 60s and 70s are in the best shape they have known (Berk LE, 2010) However, by their 80s most of these people will become frail, often have many complex medical problems, have lower abilities for independent living, may have impaired mental abilities, and often require assistance for daily activities (e.g., dressing, eating, toileting, mobility). Most frail older adults are women (partly because women live longer than men) and often receive care from an adult child (Torpy JM, 2006). In recent years increasing attention has been focused on the assessment of functional capacity in advancing age (Hopkins DH et al., 1990; Nakamura E et al., 1988; Rikli & Busch 1986, Tanaka K et al., 1992). 0ne area of particular interest has been the study of age-related changes in physical and/or motor performance.

Currently there are many approaches available for measuring physical fitness and motor performance, but only few have incorporated ADL items in their test battery, In 1995 Kim HS and Tanaka K developed a functional age using ADL items, but the range of age was wide and the subjects were only women. Therefore a number of studies into age scales in older Japanese over

75 years and older is very limited and examination of these studies shows us that they were performed on several age-groups (Chodzko-Zajko WJ and Ringel RL, 1987; Lee MS et al., 1933; Tanaka K et al., 1990; Nakamura E et al., 1988).

In fact, Cooper et al. (2011) have mentioned the necessity of investigating whether a derived composite score representing overall lower or upper body functioning.

The understanding of the physical fitness level and/or status (capability, ability,) of an individual as it, is considerable importance not only for identifying basic aging processes, but also for preventive medicine, that helps detecting weakness on time to avoid health care. In this context one of the primary health care goal is to identify and determine the degree to perform everyday tasks of older adults aged 75 years and older. An additional goal is to provide a simple way for a population to become aware of their current level of functional status, and motivate them to maintain a healthy life-style (Shigematsu & Tanaka, 2000).

Furthermore we consider that it will possible to develop or participate on a more accuracy physical fitness program to improve their physical fitness.

Understanding those patterns is considerable very important to maintain a physical independence and to maintain a vigorous active and a productive life until death of elder adults. Since the most important part of any geriatric program is not to extend the life span, or to reduce health costs, but rather to increase the well-being and quality of life (Shephard, 1978; Anderson, 1985).

The aim of this thesis is 1) Develop an age scale for assessing activities of daily living (ADLA), 2) validate and obtain the reliability of the age scale for assessing activities of daily living among community-dwelling adults aged 75 years or older and 3) to investigate the applicability of the ADLA scale through the examination of the degree to which physical functionality is enhanced by habitual exercise, 4) to investigate the applicability of the ADLA scale through the examination of the degree to which physical functionality is enhanced by a short physical intervention program in older Japanese aged 75 years and older. With this in mind, we established the following research flow, as a shown in figure 1-1

Cross-sectional Study

chapter 5

Development of an age scale for assessing activities of daily living (ADLA) by principal component analysis.

Longitudinal Study

chapter 6

Cross-validity and reliability of the ADLA among Japanese community-dwelling older adults.

Cross-sectional Study

chapter 7

Effects on the physical function using the ADLA scale among community-dwelling adults aged 75 years or older by a short exercise intervention program.

Longitudinal Study

chapter 8

Physical function benefits for activities of daily living associated with regular and non-regular exercise habituation in older Japanese

Figure 1-1 Overall flow of the current thesis

CHAPTER 2

REVIEW OF THE LITERATURE

2.1. Old age

2.1.1. Definition of old age

The definition of old age has been a frequent topic of discussion. Some gerontologists have recognized the diversity of old age by defining sub-groups. One study distinguishes the young old (60 to 69), the middle old (70 to 79), and the very old (80+) (Forman DE et al., 1992). Another study's sub-grouping is young-old (65 to 74), middle-old (75–84), and oldest-old (85+) (Claire A et al., 2009). A third sub-grouping is "young old" (65-74), "old" (74-84), and "old-old" (85+) (American Transgenerational Design matters Organization, 2015). Delineating sub-groups in the 65+ population enables a more accurate portrayal of significant life changes (Cicirelli VG, 2006). One of the most basic questions is when does old age begin? For the early stages of human development there are reasonably clear-cut physiological phenomena which can be used as the basis for establishing age categories, such as first and second dentition and the onset of puberty. However, at the moment, there is no similar physiological basis for a sound, clear-cut definition of old age. Lacking such a definition, the sociologists, behavioral scientists, and other investigators involved in the study of aged have tended, as has 20th century society in general, to accept the government's "pension age" or "retirement age" as the convenient dividing line between mature adulthood and old age. For example, entirely typical of the investigators working in this field after World War II Rowntree decided to include in his study men over 65 and women over 60 "as these ages have been established by the Widows Orphan's, and Old Age Contributory Pensions Acts of 1925 and 1940 as the earliest ages at which State pensions are paid, and in consequence most published statistics relating to old age take the pensionable ages of 65 and 60 as being synonymous with the beginning of old age." (Roebuck J, 1979) WHO in 1985 defined old age in 2 groups: the first half part (65 to 74 years) and second half part (75 years old and more), in the current study we used the term stated by WHO.

2.1.2 Old age population in Japan.

Several studies agree that the number of adults over 60 years and older will be approximately 10% to 20% of the world's population, this will be the first time that older adults outnumber younger adults. That population will undoubtedly result in higher levels of physical and cognitive disabilities.

Developed countries confront several problems of rapidly elder population in recent years and with this the increase rate of health care expenditure that in this societies became the major economic issue (Kalache A and Muir Gray JA, 2009; WHO 1984). In Japan in 2012, adults over the age of 65 exceeded 30.79 million, approximately the 24.1% of the total population, presently, 25.0% of all population in Japan is aged 65 years and more, marking a high record, being the highest percentage in the world of elderly population. It estimated that by 2050 this will be the 38.8% of the total Japanese population, however almost half of this percentage (12.3%) are considered of the second one-third part of the old age (75 years old and older) considered the most vulnerable age in the country (Japanese management and coordination agency, 1998) (Figure 2-1). Several reports, and governmental policy making in the 20th century and interest in it is likely to increase as the century progresses. If the low birth rate persists, as the current working-age population grows older, the age balance of the total population will inevitably shift to the older end of the spectrum; (Roebuck J, 1979). Japan, like any other Asian or western nations will have, in the last quarter of the 20th century a larger proportion of old people in the population than ever before. With the aging of population, the raising disability rates are becoming an increasingly important issue because of both their public health consequences in the form of adverse health outcomes and increasing health-care costs as well as the associated impairment in the quality of life of older individuals (Freedman VA et al., 2004; Liu J et al., 2009). Older adults with mobility impairments in community dwelling represent a preclinical transitional stage in the pathway to disability. Those who lose independent mobility are less likely to remain in the community, have higher rates of disease, a poorer quality of life, and a greater likelihood of social Isolation (Iezzoni L, 2013). In Japan, 40% of people aged 65 years or older have a limited ability to carry out their activities of daily living (ADL), and over 22% of women and 15% of men depend on a caretaker to carry out their ADL (Guralnik JM and Simonsick EM, 1993). Moreover, each year approximately 10% of non-disabled community-dwelling adults aged 75 years and older lose their ability to perform basic ADL independently (Gill TM et al., 1995). This situation already is promising to raise new social issues and to generate new problems which will require national responses.

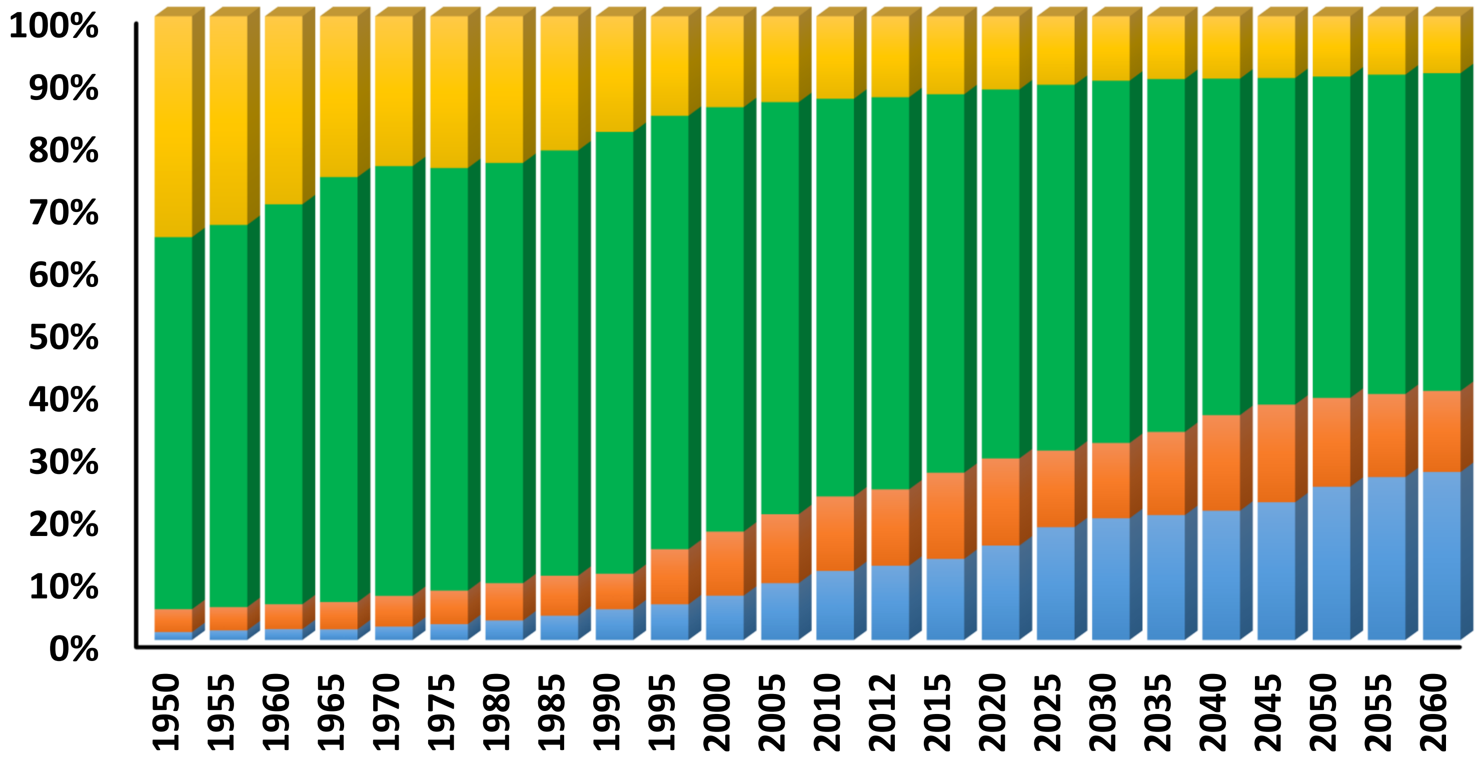

Figure 2-1. Japanese density population by age.
(Source: Cabinet Office, Government of Japan, http://www.cao.go.jp (in Japanese))

2.2 Activities of Daily Living (ADL)

2.2.1 ADL definition

When reviewing the Medline data base it was found that the term ADL was first used as a subject heading or indexing term in 1968 (Index Medicus). Prior to this date the construct was indexed as Rehabilitation related to self-care. This historical context is interesting when considering that the early assessment tools used to evaluate both overall functional status and ADL performance were also published around this time. Examples of these tools are PULSES published in 1957 (Moskowitz E and McCann C, 1957), the Katz Index of ADL (Katz et al. 1963), the Barthel Index (Mahoney FI & Barthel DW, 1965), the Kenny Self-Care Evaluation (Schoening et al., 1965) and the Self-maintaining and Instrumental ADL tools (Lawton and Brody 1969).

Activities of daily living is a term used in healthcare to refer to daily self-care activities within an individual's place of residence, in outdoor environments, or both. Health professionals routinely refer to the ability or inability to perform ADL as a measurement of the functional status of a person, particularly in regard to people with disabilities and the elderly (Encyclopedia of Nursing & Allied Health, 2002). Younger children often require help from adults to perform ADLs, as they have not yet developed the skills necessary to perform them independently.

ADLs are defined as "the things we normally do, such as feeding ourselves, bathing, dressing, grooming, work, homemaking, and leisure" (Agnes M and Guralnik DB, 2001). A number of national surveys collect data on the ADL status of the U.S. population (U.S. Federal Statistical System). While basic categories of ADLs have been suggested, what specifically constitutes a particular ADLs in a particular environment for a particular person may vary. Adaptive equipment or device may be used to enhance and increase independence in performing ADLs.

Basic ADLs (BADLs) consist of self-care tasks, including: (Roley SS et al., 2008) bathing and showering (washing the body), dressing, eating/feeding (including chewing and swallowing), functional mobility (moving from one place to another while performing activities), personal hygiene and grooming (including brushing/combing/styling hair), toilet hygiene (completing the act of urinating/defecating).

2.2.2 Assessment of the ADL.

Assessment of a patient's functional ability to perform activities of daily living is an essential part of nursing. Measuring the functional ability of older adults is a potent predictor of a patient's morbidity and hospital outcome. The information generated from assessment scales is only constructive if the information generated is clinically useful and scientifically reliable. The Katz activities of daily living and the Barthel Index are two of the oldest competing indices for assessing activities of daily living. The Katz activities of daily living and the Barthel Index evaluate a patient's function in terms of level of independence or dependence when performing certain activities required for daily living (McAuley C, 2007). Although in the forty-eight years since the Katz`s instrument has been developed, it has been modified and simplified and different approaches to scoring have been used. However, it has consistently demonstrated its utility in evaluating functional status in the elderly population. Although no formal reliability and validity reports could be found in the literature, the tool is used extensively as a flag signaling functional capabilities of older adults in clinical and home environments. On the other hand originally designed by

Mahoney and Barthel (1965) for use in scoring improvement during rehabilitation of patients with chronic neuromuscular or musculoskeletal disorders, the Barthel index has also been validated in the setting of primary brain tumors and brain metastases (Jalali R et al., 2008; Brazil L et al., 1997; Grant R et al., 1994; Herman M et al., 2003) and is considered easy to use, reliable and sensitive to change. The Barthel Index has been reported to have excellent reliability and validity and adequate responsiveness to change, in measuring neurologic physical disability. For the reasons described below, the current study applied the Barthel index as a method to measure ADL.

2.3 Assessment of the activities daily living age (ADLA).

In order to increase our understanding of factors underlying senescent changes in behavior, numerous authors have attempted to developed alternative measures of aging designed to differentiate between individuals of similar chronological age (Rikli and Busch, 1986). In the last few decades a variety of index and test battery have been developed and implemented for aging assessment. The three most common approaches are age profile analysis, multiple regression analysis and factor analysis/principal component analysis. In the last approach, information from a large number of variables is statistically reduced to a single score, usually expressed as an age score. In general principal component analysis is a useful procedure whenever the task is to determine the minimum number of independent components needed to explain most of the variance in the original set of variables. The first component obtained from this analysis is a useful statistical tool combining all of the explanatory variables into a single expression (Harman H, 1967). It is therefore the score of the first principal component can be used as a unitary index related to the aging process of various physiological or physical functions. Unfortunately this process suffers from explaining how it helps “the rate of aging” in a cross sectional study, because the first principal component is originally no extracted as a function of time. On the other hand, in estimating various influences of aging, it has been noted that the equations overestimates individual biological ages for younger person (The “young” member of the sample) and also that underestimated the opposite group who are the older persons (Webster IW and Logie AR, 1976; Dubina TL et al., 1983; Nakamura E et al., 1982). However exist a method to correct this distortion suggested by Dubina T et al., 1984. The method were accurate that has been used in several studies.

Regardless of the particular directions of future change, the pace of current change is so rapid that there is a good reason to argue that the time between the decennial censuses is too long to capture the changing characteristics of the oldest old and that interstitial surveys are needed. Also there is a good reason to argue that chronological age in itself, while often a useful indicator of characteristics and functioning, is a very imperfect measure and one that is subject to change as successive cohort’s age in different ways (Suzman R and Riley MW, 1985). Because aging is a highly personal process, have several physiological systems that deteriorate at different rates (Spirduso WW, 1995). We support the idea that the primary health care goals should be the maintenance of functional fitness, which is an indication of the degree of physical independence to perform various activities of daily living (ADL) (Shigematsu R and Tanaka K, 2000), as one of the best ways to avoid several health issues in the future. With this in mind the necessity to develop an index capable of measure the health physical status of the elder started to be one of those priorities. Until now it has been assessed using a wide variety of test known collectively as ADL inventories (Granger CV et al., 1979; Karts S et al., 1970; Klein MR and Bell B, 1982 Lawton MP and Brody EM, 1969; Meer B and Baker JA, 1966; Sarno JE et al., 1973; Shoening HA, 1965). However, most ADL`s inventories are self-report in which actual performance is not measured (Barer D and Nouri F, 1989; Pfeffer RI et al., 1982). Therefore Nakamura et al. (1988) developed an index, based on the assessment of 30 physiological factors among about 6000 Japanese men aged 30 to 80 years, suggesting that to assess the degree of individual aging, Biological age is a much better index than chronological age (Dubina TL et al., 1984; Furukawa T, 1994; Kim HS and Tanaka L, 1995). In particular biological age refers to those process that causes the eventual breakdown of homeostasis as age advances. In 1990 Tanaka et al., developed the vital age, based on biological age and using similar subjects with similar range of age (20 to 75 years). Combined physiological and psychological factors under exercise conditions. This index permit to understand the health status according to the physical fitness level. Nakamura and Tanaka (1990) conclude that persons in a state of high physical fitness maintain a relatively good biological condition, also they suggest that in older individuals regular physical activity may provide physiological improvements which in turn might reduce “the rate of aging” (Nakamura E et al., 1989). This literature suggest that is necessary to examine the rate of aging in an objective way. These measures are promising to evaluates individuals physiological status but they do not consolidate the attention on physical functioning for assess ADL and the range of age was wide, in addition the participants were only women. Therefore the number of studies into age scales in older Japanese over 75 years and older is very limited and examination of these studies shows us that they were performed on several age-groups (Chodzko-Zajko WJ and Ringel RL, 1987; Lee MS et al., 1933; Tanaka K et al., 1990;

Nakamura E et al., 1988) (Figure 2.2). For this reason we propose to investigate the physical functionality of Japanese community-dwelling adults aged 75 years and older for determined ADL, following the methods of the mentioned authors below.

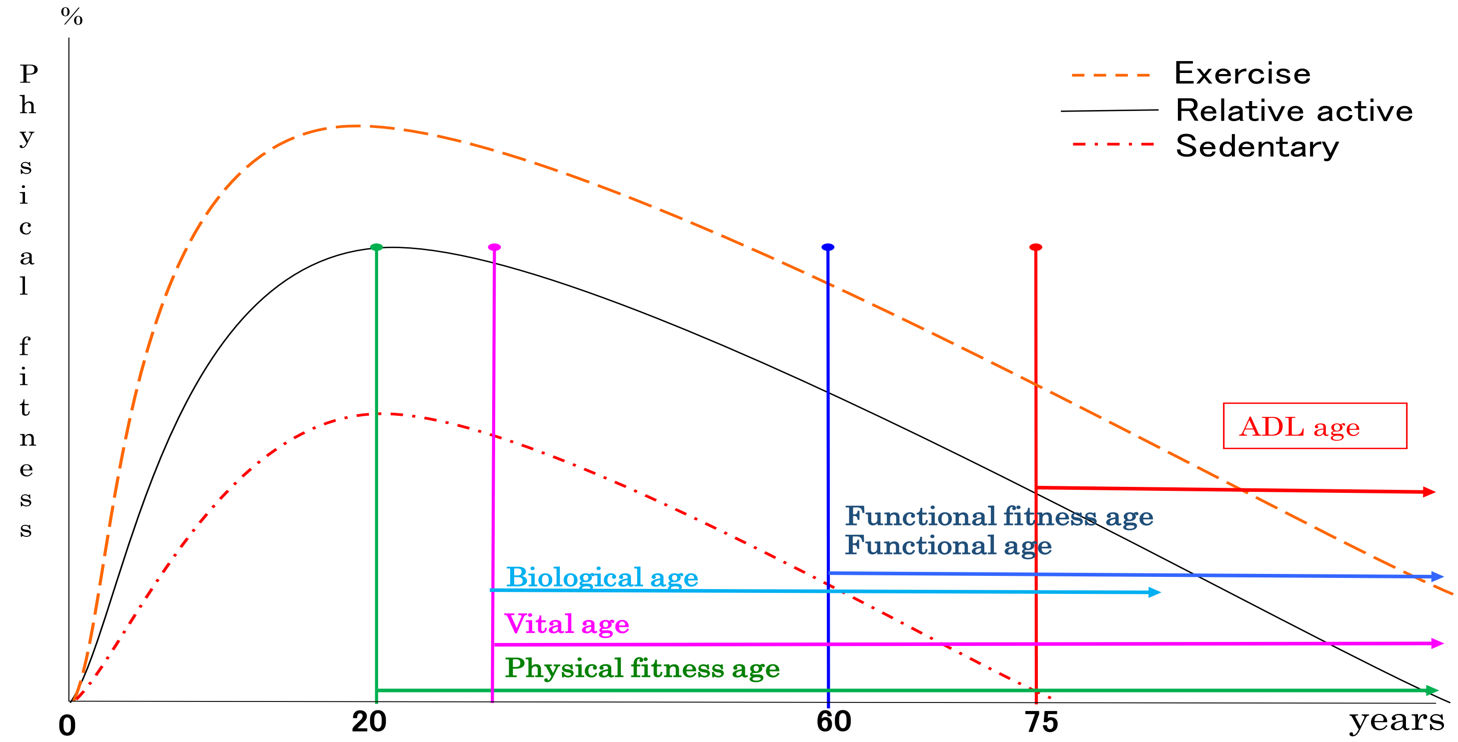

Figure 2-2 Historical overview of age assessments by age.
(Nakamura et al.,1988, Tanaka et al.,1990, Kim et al., 1995, Shigematsu et al., 2000, Yabushita et al., 2004)

CHAPTER 3

3.1 Statement of the problem

In Japan adults over the age of 65 exceeded 30.79 millions, approximately the 24.1% of the total population, marking a high record, being the highest percentage in the world of elderly population. Particularly almost half of this percentage are 75 years old and older, being the most vulnerable age. In addition the screening methods of using principal components to assess the functionality of an individual from a large number of variables to reduce to a single score, then expressed as an age score will provide information about the current level of functional status and motivate to maintain a healthy life-style. However specific assessment for population over 75 years old using activities of daily living by the principal component analysis in Japan is not established.

3.2 Hypotheses

a. According the life-style of the individuals who share the same chronological age could differ in the quality of their functional status.

b. Persons with an active life-style have a better health condition and the rate of aging is reduced.

c. An age scale based in physical fitness measures is more effective than a simple index obtained with questionnaires.

3.3 Delimitations and limitations

A. Delimitations

a. All the participants had to meet the inclusion following criteria: community dwellers aged 75 years or older.

b. All participants were not care-dependent or support-dependent on a Japanese long-term care insurance system.

c. All participants were not restricted from exercising by a doctor.

B. Limitations

a. Although the sample size was relatively big, it could not be the representative of the all Japanese population.

b. Because we recruited the participants at community centers, exist a limitation on the participation only to visitors of those centers.

c. All participants had a sufficiently mobile to commute to our study center, thus, relatively healthier people tend to participate with a positive effect in the strata.

d. ADLA has been established exclusively from cross-sectional data, and with nondisabled Japanese population over 75 years or older.

e. Equations could not be functional in other countries with/or younger populations, because of complex factors related with lifestyle (environmental) and/or ethnicity.

f. The current study findings might not be generalizable to older adults who are frail. The equations are only appropriate for Japanese community-dwelling aged 75 years or older.

3.4 Significance of the Study

The accuracy of the current equation may clarify the physical function for activities of daily living. These results would offer the advantage to be measure with the minimal tools and could be an easy way for older adults to understand by them self's, their actual functional status as a prevention of health care services.

CHAPTER 4

GENERAL METHODS

This chapter presents the procedures employed during the studies described in the current thesis. The majority of the procedures are common to each study. All studies were conducted under the approval of Ethics Review Committee at the University of Tsukuba.

4.1 Participants.

Participants included in this investigation were Japanese community dwellers that were 75 years and older, who were recruited from 6 cities in 4 prefectures: Fukushima, Ibaraki, Chiba, which are located to the north east of Tokyo in the Kanto region and Kanagawa in the southwest. The participants were recruited through poster advertisement and flyers that were displayed in senior centers, leisure centers and residential retirement communities within Japanese community support projects. Inclusion criteria stated that the participants were community dwellers aged 75 years or older. The exclusion criteria were as follows: (1) participants unable to perform the physical test; and (2) unable to understand the instructions for the test and questionnaires. Prior to the test, participants 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.

4.2 Anthropometry.

Body height and weight were measured with minimal clothing and no shoes. Body weight was measured to the nearest 0.1 kg using a digital scale (TBF-551; Tanita,Tokyo, Japan), and height was measured once to the nearest 0.1 cm using a wall-mounted stadiometer (YG-200; Yagami, Nagoya, Japan), both measurements were applied by trained instructors. All the participants were asked to be barefoot and with the minimal clothes with them before step on the scale. BMI was calculated as weight (in kilograms) divided by height (in meters) squared.

4.3 Demographic and health-related information

Participants were interviewed to obtain demographic information, which included age, pain sites, comorbidities and health-related information. Participants were asked to rate their current health status as poor, good, or very good.

4.4 Assessment of ADL ability status

The ADL status was assessed through the Barthel Index which consists of 10 items that measured a person's daily functioning specifically the activities of daily living and mobility. The items include feeding, moving from chair to bed and return, grooming, transferring to and from a toilet, bathing, walking on level surface, going up and down stairs, dressing, continence of bowels and bladder. Participants were assessed by using self-reported responses. The assessment was used to determine a baseline level of functioning and to monitoring the activities of daily living. The person receives a score based on whether they have received help while doing the task. The scores for each of the items were summed to create a total score. Total possible scores range from 0 – 100, with lower scores indicating increased disability (Mahoney FI and Barthel DW, 1965).

4.5 Exercise regimen

All of the exercise training sessions and program were supervised and conducted near our facility by trained physical instructors who are familiarized and experienced in the gerontological field. The exercise program consisted primary of 90 minutes of strength training once a week during 12 weeks (3 months). All sessions were as follows: The first 15 minutes of warm up, followed by 10 minutes of recreation games activities such as that that involved bodywork in a low-intensity level. The next 40 minutes were the main exercise, the last 15 minutes were used for cool down. There were four principal exercises described as follows.

1. Toe raises.

Participants sat on a chair with the knees bent and feet on the floor. Lifted the toes and forefoot of both feet off the floor/ground, keeping the heel in contact with the floor. Lifted as high as they could to really squeeze at the top and point the toes to the ceiling, then release the toes back to the floor to return to the starting position.

15 to 20 repetitions of this exercise per set. Completing from 3 to 4 sets according to the individuals level. The toe raise exercise was used to strengthen the muscles at the front of the lower leg, such as Tibialis anterior, Extensor digitorum longus, Extensor hallucis longus. It is a common exercise in the rehab of ankle injuries and shin splints. Other muscles groups were the peroneus longus and brevis.

2. Heel raises or calf raises

Participants sat on a chair with the knees bent and feet on the floor. They slowly raise the heels until be on their tiptoes. Balancing the body weight on the balls of the feet, pause for a second, then slowly lower back to the floor to return to the starting position. 15 to 20 repetitions of this exercise per set. Completing from 3 to 4 sets according to the individuals level. There were two variables. Seated calf raises or in standing up position, grasping a chair or wall for balance. The heel raise exercise works the calf muscles, which are two separate muscles. The first is the gastrocnemius muscle, which is the outermost calf muscle on the back of the lower leg. Soleus muscle is the second part of the calf muscle and rests underneath the gastrocnemius.

3. Single-leg bent knee thigh raises

Participants sat on a chair with the knees bent and feet on the floor. They slowly raise the leg with the bent knee until the heel be in the opposite knee, holding this position for a count and then slowly lower the foot back to the floor to raise their foot. Completing 15 to 20 repetitions per leg. Completing from 3 to 4 sets according to the individuals level. Participants with a high physical fitness level performed in a standing up position, grasping a chair or wall for balance. The single-led bent knee thigh raise exercise targets the hip flexors and quadriceps, which are responsible for hip flexion - moving the thigh toward the pelvic bone.

4. Squat with chair

Participants sat in the edge of a chair putting the arms in the chest with their feet slightly wider than their hips in a straight line. Recommending that the toes should be pointed slightly outward – about 5 to 20 degrees outward. Also with the recommendation to look straight ahead and pick a spot on the wall in front of them. Looking at this spot the entire time of the squat, not looking down at the floor or up at the ceiling. Starting to pull the belly button towards the spine and contracting the abdominal muscles. Then slowly lowing the body, as though they were sitting in the chair. Keeping the back straight, the weight in heels, slowly pushing body back to starting position with the neutral spine, and chest and shoulders up. As they squat down, focus on keeping the knees in line with the feet. Repeating the movement 15 to 20 times, performing 1 to 2 sets. For each repetition, we were counting to 3 on the way up and on the way down to ensure we were not going too fast. Participants with a high physical fitness level performed in a standing up position, grasping the back side the chair without going back to the sit position.

All items described above had a rest of 30 to 60 seconds in between sets.

4.6 Physical performance items

The following 8 physical performance items were selected according to further research that recognize them as a significantly related to activities of daily living (Arao T et al., 1991; Bravo G et al., 1994; Clark BC, 1989; Clarke HH, 1970, Voorrips LE et al., 1993).

1. Hand-grip strength

Participants held the dynamometer in the hand in the standing position with their arms at right angles and the elbow by the side of their body. The handle of the dynamometer was adjusted if was required. Participants squeezed the dynamometer with maximum isometric effort, which was maintained for about 3 seconds. No other body movement was allowed (Shinkai S et al., 2003). The participant was strongly encouraged to give a maximum effort with good respiration to obtain a high record. The test was performed twice for each hand alternatively. The average of the sum of the scores of all trials, in kg, were used in the analysis. The hand-grip dynamometer was a GRIP-D, T.K.K 5401; Takei Scientific Instruments Co. Ltd., Tokyo Japan.

2. Alternate step

Participants were asked to raise their legs alternately 8 times, which simulates walking stairs or walking in place. The highest recorded step was

19 cm. (Menz HB and Lord SR, 2001). The time until the last step taken was in seconds 0.01. Participants were allowed to do 2 trials. We used the average of both trials for the analysis.

3. One-legged stance with eyes open

With open eyes, gazing straight forward and with the hands on hips, participants were asked to stand on their preferred leg for a maximum of 60 seconds, raising gradually from the floor to a height of 10–20 cm, maintain balance as long as possible. The test was performed twice. The average of the sum of both scores, in seconds, were used in the analysis (Rikli R and Busch S, 1986).

4. Functional reach

Participants were asked to stand with their feet together, raise their arms, and hold the tips of their clasped hands at the 0-cm level of the scale while keeping their arms straight and horizontal. This test was assessed by the maximal distance that the participant could reach beyond arm's length. The average distance recorded that was nearest to 1 cm during two trials was used in the analysis (Duncan PW et al., 1992).

5. Manipulating pegs

The subjects were standing in front of a standard-height desk or table where a peg board was installed (Takei Scientific Instruments Co., Ltd.), this board had 96 holes divided in 2 sides, 48 at front and 48 at back side, there are only 48 pegs that were installed in the front side, the subjects were asked to move them from the front side to the back side using both hands (moving 2 pegs at a time) during 30 seconds. The number of pegs transferred during that time was used in the analysis (Kim HS and Tanaka K, 1995).

6. Timed up and go (TUG)

Participants were asked to sit down on a standard-height chair, after a signal they would stand up from that chair and walk forward as quickly as possible to a distance of 3 m, where a red cone was placed, turn 180 degrees at the cone, and walk back to the chair and sit down. Participants were allowed to use canes or walkers. The average time recorded was rounded to the nearest 0.01 s and times from the two trials were used in the analysis (Podsiadlo D and Richardson S, 1991).

7. Usual gait time

Participants were instructed to stand with their feet behind them with their feet just touching a starting line marked with tape. After the tester's command, they started to walk at their normal pace along a 7-m course (Shinkai S et al., 2000). Participants were allowed to used canes or walkers. The actual walking time was measured over 5-m starting with the first step past the 1-m line and ending with the first step after the 6-m line. The average of the two trials was used in the analysis. The time nearest to 0.01 s was recorded.

8. five-chair sit to stand test (SST)

Participants were asked to stand up and sit down on a standard-height chair as quickly possible. Specifically, the start position was sitting with the knee joint angle at 90 degrees and the soles of their feet touching the floor completely. 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 nearest to 0.01 s during two trials was used in the analysis (Guralnik JM et al., 1995).

CHAPTER 5

DEVELOPMENT OF AND AGE SCALE FOR ASSESSING ACTIVITIES OF DAILY LIVING BY PRINCIPAL COMPONENT ANALYSIS.

5.1 Purpose

The aim of this study is to develop of an age index for using activities of daily living by the principal component analysis.

5.2 Methods

5.2.1 Participants

One thousand and two hundred two Japanese community dwellers aged over 75 years and older, who were recruited from 6 cities in 4 prefectures: they were recruited through poster advertisement and flyers that were displayed in senior centers, leisure centers and residential retirement communities within Japanese community support projects. Inclusion criteria stated that the participants were community dwellers aged over 75 years or older. The exclusion criteria were as follows: (1) participants unable to perform the physical test (n=187, (15.6%)); and (2) unable to understand the instructions for the test and questionnaires (n=9, 0.7%)). The remaining 1006 participants (84.7%; 312 males aged 79.6 ± 4.3 years and 694 women aged 79.9 ± 5.4 years) were included in the current study. The individuals who were recruited required nursing care, prevention programs or day-care service. Prior to the test, participants read and signed the informed consent form, which was approved by the institutional review board (IRB approval no.696)

5.2.2 Measurements

Basic anthropometric measures as body weight and height followed by self-report information about the use of medications, pain sites, comorbidities and health-related information. Secondly participants started the physical fitness measure, all items have been previously described in the chapter 4.

5.2.3 Statistical analyses

Statistical analysis of the data began with calculation of the arithmetic means and standard deviations (SDs), and a correlation matrix among the 8 variables. The Spearman rank-order correlation coefficient was calculated to determine the association among BI score and each of the variables and submitted to principal component analysis (Harman HH, 1967), as shown in figure 5.1. The first principal component, which accounts for the largest variance among the extracted components, is a useful statistical tool for the purpose of combining all the independents variables into a single expression. The first principal component was used as the best single descriptor of total ADL performance (Harman HH, 1967). This approach has been frequently adopted in Gerontological researches (Nakamura E et al., 1988; Chodzko-Zajko WJ and Ringel RL, 1987; Hofecker G et al., 1980; Kim HS and Tanaka K, 1995; Tanaka K et al., 1990; Seino et al., 2009; Shigematsu R et al., 2000; Yabushita N et al., 2004).

In this study, the first principal component score was used as a unitary index ADL score (ADLS). To calculate individual ADLS, each score was first standardized, and the summed across tests in a weighted manner, using the coefficients of principal component scores obtained from the principal component analysis. To do so, the ADLS was converted into an age scale where the average and SD of CA was used. During this process, the fact that ADLs were distributed with a mean of 0 and a SD of 1.0 were taken into consideration. Finally, the equation was corrected as suggested by Dubina et al., 1984, due to the distortion of the individual ADLA at the regression edges. The data was analyzed using IBM SPSS Statistics software, version 21 (SPSS Inc., Chicago, IL, USA), with the level of statistical significance set at 5%. Statistical analysis of the data began with calculation of the arithmetic means and standard deviations (SDs), and a correlation matrix among the 8 variables.

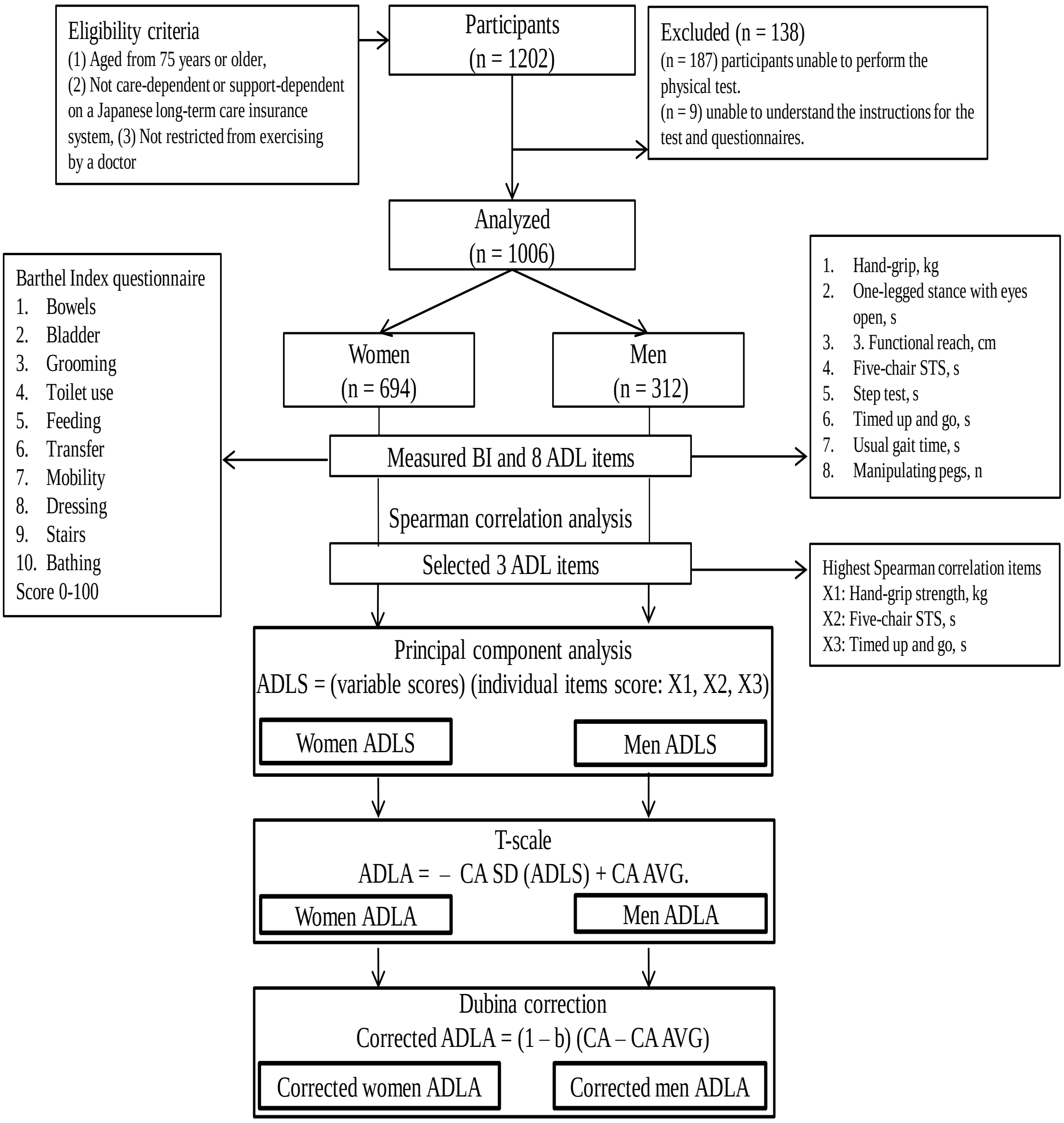

Figure 5-1. Flow chart of the study participants and development of the ADLA equations.
CA: Chronological age, SD: Standard deviation, ADLS: activities of daily living score, ADLA: activities of daily living age, AVG: average, b: coefficient of simple linear regression

5.3 Results

Table 5.1. Characteristics of the study participants (n =1006)

Variables	Mean ± standard deviation or n (%)	
	Women (n = 694)	Men (n = 312)
Age, years	79.9 ± 5.5	79.6 ± 4.3
Geographic area, n (%)		
FUKUSHIMA	112 (16.1)	65 (20.8)
IBARAKI	391 (56.3)	149 (47.8)
CHIBA	168 (24.2)	82 (26.7)
KANAGAWA	23 (3.3)	16 (5.1)
Height, cm	144.9 ± 6.3	159.7 ± 6.8
Weight, kg	49.4 ± 8.3	60.9 ± 8.8
Body mass index, kg/m^2	23.5 ± 3.7	23.9 ± 3.1
Chronic disease, n (%)		
Hypertension	307 (44.2)	130 (41.7)
Stroke	21 (3.0)	21 (6.7)
Heart disease	83 (12.0)	50 (16.0)
Diabetes mellitus	76 (11.0)	50 (16.0)
Self-rated health, n (%)		
Excellent to good	669 (96.4)	302 (96.8)
Fair to poor	25 (3.6)	10 (3.2)
Alcohol drinking status, n (%)		
Current	338 (48.7)	220 (70.5)
No drink	356 (51.3)	92 (29.5)
Smoking status, n (%)		
Current	30 (4.3)	100 (32.1)
No smoke	664 (95.7)	212 (67.9)
Body pain, n(%)		
Waist	212 (30.5)	67 (21.5)
Shoulder joint	94 (13.5)	40 (12.8)
Elbow joint	10 (1.4)	4 (1.3)
Hip joint	28 (4.0)	13 (4.2)
Knee joint	230 (33.1)	59 (18.9)
Feet	48 (6.9)	6 (1.9)

Table 5.1. Shows the characteristics of subjects. All subjects claimed no known neuromuscular, musculoskeletal or cardiovascular pathology that affected their ambulatory capacity to perform the items of the current study. Descriptive statistics for the BI and the 8 ADL performance test items and the Spearman rank-order correlations for the 8 performances items and the

BI score are presented in Table 5.2. where all of the 8 variables showed statistical significant correlations with BI in women and men. Statistical significance p values of all items were less than 0.01. r^a means the Spearman correlation among BI score and ADL tests. Although all items presented high correlation, we primarily decided for the highest Spearman rank-order correlation, according to this, the three items were selected. The order from the highest to the lowest for women were as follows: TUG, 5-m usual gait time, manipulating pegs, five-chair SST, alternate step, hand-grip strength, one-legged stance with eyes open and functional reach. For walking skills; the highest was TUG, and we cast the other 2 items aside (5-m usual gait time and alternate step). Lower extremity strength was five-chair STS that showed a higher correlation too and the last item for upper extremity strength was hand-grip strength.

In the case of men for walking skills TUG, represent the highest correlation with the total score of the BI, 5-m usual gait time and alternate step were eliminated from the list. For lower extremity strength, five-chair SST. For the upper extremity strength was hand-grip strength. After the selection of the 3 items, those were subjected to the principal component analysis.

Table 5.2. Descriptive statistic for the 8 ADL performances test, Barthel index and Spearman correlation coefficients.

Variables	mean ± standard deviation or n (%)									
	Women (n = 694)			r^a		Men (n = 312)			r^a	
Barthel Index (BI), score (0-100)	96.4	±	9.2	1.0		97.6	±	7.4	1.0	
Physical performance measures										
hand-grip strength, kg	18.6	±	4.6	0.325	**	29.5	±	7.0	0.365	**
one-legged stance with eyes open, s	18.9	±	20.0	0.314	**	25.9	±	22.9	0.208	**
functional reach, cm	23.0	±	6.8	0.245	**	25.8	±	6.7	0.161	**
five-chair SST, s	10.4	±	5.1	-0.397	**	9.0	±	3.9	-0.332	**
step test, s	6.1	±	2.9	-0.349	**	5.4	±	2.2	-0.392	**
timed up and go, s	9.9	±	6.3	-0.472	**	8.2	±	4.1	-0.377	**
usual gait time, s	5.50	±	3.80	-0.438	**	4.70	±	2.50	-0.349	**
manipulating pegs, n	35.60	±	6.90	0.422	**	34.70	±	7.00	0.351	**

r^a: Spearman correlation coefficients between 8 performance test and BI. ** $p<0.01$

The results of the principal component analysis are presented in Table 5.3. Although one principal component was identified that met the minimum eigenvalue (< 1) criterion, the first principal component analysis accounted for a significantly greater proportion of the variance (eigenvalue = 2.15 for men and 2.12 for women) than any of the other components. The first component explained about the 71% and 70% for men and women respectively of the all variables. These results suggest that the first principal component can be used as a relatively comprehensive index of ADL functioning.

Table 5.3. Factor loadings by principal component analysis.

Variables	Factor I	
	Women	Men
hand-grip strength, kg	-0.749	-0.766
five-chair SST, s	0.872	0.875
timed up and go, s	0.894	0.891
Eigen value	2.12	2.15
Percent variance	70.7	71.0

In order to compute ADLS for each subject, we calculated principal scores as Σ ai xi where ai is the factor loading of the 3 test items and the xi is an individual's standard score on the 3 test items.

The following equations were obtained for the ADLS:

For women

$$ADLS = 0.075\ X_1 - 0.082\ X_2 - 0.063\ X_3 + 0.124$$

For men

$$ADLS = 0.051\ X_1 - 0.105\ X_2 - 0.099\ X_3 + 0.249$$

Where X_1 = hand-grip strength, (kg), X_2= five-chair SST (s), X_3 = TUG (s).

The correlation between the first principal component score and the CA was r = − 0.485 for men and r = − 0.474 for women.

To transform the individual ADLS to the age scale, using the T-scale idea and taking in consideration that they are distributed with a mean of 0 and a SD of 1.0. First the scores were standardized using the average and SD of the CA.

The following equation for the ADLA was derived:

For women

$$ADLA = -5.493\ ADLS + 79.90$$

For men

$$ADLA = -4.272\ ADLS + 79.57$$

The above figures − 5.493 and 79.90 in women and − 4.272 and 79.57 are respectively the mean and SD of the CA of our sample of 1006 participants.

There were considerable differences between the slopes of the regression lines.

Figures 5-2a and 5-2b show the relation between the estimated ADLA and the CA. Although the estimated ADLA scores should ideally be scattered symmetrically above and below the identity line CA = ADLA, the slope of the regression differed considerably from 1.0. Before any statistically meaningful comparison could be made between ADLA and CA, the distortion of ADLA at the regression edges as a function of CA and the disagreement between the slopes of both regression lines had to be corrected as suggested by Dubina et al. (1984). We calculated the following correction term according to the method of Dubina et al. (1984). The correction is calculated from $Z = (1 - b)(Y_i - Y)$, where "Y_i" is the CA of an individual, "Y" is the mean CA, and "b" is the coefficient of simple linear regression that expresses the relation between ADLA and CA. Finally, corrected ADLA was obtained summing the Z in the second equation.

The equations after correction were as follows:

$Z = (1 - 0.553)\ (CA - 79.90)$

Women $ADLA = 0.447CA - 5.49ADLS + 44.17$

$Z = (1 - 0.480)\ (CA - 79.57)$

Men $ADLA = 0.519CA - 4.27ADLS + 38.26$

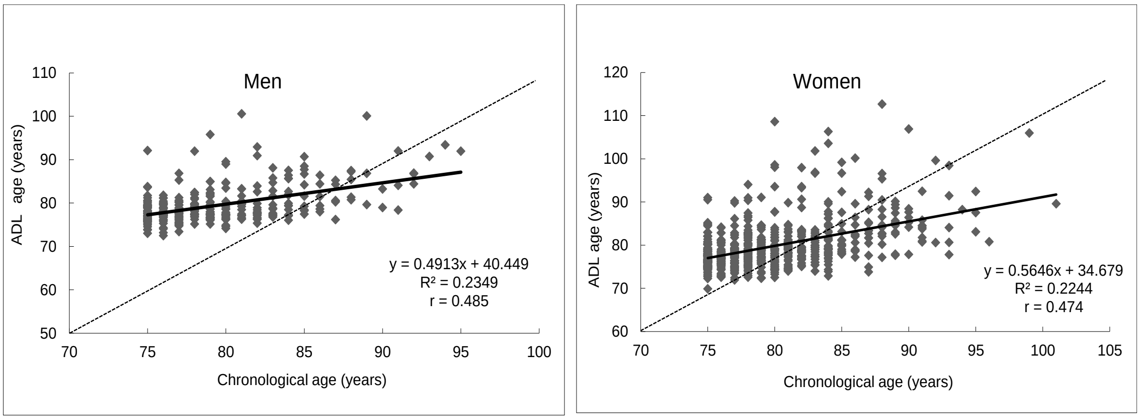

Figure 5-2a. Scatter diagram between chronological age and uncorrected activities of daily living age.

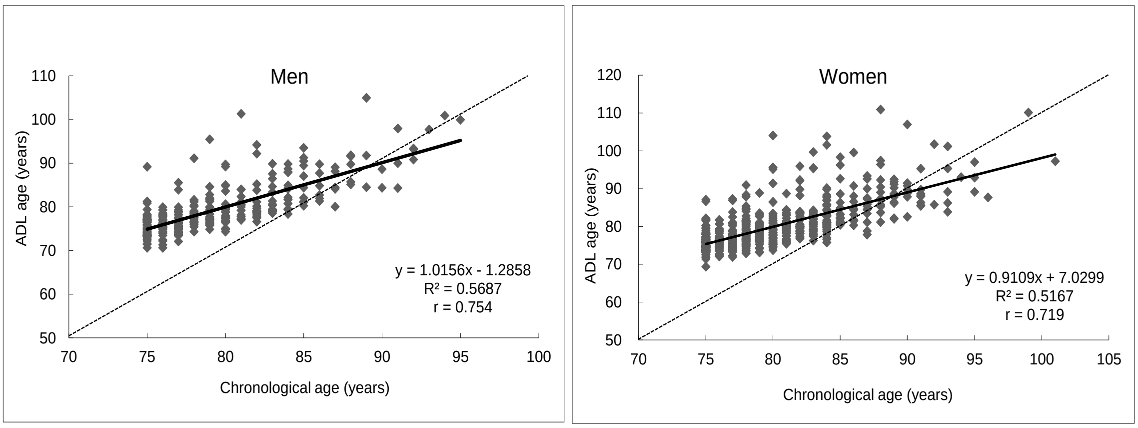

Figure 5-2b. Scatter diagram between chronological age and after correction activities of daily living age.

Figure 5-2a shows the relationship between CA and the uncorrected ADLA. The correlation between ADLA and CA was (r = 0.485 in men and r = 0.474 in women).

The corrected ADLA scores were almost symmetrically scattered above and below the line of identity CA = ADLA. The correlation between ADLA and CA was significant (r = 0.754 for men and r = 0.719 for women) as shown in Figure 5-2b. These data suggest that ADLA and CA are highly related but are not identical constructs.

5.4 Discussion

In the current study, we developed an equation of ADLA with the aim to use it as a tool to assess the physical functionality among older Japanese community dwellers aged 75 years or older, in order to respond to the necessity of the ADL. The findings of the present study showed that 3 ADL performance test can be used together to identify or monitor the characteristics of ADL levels of physical abilities. When Spearman rank-order correlation analysis was applied, 3 ADL items of 8 were found to represent the major elements of physical functioning that are necessary for the successful completion of many ADL. Specifically, the 3 items assessed walking ability, upper and lower body extremity strength. As the statistical significance p values of all items were less than 0.01. According to the results of the principal component that equations have the potential to recognize the physical functionality in about 71% by the factor loadings as shown in Table 3, representing the major elements necessary for the successful completion of ADL.

Our method for the process of computing the ADLA is generally consistent with several approaches previously reported in the experimental literature.

(Chodzko-Zajko WJ and Ringel RL, 1987; Hofecker G et al., 1980; Lee MS et al., 1993; Tanaka K et al., 1990). A common feature of all indices of biological age is the requirement to reduce a large number of variables to a single score. Specifically, the linear combination of measures that maximizes the prediction of CA is used to generate biological age, functional age or in this case ADLA (Furukawa T et al., 1975; Heikkinen E et al., 1974; Nakamura E et al., 1989; Voitenko VP and Tokar AV, 1993; Borkan Ga and Norris AH, 1980). As shown in Table 5.2, we decided primarily for the highest Spearman rank-order correlation to 1. From the higher rank of correlation for women were as follows: 1) TUG, 2) 5-m usual gait time, 3) manipulating pegs, 4) five-chair SST, 5) alternate step, 6) hand-grip strength, 7) one-legged stance with eyes open and 8) functional reach. We chose the highest items by similar group of ability, the first 2 items refer to walking skills, for example for walking skill TUG was the higher compared with 5-m usual gait time and alternate step. We selected TUG cast the other 2 items aside. For the lower extremity strength five-chair SST showed a higher correlation too. The third item was selected for the upper extremity strength (i.e., hand-grip strength). In the case of upper extremity strength we decided to implement hand-grip strength for both sexes, to synchronize with the items used in men. The reason we decide hand-grip strength although this showed lower correlation than manipulating pegs in women was that according to some researches (Rantanen T et al 1999), hand-grip strength is not just a better descriptor of upper extremity strength, it also provides strong evidence that predicts functional limitations and disability while manipulating pegs involve finger-synchronization skills. A 25 years cohort study of Japanese-American subjects showed that people with lowest hand-grip strength tertile had the greatest risk and those in the middle tertile had intermediate risk compared with those in the highest tertile. Muscle strength is found to track over the lifespan: those who had higher hand-grip strength during midlife remained stronger than others in old age (Rantanen T et al 1998). People with greater muscle strength during midlife are at lower risk of becoming disabled because of their greater reserve of strength regardless of chronic conditions that may develop. Also, hand-grip strength has been found to be correlated with strength of other muscle groups and is thus a good indicator of overall strength (Rantanen T et al 1994). Consequently, hand-grip strength measurements could be used for early screening of populations to identify those at higher risk of physical disability related to low muscle strength. In these persons, exercise interventions aimed at improving strength in all muscle groups could potentially lower the risk of subsequent physical disability. There are also other potential explanations that hand-grip strength may be a marker of physical activity which itself preserves function and prevents disability (LaCroix AZ et al 1993). Muscle strength can be increased substantially by physical exercise at all ages (Fiatarone MA et al 1994; Frontera WR et al., 1988; Sipilä S et al., 1996). With this in mind, our aim is to focus more on those items which are closely related with the physical function and avoid motor disabilities, especially in the weak population that are people of 75 years or older. Finding in aforementioned references helped to choose hand-grip strength for women too.

For men, walking skills and lower extremity were the same items as women (TUG, five-chair SST and hand-grip strength), Although men's data were fewer than women's we conclude that this synchronization of items are credible by the reason that it has been proved that women have a notable lower death rate than men at all ages, women also seem to resist diseases better than men and seem to respond more readily to medical treatment at the same CA (Verbrugge LM, 1982; World Health Organization Health of the elderly, 1989; Siegel JS and Hoover SL, 2000).

After the first principal component analysis was applied to the three selected items, results showed that those items explained nearly the 71% of the total variance. This explanatory percentage is almost identical to that reported in previous studies (Nakamura E et al., 1988; Hofecker G et al 1980; Tanaka K et al 1990). Our data suggests that these 3 items (highly reliable ADL test and proved to assess functionality on elder population) (Tanaka K et al 1990), could be combined into an index of functional status (ADLA), which, found to be highly correlated with BI, has the potential to discriminate among individuals of similar CA but differing in the functional abilities.

The relevance of this study is that the ADLA equation it is an easy and compact index that can be used with short ADL variables while avoiding the fatigue of the elderly with a long battery of test. In comparison to other studies this is the first time that an index for people over the age of 75 has been developed, previous studies typically have an elaborated index for healthier, and younger participants.

Hand-grip strength, five-chair SST and TUG can be used together to identify or monitor the characteristics of ADL levels of physical abilities on people over 75 years as an additional measure of senescence that may help researchers and clinicians to discriminate between individuals who are of the same CA but who differ in a physical function status.

This study has some limitations. First, our sample of the population could not be the representative of the all Japanese population, because we recruited our participants at community centers, limiting the participation in our study only to visitors of those centers. Second, the subjects had a sufficient mobile to commute to our study center, thus, relatively healthier people tend to participate with a positive effect in the strata. Third, the current ADLA has been established exclusively from cross-sectional data, and with non-disabled Japanese population over 75 years or older. Equations could not be functional in other countries or younger populations, because of complex factors related with lifestyle (environmental) and/or ethnicity. However, our findings might not be generalizable to older adults who are frailer. The equations are only applicable to Japanese community-dwelling aged 75 years or older. It is necessary to assess the validity of it in longitudinal studies and or in short or long training studies as well (exercise interventions) in which there is an attempt to alter functional status through an intervention program.

CHAPTER 6

CROSS-VALIDITY AND RELIABILITY OF THE ADL AMONG JAPANESE COMMUNITY-DWELLING OLDER ADULTS.

6.1 Purpose

The aims of this study are to determine the validity using cross-validation and the test re-test reliability using absolute reliability of the developed ADLA on a measure that was given on 2012 and re-tested again one year later (2013). It is expected that ADLA is an enduring trait. Hence the score in the first rating should agree with the score in the second rating.

6.2 Methods

6.2.1 Participants

Participants included in this investigation were 100 Japanese community dwellers aged 75 years and older. The participants were recruited through poster advertisements and flyers displayed in senior centers, leisure centers, and residential retirement communities in Fukushima and Ibaraki prefectures, northeast of Tokyo. To be included, the participants needed to be community dwellers aged 75 years or older. Exclusion criteria were as follows: being unable to perform or participate in the physical test in both sessions (n = 7) or being unable to understand the instructions for the test and questionnaires (n = 4). The remaining 89 participants (42 women with a mean age of 78.9 ± 3.7 and 47 men with a mean age of 79.1 ± 3.8) 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 an 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 of the University of Tsukuba, Japan.

6.2.2 Measurements

Basic anthropometric measures as body weight and height follow by self-report information about the use of medications, pain sites, comorbidities and health-related information. Secondly participants started the physical fitness measure, all items have been previously described in the chapter 4.

6.2.3 Physical performance items

The 3 physical performance items described below formed the basis for the ADLA equation, which was used to obtain the ADLA (Figueroa et al., 2015). These items were selected based on previous research, in which they were recognized as significantly related to ADL (Bravo et al., 1994). In order to determine test-retest reliability, selected physical performance items, or tests, were assessed at the baseline in 2012 and again one year later.

1. Hand-grip
2. 5 chair sit to stand test
3. Timed up and go

All items have been described in the chapter 4.

6.2.4 Statistical analyses

Statistical analysis was carried out using the IBM SPSS Statistics software, version 21 (SPSS Inc., Chicago, IL, USA), with the level of statistical significance set at 5%.

The reliability of the ADLA was measured by analyzing internal consistency using Cronbach's α coefficient (Cronbach LJ and Warrington WG, 1951). Inter-rater and intra-rater reliabilities was calculated by means of the Intraclass Coefficient Correlation (ICC) (Lord FM and Novick MR, 1968).

The ICC was chosen because it provides a powerful and flexible method to examine the reliability of the ADLA (Ottenbacfhef JK and Tomcheck SD, 1993). Coefficients below 0.50 indicate poor reliability, those between 0.50 and 0.75 indicate moderate reliability, and those above 0.75 indicate good reliability (Portney LG and Watkins MP, 2000).

The following two aspects of the ADLA's reliability were assessed: (1) test-retest reliability was determined for the total score of the three components and (2) internal consistency was determined using Cronbach's α coefficient for all tasks within the three motor domains. The model was two-way mixed and the type was absolute agreement. In the present study, we expected the two ADLA scores to match.

Cross-validation sample: In order to assess the stability of the ADLA equation for a different sample of subjects, ADLA scores were computed using the original regression equation for this new sample of 89 participants. Correlations between ADLA and CA were determined in order to assess the stability of the ADLA-CA relationship across the two sample groups.

6.3 Results

The baseline characteristics of the 89 study participants are summarized by gender in Table 6.1. All participants claimed no known neuromuscular, musculoskeletal or cardiovascular pathology that would affect their ambulatory capacity to perform the tasks in the current study. Also, most of the participants rated their current health status as good to very good.

Table 6.1. Characteristics of the study participants (n = 89)

Variables	mean ± standard deviation or n (%)	
	women (n = 42)	men (n = 47)
Age, years	78.9 ± 3.7	79 ± 3.9
Height, cm	146.1 ± 5.9	157.1 ± 6.2
Weight, kg	49.9 ± 7.4	57.3 ± 9.0
Body mass index, kg/ı	23.5 ± 3.9	23.2 ± 2.9
Chronic disease, n (%)		
Hypertension	22 (51.2)	15 (31.9)
Stroke	2 (4.7)	4 (8.5)
Heart disease	5 (11.6)	5 (10.6)
Diabetes mellitus	5 (11.6)	2 (4.3)
Self-rated health, n (%)		
Excellent to good	41 (95.3)	47 (100.0)
Fair to poor	2 (4.7)	0 -
Alcohol drinking status, n (%)		
Current	20 (46.5)	22 (46.8)
No drink	23 (53.5)	26 (55.3)
Smoking status, n (%)		
Current	1 (2.4)	24 (51.1)
No smoke	41 (97.6)	23 (48.9)
Body pain, n(%)		
Waist	20 (46.5)	11 (23.4)
Shoulder joint	4 (9.3)	3 (6.4)
Elbow joint	0 -	1 (2.1)
Hip joint	0 -	1 (2.1)
Knee joint	15 (34.9)	10 (21.3)
Feet	4 (9.3)	1 (2.1)

Table 6.2. shows a comparison between CA and ADLA in the validation and cross-validation groups. For both sexes, no differences were found between either CA or ADLA. The correlation between the ADLA and CA in the cross-validation samples (r = 0.62 women, r = 0.61 men) was not significantly different from the relationship observed in the original sample in women (r = 0.72 women P = 0.636 and r = 0.75 men P = 0.571).

Table 6.2. Comparison of chronological age and ADL age in validation and cross-validation groups (n = 89)

Variables	mean ± standard deviation or n (%)			
	Validation group (n= 1006)		Cross-validation group (n= 89)	
	women (n = 694)	men (n = 312)	women (n = 42)	men (n = 47)
Chronological age, years	79.9 ± 5.4	79.6 ± 4.3	78.9 ± 3.7	79.1 ± 3.8
ADLA	79.8 ± 6.0	79.6 ± 7.4	85.4 ± 3.8	79.9 ± 4.5
Correlation ADLA/CA	*r* = 0.72	*r* = 0.75	*r* = 0.62	*r* = 0.61
			NS	*NS*

r : Correlation between ADLA and CA.

p = NS: No significance diference between ADLA and CA among the original and the cross-validation samples.

ADLA: Activities of daily living age

CA: Chronological age

As shown in Table 6.3. internal consistency of the scale was good for both sexes with a Cronbach`s α coefficient of 0.919 for women and 0.968 for men. The inter-rater reliability (test re-test) was analyzed using ICC, where the average measure was rated for all of the items independently, obtaining 0.906 for women and 0.958 for men.

Table 6.3. Intraclass correlation coefficients of the study participants (n= 89) by gender

Variables	intraclass correlation	
	women (n= 42)	men (n= 47)
single measure	0.829	0.920
average measure	0.906	0.958
Cronbach`s Alpha	0.919	0.968

Similarly, inter-rater reliability and intra-rater reliability (test-retest) among the different items was analyzed using ICC, and all items were found to have values higher than 0.8 (table 6.4.).

Table 6.4. Internal consistency and intra-rater raliability of the ADLA (89)

Subscales	women (n= 42)						men (n= 47)					
	Rating 1 mean (SD)	Rating 2 mean (SD)	ICC	95%CI lower	95%CI upper	C.α	Rating 1 Mean (SD)	Rating 2 Mean (SD)	ICC	95%CI lower	95%CI upper	C.α
1. Hand-grip, kg	19.7 (41)	19.3 (3.3)	0.803[a]	0.634	0.894	0.801	30.1 (6.6)	29.0 (6.2)	0.947[a]	0.898	0.972	0.953
2. 5-chair SST, s	8.4 (3.1)	8.7 (3.0)	0.798[a]	0.625	0.891	0.796	11.1 (4.7)	11.5 (5.1)	0.960[a]	0.928	0.978	0.961
3. Timed up and go, s	7.8 (2.5)	7.9 (3.0)	0.912[a]	0.836	0.953	0.910	7.4 (2.7)	7.6 (3.9)	0.908[a]	0.835	0.949	0.907

ADLA, activities of daily living age; SD, standard deviation; ICC, Intraclass correlation coefficient; CI, confidence intreral; C.α, Cronbach`s alpha. SST, sit to stand test; [a] correlation is significant at the .01 level.

6.4 Discussion

To the best of our knowledge, this is the first ADLA assessment for Japanese people aged 75 years and older. Moreover, our results have shown that the physical performance assessed by ADLA can indicate with high confidence low physical function in older subjects. The results suggest that the ADLA is a highly valid and reliable tool for the assessment of ADL.

The correlation between the ADLA and CA in the cross-validation sample of 89 participants was not significantly different from the relationship observed in the original sample which consisted of 1006 subjects. Obtained results thus indicate a satisfactory validation of ADLA assessment and correspond well with previous findings (Kim HS and Tanaka K, 1995; Yabushita et al., 2004). For example, a study of Korean women by Kim and Tanaka (1995) assessing functional age using ADL has also shown that there were no differences between the original sample (r = 0.77) and the cross-validation group (r = 0.68) (Kim HS and Tanaka K, 1995). In addition, Yabushita et al. (2004) demonstrated that there was no significant difference between the first sample and a second sample 10 months later regarding the relationship between CA and the study's physical fitness assessment for older Japanese (Yabushita et al., 2004). Similarly, our results imply that the ADLA-CA relationship remained stable across the two samples.

Satisfactory test-retest reliability was also indicated by the fact that the ICC of the items that compose the ADLA assessment ranged from 0.80 to 0.91 for women and 0.91 to 0.96 for men. In the present study, Cronbach's α for internal consistency also ranged from 0.80 to 0.91 for women and 0.91 to 0.96 for men.

Furthermore, the ICC of the ADLA was 0.91 for women and 0.96 for men, and Cronbach's α coefficient was 0.92 for women and 0.97 for men. Obtained results therefore indicate that the ADLA assessment has adequate reliability and this corresponds well with previous findings for community-dwelling older individuals. Shigematsu et al. (1998) analyzed the reliability and objectivity of test items that assessed the functional fitness required for performing ADL among older adult Japanese women (n = 207; people aged 60-91 years), and they obtained excellent test-retest reliability for hand-grip strength (ICC = 0.91) (Shigematsu et al., 1998). Schaubert et al.'s (2005) study (n = 10; mean age = 75.5 years) found adequate test-retest reliability for 5SST (ICC = 0.82); this study used the MicroFET 2 hand-held dynamometer (knee extension strength), the Jamar dynamometer (grip strength), and the 5SST. Mobility was tested using TUG and a timed-walk test. Intra-class correlation coefficients, which were used to characterize the reliability of the strength tests, ranged from 0.807 to 0.981. Pearson correlations between the lower extremity strength measures and the TUG and gait speed ranged from 0.635 to -0.943. Their examination of these three measures thus adds to the previous evidence of the stability of these strength measures; and this further justifies the use of hand-held dynamometry and the 5 SST test when investigating limitations in mobility, as the current study does (Schaubert KL and Bohannon RW, 2005). In addition Tiedemann et al. (2008); (n = 362; people aged 74-98 years), obtained adequate test-retest reliability (ICC = 0.890) (Tiedemann et al., 2008), and Bohannon, 2007 captured an excellent test-retest reliability (ICC = 0.957) in 5SST (Bohannon et al., 2007).

Similarly, Nordin et al. (2004), in a study of the Timed "Up & Go" (TUG) Test investigated the expected variability of TUG scores among older dependent subjects (n = 78; mean age 84.8 ± 5.7). The TUG assessments were performed on 3 different days. The intra-class correlations were greater than 0.90 and were similar within and between raters (Nordin et al., 2004).

Previous research has also shown that the ICC is strongly affected by the range of scores used to calculate the coefficient: the ICC is high when the difference in scores between measurements is small in comparison with the range of scores among the studied participants (Bland JM and Altman DG, 1990; Domholdt E, 2000; Atkinson G and Nevil A, 1998).

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, because we recruited our participants at community centers, thus limiting participation in our study to these centers' visitors. Second, our participants were a convenient sample and not randomly selected. The sample consisted only of relatively healthy older

Japanese aged 75 years and over who were sufficiently mobile to commute to our study center, and thus tended to participate with, which had a positive effect in the strata. Third, it must be noted that there is no universal agreement on the interpretation of correlation coefficients. A variety of guidelines are suggested in the literature: > 0.75 equals "excellent reliability," (Shrout PE and Fleis JL, 1979) ≥0.80 is "very reliable," (Curirer DP, 1990) and >0.75 indicates "good reliability" (Portney LG and Watkins MP, 2000). Therefore, several factors may have been involved in these results, especially since there was an average of one year between test and retest.

In conclusion, this study found further evidence that the ADLA is a reliable and valid tool for the assessment of ADL for people 75 years and older. In this study, the Cronbach's α coefficient values were good, and there were high values for test-retest reliability for almost all the test items. The good construct results therefore indicate that the ADLA can be used with confidence. However, a validation process should be confirmed by more than one approach and using multiple techniques (Nunnally JC and Bernstein IH, 1994). Future research efforts are thus required to provide more evidence for the reliability and validity of ADLA assessment in different groups of older

Japanese people, with and without movement difficulties.

CHAPTER 7

PHYSICAL FUNCTION BENEFITS FOR ACTIVITIES OF DAILY LIVING ASSOCIATED WITH REGULAR AND NON-REGULAR EXERCISE HABITUATION IN OLDER JAPANESE

7.1 Purpose

In the previous studies although the equation showed confident results under physical exercise intervention, it is still unknown whether it has clinical applicability on subjects relatively active and inactive.

The purpose of this study was to state the applicability of the ADLA equation by the comparison among community-dwelling older adults aged 75 years or older, who are engaged in a regular exercise activities and those who are considered sedentary.

7.2 Methods

7.2.1 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 centers, leisure centers and residential retirement communities. Participants were recruited from 3 prefectures located north east of Tokyo: Fukushima, Ibaraki, and Chiba. Inclusion criteria was 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%; 212 males aged 79.1 ± 3.8 years and 386 women aged 79.0 ± 3.5 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 divide into 2 groups according to the "frequency of exercise and time of 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.

7.2.2 Measurements

Participants were interviewed to obtain Basic anthropometric measures as body weight and height follow by self-report information about the use of medications, pain sites, comorbidities and health-related information. Secondly participants started the physical fitness measure, all items have been previously described in the chapter 4.

7.2.3 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 Center 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 (Church et al., 2009).

7.2.4 Physical performance items.

The 3 physical performance items described below formed the basis for the ADLA equation, which was used to obtain the ADLA. These items were selected based on previous research, in which they were recognized as significantly related to ADL. In order to determine functional status, selected physical performance items, or tests, were assessed in both groups.

1. Hand-grip
2. 5 chair sit to stand test
3. Timed up and go

All items have been described in the chapter 4.

7.2.5 Statistical analysis

The ADLA equation was applied beginning from the ADL score (ADLS) equation that was obtained from the 1006 subjects in previous study (Figueroa et al., 2015). Statistical analysis was carried out using the IBM SPSS Statistics software, version 21 (SPSS Inc., Chicago, IL, USA), with the level of statistical significance set at 5%.

7.3 Results

The characteristics of the participants are summarized by gender in Table 7.1. Although all participants claimed no known neuromuscular, musculoskeletal or cardiovascular pathology that would affect their ambulatory capacity to perform the tasks in the current study, And also, most of the participants rated their current health status as good to very good, the data showed that more participants in the non-exercise group have poorer health than those in the active group including some body pains and a bad habits such as consuming alcohol.

Table 7.1. Characteristics of the study participants (n =598)

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/	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

NE: Non-exercise group
A: Active group
* P< 0.05, ** P< 0.01

In women between NE and A, age, some chronic disease as hypertension, stroke, alcohol consumption and knee joint pain were significant different. In men, age, height, and hypertension presents a significant difference.

Table 7.2. Descriptive statistics (n =598)

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 -	
aquafitnnes	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	**	0.1 ± 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 execercise, 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)	

NE, non-exercise group; A, Active group; ** p<0.01

Table 7.2. 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 groups 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.

Table 7.3. Descriptive statistic for the 3 ADL performances test (n =598)

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

NE, non-exercise group; A, Active group; ** p<0.01

Table 7.3 shows the difference between all the ADL performance test scores. The mean of hand-grip strength in women`s A group (20.4 ± 3.8 kg) was 1.6 kg significantly (p <0.01) higher than the mean of NE group (19.0 ± 4.2 kg), the mean of 5-chair SST in A group (8.2 ± 3.1 s) was 2.5 seconds significantly (p <0.01) faster than the mean of NE group (10.7 ± 4.2 s) and the mean of the TUG in the A group was (7.3 ± 2.1 s) 1.4 seconds significantly (p <0.01) faster compared with the mean of the NE group (8.7 ± 2.0 s) in the same gender. On the other hand in men`s A group, the mean of hand-grip strength was (31.8 ± 5.8 kg) 3.0 kg stronger than the mean of NE group, the mean of 5-chair SST in A group (7.7 ± 2.6 s) was 1.6 seconds significantly faster compared with the mean in NE group (9.3 ± 4.2 s) and in the same gender the mean of TUG in A group (6.8 ± 1.9 s) was 1.4 seconds significantly higher compared with the mean of NE group (8.2 ± 2.7 s). All ADL performance test in both genders were significantly differed among NE and A groups ($P < 0.01$). In women the mean of the ADLA in NE group (78.9 ± 4.3 years) compared with A group (76.3 ± 3.7 years) were statistical significant ($P < 0.01$) higher (older) by a difference of 2.6 years. The mean of ADLA in the A group compared with the mean of their CA was statistical significant lower ($P < 0.01$) by 2.3 years younger. In the other hand the mean of the ADLA in the NE group compared with the mean of their CA was significantly ($P < 0.05$) lower (younger) by 0.5 years (Table 7.4).

In men the mean of the ADLA in NE group (80.0 ± 5.1 years) was statistical significant($P < 0.01$) higher (older), by 2.7 years than their mean in A group (77.3 ± 3.4 years), also the mean of the ADLA in A group was significantly lower (younger) at the 0.01 level than their mean of CA, by 1.1

years, and at the end the mean of ADLA in NE group compared with their CA was higher but not showed significant differences (Table 7.4). Thus, indicating that participants in the A group are in a significantly higher state of physical fitness than NE participants.

Table 7.4. Comparison of chronological age and ADL age between NE and A groups (n =598)

		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		**
A	CA	246	78.6	±	3.5	**		147	78.4	±	3.3	**	
	ADLA		76.3	±	3.7				77.3	±	3.4		

NE, non -exercise; A, active; CA, chronological age; ADLA, activities of daily living age.
NS, no significance diference; * p<0.05, ** p<0.01

7.4 Discussion

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. This might suggest that in Japanese people over 75 years and older community-dwellers regular physical activity may provide physical functionality improvements 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 (Nakamura et al., 1989). In conclusion our findings suggest that even people over 75 years and older 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 (Nakamura et al., 1989).

The study has some limitations because the sample consisted only in relatively healthier older Japanese over 75 years and older that had a sufficiently mobile to commute to our study center, thus, tend to participate with a positive effect in the strata. In the other hand because the lack of information about the real intensity of the exercise, exist the probability to differ with other studies and with effect on the results. 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, and with this obtain a more accurate result of the degree of the health benefits of the exercise in terms of physical functionality for elderly Japanese over 75 years and older.

The findings showed that the ADL tests for walking ability, upper and lower extremity strength are useful to identify or monitor the characteristics of ADL physical function. Therefore this ADL age may be a useful tool in identifying individuals who require intervention.

CHAPTER 8

EFFECTS ON THE PHYSICAL FUNCTION USING THE ADLA SCALE AMONG COMMUNITY-DWELLING ADULTS AGED 75 YEARS OR OLDER BY A SHORT EXERCISE INTERVENTION PROGRAM.

8.1 Purpose

In the previous studies although the validation and reliability showed confident results, it is still unknown whether it has clinical applicability.

The purpose of this study was to state the applicability and responsiveness of the ADLA scale and to observe the benefits in terms of physical function through a 3 months exercise program among community-dwelling adults aged 75 years or older.

8.2 Methods

8.2.1 Participants

Participants were 166 Japanese community dwellers over 75 years and older (126 women 80.3 ± 4.1 and 40 men 82.8 ± 4.0), who completed a 12 weeks (3 months) exercise program. The participants were recruited from the Yachiyo city in Ibaraki prefecture, through poster advertisement and flyers that were displayed in senior centers, leisure centers and residential retirement communities within Japanese community support projects. The participants were selected based on the following eligibility criteria 1) community dwellers aged over 75 years and older, 2) not on a medical treatment for cardiac disease or another delicate illness to impede do exercise. The exclusion criteria were as follows: 1) participants unable to perform the physical test, 2) unable to understand the instructions for the test and questionnaires 3) breathlessness, palpitation, lumbago, hemoglobin less than 10.9g/dl, systolic blood pressure more than 180mmHg and diastolic blood pressure more than 110mmHg.

8.2.2 Measurements

Participants were interviewed to obtain Basic anthropometric measures as body weight and height follow by self-report information about the use of medications, pain sites, comorbidities and health-related information.

Secondly participants started the physical fitness measure, all items have been previously described in the chapter 4.

8.2.3 Exercise intervention regimens

All participants described in this chapter were involved in a 12-weeks strength exercise program as is described in the chapter 4.

8.2.4 Physical performance items

The following 3 physical performance items were the base to construct the ADLA equation, those are need to obtain the ADLA. In order to determine the effects of the exercise the measure was given once (pre the physical intervention) and again three months later (post physical intervention program).

1. Hand-grip
2. 5 chair sit to stand test
3. Timed up and go

All items have been described in the chapter 4.

8.2.5 Statistical analysis

The activities of daily living age equation was applied beginning from the ADL score (ADLS) equation that was obtained from the 1006 subjects in previous study. The data were analyzed using SPSS version 13.0 for windows package (SPSS Inc., Chicago, USA). A statistically significant level was set at p <0.05.

7.3 Results

Table 8.1. Characteristics of the study participants (n = 166)

Variables	mean ± standard deviation or n (%)	
	women (n = 126)	men (n = 40)
Age, years	80.3 ± 4.9	81.6 ± 5.5
Height, cm	144.0 ± 5.9	156.0 ± 5.3
Weight, kg	49.8 ± 8.7	58.3 ± 9.0
Body mass index, kg/m^2	24.0 ± 3.8	23.9 ± 3.5
Chronic disease, n (%)		
Hypertension	49 (38.6)	10 (25.0)
Stroke	7 (5.6)	8 (20.0)
Heart disease	11 (8.7)	4 (10.0)
Diabetes mellitus	5 (4.0)	4 (10.0)
Self-rated health, n (%)		
Excellent to good	116 (92.1)	37 (92.5)
Fair to poor	10 (7.9)	3 (7.5)
Alcohol drinking status, n (%)		
Current	55 (43.7)	28 (70.0)
No drink	71 (56.3)	12 (30.0)
Smoking status, n (%)		
Current	5 (4.0)	7 (17.5)
No smoke	121 (96.0)	33 (82.5)
Body pain, n(%)		
Back	38 (30.2)	11 (27.5)
Shoulder joint	20 (15.9)	6 (15.0)
Elbow joint	3 (2.4)	1 (2.5)
Hip joint	3 (2.4)	1 (2.1)
Knee joint	37 (29.4)	10 (25.0)
Feet	6 (4.8)	0 -

A description of the characteristics of the 166 participants is presented in table 8.1. All participants claimed no known neuromuscular, musculoskeletal or cardiovascular pathology that affected their ambulatory capacity to perform the items of the current study. Also most of the participants rate their current health status as good to excellent.

The comparison of the all ADL performance test scores are showed in figure 8-1a and 8-1b. Hand-grip showed an improvement of 0.6 kg after the 3 months physical intervention program but it was not significant different in both sexes. In the other hand, 5SST and TUG in men showed an improvement of -2.0 s and -1.1 s respectively, showing a significant difference (P <0.01), In comparison with the pre-physical measurement subjects became faster to carry out the tests. In women, the results were similar than in men, there was a small quantity of improvement of hand-grip (0.3 kg) with a non-significance difference. 5SST and TUG showed a significance difference (P <0.01) improvement of -1.2 s and -1.1 s respectively in comparison with the pre-physical measurement (Fig 8-1a and 8-1b).

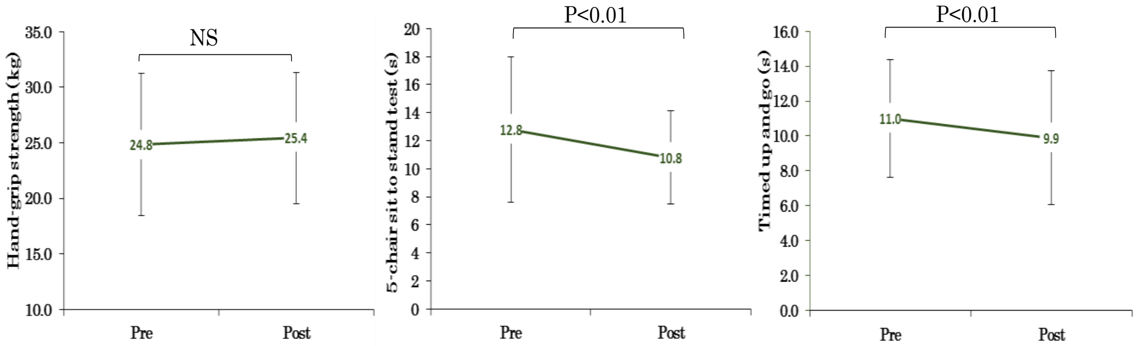

Figure 8-1a. Comparison of the all physical items test between pre and post physical intervention program in men.

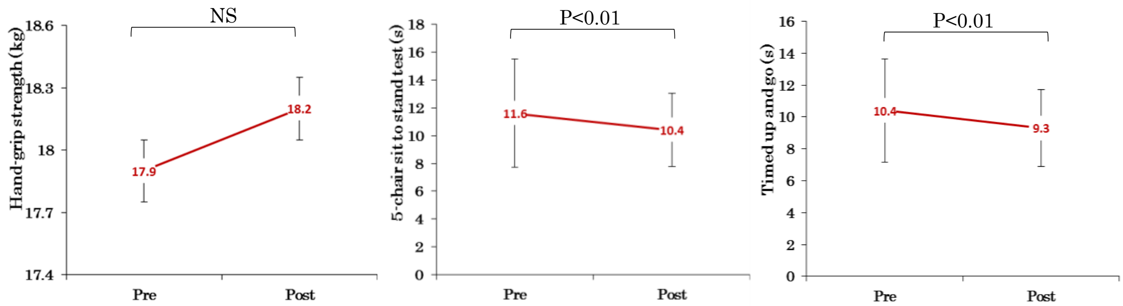

Figure 8-1b. Comparison of the all physical items test between pre and post physical intervention program in women.

The items descripted below were necessary to apply the developed ADLA equation to obtain the score in terms of years. Men were 84.5 years old before the 3 months physical intervention and 82.1 years old in the post-intervention, becoming significant younger (P <0.05) by -2.4 years. Also women in comparison between the pre (81.0 years old) and post (80.0 years old) physical intervention were significant younger (P <0.01) by -1.0 years (figure 8-2).

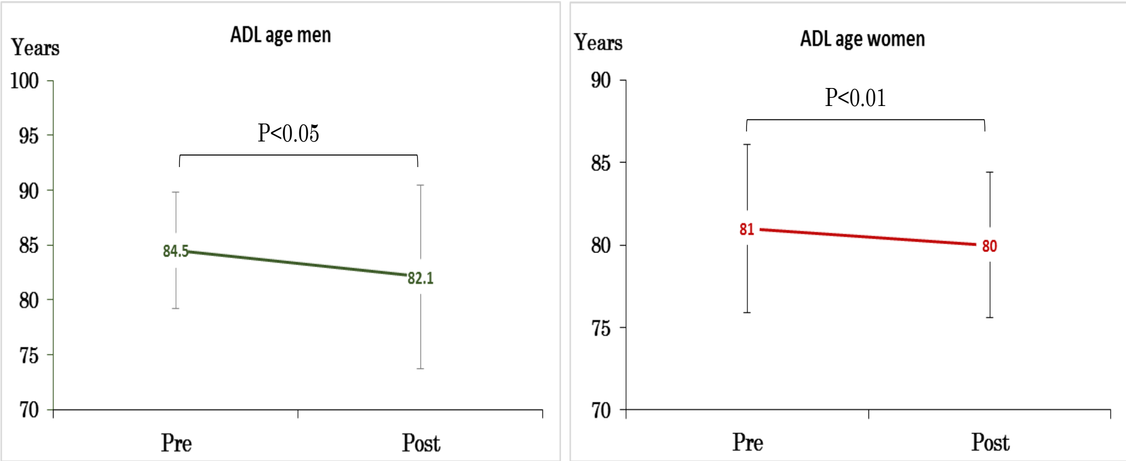

Figure 8-2. ADL age comparison between pre and post physical intervention program in men and women.

7.4 Discussion

The primary findings of this study were that according to the results, 5SST and TUG showed significant difference improvement in both sexes, those performance are direct related to the ambulatory skill. This means that the benefits will be appeared in the lower extremity of the body, therefore the results suggest that poor lower extremity performance not only correlate with functional status (e.g., functional limitation and disability), but also predicts them prospectively (Guralnik JM et al., 1994, 1995, 2000; Shinkai et al., 2000; Cesari et al., 2005; Kim et al., 2010).

In the other hand, although among upper extremity performances, only hand-grip strength test has been considered as accurately discriminate each functional status, in addition numerous studies have consistently demonstrated that hand-grip is an independent predictor of frailty (Sayer et al 2006), disability (Ranten et al., 1999), and cause-specific and total mortality (Ranten et al., 2003). In the current study the perception of improvement of the hand-grip was a small quantity in both sexes although it had a range of almost 0.5% of p value, but there were no significant difference. However, this results suggest that: 1) Even in a short time of exercise program, improvements on upper extremity could be meaningful; 2) Considerable physical benefits appear even in people aged 75 years or older; 3) Due the improvement of physical function people could carry out ADL without problems and also remain independent of nurse cares.

There were several limitations in the current study, first, population studies of older adults may sometimes be affected by selection bias, because relatively healthier people that had a sufficiently mobile to commute to our study center tend to participate with a positive effect in the strata. Second, our participants were a convenient sample and not randomly selected. Third as it was described below since the hand-grip did not demonstrate a significance difference, it means that the physical intervention program was not enough and was not 100% appropriate to improve the upper extremity function (The program apparently was focused more on lower extremity neglecting the upper extremity).

In conclusion ADLA scale showed positive responsiveness for detecting the degree to which physical functionality is enhanced by an exercise program in older Japanese aged 75 years and older. The results of the present study showed that in the attempt to refine the ability to discern limitations and disability, the advantages were less than the expectation. Although the results suggest even older adults aged 75 years or older may provide physical functionality improvements with a regular physical activity which in turn might reduce the dependence on somebody or nurse care. This will helps in reduce the rate of aging as one of the principals health benefits. Also the findings suggest that older adults who engaged in a regular exercise with a not large amount of exercise might possess significantly higher levels of physical function and consequently physiological improvements (Nakamura et al., 1989).

CHAPTER 9

CONCLUDING REMARKS

9.1 Concluding remarks

In the current thesis we aimed to develop an age index capable of assessing activities of daily living by the principal component analysis, among community-dwelling adults aged 75 years or older. And determine the utility of this age scale under different factors such as exercise. Taking this into consideration, it was established the following research objectives and conducted the relevant studies.

1. To develop an age scale for assessing activities of daily living (ADLA) among community-dwelling adults aged 75 years or older (Cross-sectional study) (Chapter 5).
2. To determine the validity using cross-validation and the test re-test reliability using absolute reliability of the developed ADLA (Longitudinal study) (Chapter 6).
3. To state the applicability of the ADLA equation by the comparison among

community-dwelling older adults aged 75 years or older, who are engaged in a regular exercise activities and those who are considered sedentary (Cross-sectional study) (Chapter 7).

4. To state the applicability and responsiveness of the ADLA scale and to observe the benefits in terms of physical function through a 3 months exercise program among community-dwelling adults aged 75 years or older (Longitudinal study) (Chapter 8).

Firstly it was conducted principal component analysis to state the ADLA scale, secondly it was stated the validity and reliability.

In order to assess the stability of the ADLA it was used cross-validation sample. The reliability of the ADLA was measured by analyzing internal consistency using Cronbach's α coefficient, Inter-rater and intra-rater reliability was calculated by means of the Intraclass Coefficient Correlation (ICC). Thirdly to state the applicability of the scale, it was applied the ADLA scale under two factors: 1) comparison between active people versus sedentary people, 2) Comparison of before (pre) and after (post) 3-months of a physical intervention program. It was identified the following key findings.

1. 3 items were selected to be the highest Spearman rank-order correlation among Barthel Index score and ADL tests, those were subjected to the principal component analysis. In order to compute ADL score for each subject, we calculated principal scores as Σ ai xi where ai is the factor loading of the 3 test items and the xi is an individual's standard score on the 3 test items.

The following equations were obtained for the ADLS:

For women = $0.075\ X_1 - 0.082\ X_2 - 0.063\ X_3 + 0.124$

For men = $0.051\ X_1 - 0.105\ X_2 - 0.099\ X_3 + 0.249$

Where X_1 = hand-grip strength, (kg), X_2= five-chair SST (s), X_3 = TUG (s).

To transform the individual ADLS to the age scale, using the T-scale idea and taking in consideration that they are distributed with a mean of 0 and a SD of 1.0. First the scores were standardized using the average and SD of the CA.

The following equation for the ADLA was derived:

For women = − 5.493 ADLS + 79.90

For men = − 4.272 ADLS + 79.57

The above figures − 5.493 and 79.90 in women and − 4.272 and 79.57 are respectively the mean and SD of the CA of our sample of 1006 participants.

Finally the equation was corrected as suggested by Dubina et al. (1984), obtaining the follow ADLA equation:

Women = 0.447CA − 5.49ADLS + 44.17

Men = 0.519CA − 4.27ADLS + 38.26

2. The correlation between the ADLA and CA in the cross-validation sample of 89 participants was not significantly different from the relationship observed in the original sample which consisted of 1006 subjects. Implying that the ADLA-CA relationship remained stable across the two samples.

Satisfactory test-retest reliability was also indicated by the fact that the ICC of the items that compose the ADLA assessment ranged from 0.80 to 0.91 for women and 0.91 to 0.96 for men. Cronbach's α for internal consistency also ranged from 0.80 to 0.91 for women and 0.91 to 0.96 for men. Furthermore, the ICC of the ADLA was 0.91 for women and 0.96 for men, and Cronbach's α coefficient was 0.92 for women and 0.97 for men. Obtained results therefore indicate that the ADLA assessment has adequate reliability.

3. 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 indicates that people who engage in a regular exercise with a not large amount of exercise might possess significantly higher levels of physical function.

4. After a 3-months of an exercise program, ADLA scale showed positive responsiveness according to the results, 5SST and TUG showed significant difference improvement in both sexes. This means that the benefits will be appeared in the lower extremity of the body, therefore the results suggest that poor lower extremity performance not only correlate with functional status (e.g., functional limitation and disability), but also predicts them prospectively.

9.2 Recommendation for future research

It is also important to recognize that this study needs further investigations to expand and generalize the key findings of this thesis, such as the following points.

1. To attain more stable conclusions, a significantly large number of participants would be needed in each study.

2. To obtain extra validity results, the ADLA scale would be applied under

other factors such as utility in frailty people participants, and/or sarcopenic subjects.

3. To develop a more comprehensive understanding, further studies to determine the other factors associated with ADL, including health, frailty, sarcopenia, mobility limitation, and other lifestyle variables.

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