The effects of physical and non-physical functioning on one-leg standing Balance in a population of institutionalized adults

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Abstract. Aim: To determine the effects of physical and non–physical functioning on one-leg standing balance ability, eighty five institutionalized persons older than age 55 (48 women, 37 men; mean age 73.13±8.06) were examined. Methods: This study was carried out from February 2007 to June 2007 in different two rest homes in Denizli, Turkey. One- leg standing balance (OLSB) test was performed on right limb with eyes open and closed. Philadelphia Geriatric Center Morale Scale (PGCMS), Abbreviated Mental Test (AMT) were used to evaluate the non–physical functioning. To examine physical functioning of the subjects, Elderly Mobility Scale (EMS), and 6-m. Walking Speed Test (WST) were also used. All the participants could perform all five tests. Results: Elderly women had lower scores regarding all the outcome continuous variables compared to the older men. Stepwise regression analysis showed that mobility level was the most effective factor on the one-leg standing balance ability, while the non–physical functioning had no any effect. Conclusion: The data support that elderly people with a decreased mobility level are at risk for standing balance.
Keywords: *Institutionalized elderly, morale status, mental health, mobility level, walking velocity, balance ability.*

Introduction

Increasing age has been associated with impairments in sensory, effector, and central processing factors. Sensory factors, including visual, proprioceptive, and vestibular function become compromised in older people. Decline in muscular strength has been documented consistently in the elderly. Accompanying the strength decline, there is a concomitant decline in physical functioning including range of motion, muscle flexibility, balance, and mobility. (1)
Gait and balance ability to negotiate stairs, and a myriad of others activities decline with age. The etiology of this decline in physical performance is of intense interest to health professionals caring for the elderly. The decline in functional mobility in elders without severe pathology may be better explained by the accumulation of deficits across sensory system and central processing domains than by any specific common deficit.
Of course in general practice, a patient may have overwhelming impairment in one sensorimotor domain that significantly affects physical function (e.g., walking) (2,3).
There are a number of sensory and motor changes that occur in the normal aging process that may be related to static and dynamic balance. There are alterations in visual, proprioceptive, and vestibular input, as well as reaction time and skeletal muscle strength, which may affect postural control and gait function (2,4,5). Some researchers have found lower- extremity power to be the number one predictor of physical functioning in elderly person (6,7). Other researchers have concluded that leg power may be a better predictor of physical performance and function than muscular strength in older adults. A minimum level of leg power has been shown to be required for daily activities such as lifting, rising from a chair, and climbing stairs (7,9).
Depression in older people is likely to be very high, even after allowing for the effect of associated social isolation and physical disability. Depression is also an inadequately diagnosed mood disorders in elderly women and men as a result of chronic diseases, functional disability and so on. Mood disorders particularly depression and decreased cognitive status have been shown to be associated with decreased physical function and increased morbidity and mortality for various diseases (10,14). The purpose of this study was to examine the effects of physical functioning, including mobility level and walking speed and non–physical functioning (i.e., morale level and

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cognitive status) on OLSB in a population of institutionalized persons. In this study, we are especially focused on determination of the impact of each of factors on one – leg standing balance test score.

Methods

Approximately 300 institutionalized adults living in different two rest homes in Denizli, Turkey were invited to participate in the current study. For inclusion into the study, participant had to be at the age of 55 or above, mobile and able to perform the tests just selected to use in the study and had no medical conditions, which would interfere in the study. Participants were excluded if they were:

1. wheelchair- bound; this precluded required balance, mobility, and walking testing.
2. unable to stand unassisted.
3. unable to walk unassisted.
4. unable to communicate with investigators.
5. having demans, severe depression, aphasia, severe visual impairments, or severe hearing problems.

Although majority of the participants had systemic problems, such as diabetes mellitus, heart disease, hypertension or renal disease etc., they were physically active and free from musculoskeletal injury at the testing. The sample included 85 eligible institutionalized adults (48 women, 37 men). The average age with standard deviation was 73.13 ± 8.06 years (range, 55-94). All the subjects gave their informed consent for participating to the study. Participants were recruited through arranged visits to the rest homes. To achieve this, a written consent was taken from the authorized person of the local office for rest homes in Denizli.

The design of the current work was cross-sectional cohort descriptive. The information about the sample collected during the visit to the rest homes included (1) sociodemographic data, which included personal information; (2) physical health information; and (3) history of falling and physical aid usage. Table I illustrates the sociodemographics and the physical health information belonging to the sample.

All participants were evaluated individually by Research Assistant (RAs) from Pamukkale University, School of Physical Therapy and Rehabilitation in Denizli, Turkey for the study at a period of 10 months (September 2004- June 2005). The study was supported and approved by the Committee on Research of Pamukkale

University, School of Physical Therapy and Rehabilitation.

In the study, the following variables were used: Dependent variables are (1) right limb stance (eyes open) and (2) right limb stance (eyes closed) Independents variables are "Age", "Morale Status", "Cognitive Level", "Mobility", and "Walking Speed".

The Philadelphia Geriatric Center Morale Scale (PGCMS), Abbreviated Mental Test (AMT), Elderly Mobility Scale (EMS), Walking Speed Test (WST), One- leg Standing Balance (OLSB) were selected as the primary outcome measures.

The PGCMS is a brief; 17-item scale taps feeling of well-being and perceived morale. Developed in the USA, there is a UK version. It is designed for self-administration but, most participants in the study preferred the physical therapist read the items to them.[15-17] The AMT is widely used in the UK. Commonly known as the MTS or AMTS, it has ten items and is simple to administer. The results don't provide a diagnosis but indicate level of cognitive functioning, recognize organic symptoms, and detect changes in sensitivity. A low MTS score warns physical therapists, occupational therapists, and nurses that an elderly person may have difficulty co-operating in treatment (15, 18-22).

The EMS provides health provides with a standardized validated scale for assessment of frail elderly people. The EMS tests the following: lying to sitting, sitting to lying, sitting to standing, standing, gait, walking speed and functional reach. The maximum score possible, which represents independent mobility, is 20 and the minimum score is 0. As such it covers locomotion, balance and key position changes which are pre-requisites to more complex activities of daily living (20).

The WST was used to measure the velocity of the lower extremities. A 6-m. walking test just selected to use in this study. Each subject was advised to rest and relax before the test and they were informed about the procedure. He/she was also asked to perform 6-m. distance walking test between marked lines as fast as possible. When each subject reached the final, the chronometer was stopped and the score was recorded in seconds (20, 21).

The OLSB was used to measure static balance ability on one- leg of the participants (right limb). The test was performed during quiet standing. Subjects were instructed to stand as still as possible during each of the balance tasks.

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Each participant was asked to stand on his/her right limb with and without eyes open respectively. To measure the efficiency of postural control and static balance ability, the test was performed while standing on a stable surface without shoes by each participant. Both tests (eyes open and closed) were performed on right limb. The score was recorded in seconds (22-24). Data were collected at each of the four arranged visits, through self-report questionnaire by RAs, who had at least 3 years experience in geriatric rehabilitation. Interviews, physical and non – physical functioning assessments and examinations were performed by the same RAs. At the first visit, socio- demographics and physical health information were also recorded. The analysis was performed using the SPSS package program (version 13.0). The significance levels were generally designated as $p<.05$. Descriptive statistics were generated for continuous variables, including the mean and their standard deviations (Mean±SD) and were compared using independent samples T-test. Stepwise regression analysis was used to determine the most effective independent factor on OLSB (25).

Results

Our study population had a mean age of 73,13±8,06 years (ranging from 55 to 94 years). Sex distribution was 56,4% women, 43,6% men.

When the right limb stance (eyes open) score was taken into account as a dependent variable; only one variable (mobility level) of the independent variables (age, morale status, cognitive level, walking speed) had a significant effect on the dependent variable (right limb stance, eyes open) (P= 0.007). The information of the model summary is; $R^2 = 0.107$; standard error of the estimate 5.47.

When the right limb stance (eyes closed) score was taken into account as a dependent variable; only one (also, mobility level) of the independent variables mentioned above had a significant effect on the independent variable (P= 0.023).The information of the model summary is; $R^2 = 0. 077$; standard error of the estimate = 1.67.

In brief; the results of the step wise regression analysis showed that the mobility level was found as the most effective independent variable on the right limb stance (eyes open and closed) score in the current work.

Discussion

The pragmatic aim of the current work was to examine the effects of the physical functioning and non- physical functioning on one-leg standing balance of recruiting adults age of 55 years or older. While the study was quite successful in terms of recruiting participants and performing the tests, our results should not be generalized to other population. The obtained results from this study may be statistically, but not clinically, significant. The current results are based on 85 subjects (48 women, 37 men). The findings show that there is a strong relationship between standing balance and mobility level among older adults. According to our observation during the study, the majority of this population is not willing to participate in physical exercises program. In fact, motor performance depends on mobility level and balance ability. And to improve motor performance has a lot of positive effects on balance ability.

We acknowledged of some limitations in this study. First, a comparison group, whose subjects had regular physical exercise habit, was not included. Second, the current study was limited to a population subjects living rest homes in Denizli, Turkey. It could be better if elderly people living different residencies (i.e., their own home, community dwelling) would be included.

Many previous studies have documented the physiological changes and impairments associated with aging. Significant age-related declines in all the major sensory and motor systems that are considered to be important for balance and mobility have been reported (2,3, 26-28).

In a longitudinal study, Williams and Hornberger studied 27 institutionalized older adults for two years to determine the relevance of using impairment and functional measures in predicting changes in the health status of older adults. In the study, forty randomly selected residents of an intermediate level care facility were tested for mental ability (time to complete standardized manual tasks), mental status (10-items questionnaire that evaluated memory and analytic skills), grip strength, and mobility (time to walk 6 ft. independently). Poor performance in impairment and functional measures (grip strength, ambulation, mental status, and mental ability) was found as a significant predictor of transfer to a skilled nursing care facility (29). Kull, investigated that the associations between leisure time physical activity and health status, mental health and depression.

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The results revealed that physically active women experienced better mental health, less depression and they had better general health status. Differences in the emotional state and depression between active and inactive women were significant. The study by Kull et al. and a study by Fansler et al. also support that there is a strong relation among health, depression and physical performance (30,31).

As understood from studies mentioned above the existing literature clearly supports that the symptom of depression and poor morale status has a negative effect on mental health and mobility in elderly people. It is also well-documented that walking velocity decreases with age. With this decrease in velocity, there is also a decrease in stride length and step length, but no decrease in cadence (32,33). The results obtained from this study are in agreement with the literature. Namely, our results also showed that walking velocity decreases in years. However we did not found that it was not very important factor affecting one- leg standing balance score among older adults.

Kose et al. investigated risk factors of falling and their correlations with balance, depression, and cognitive impairment and mobility skills in elderly nursing home residents. At the end of their study, it was found that the correlation among all outcome measures just selected to use in their study was significant. Also their results confirmed that all the parameters affect each other and there is a vicious circle among these parameters (34). In another two study by Dirik et al. and Cavlak et al. mental impairment and depressive symptoms decrease both functional status and mobility level of the institutionalized elderly people (35,36). In the literature, it was showed that there was a strong relation among mental health, depression, motor performance.

In this study since we focused on the effects of morale status on physical functioning, we did not collect data concerning depression level of the elderly subjects. This may be accepted another weakness of the current work. On the other hand, although we recorded some information about history of falls and reason of falling, we did not take the relationship between falling and outcome measures in our agenda. Not to keep the manuscript long here we focused on

only standing balance. Despite the limitations mentioned above, the study has a strength including its focus on the relationship between one- leg standing balance, and physical functioning and non- physical functioning.

In two studies by Velles et al (37, 38), the authors determined if one- leg standing balance might be a useful marker of functional status in institutionalized adults independently living in an urban community. At the end of the study, Vellas et al. pointed out that the test might be a simple, predictive and inexpensive marker helpful in screening balance for low functional level and frailty in clinical practice. Drusini et al. (39) are agreement with Vellas et al. and support the findings related to this case. Thus, the one- leg standing balance test was just selected to measure the balance ability of the participants for the current work. Contrary, we focused on to show the effects of physical functioning and non- physical functioning on standing balance rather than to determine if the test might be a useful marker of functional status in the elderly. The findings show that mobility level of the participants was seen to be the most effective independent variable for one- leg standing balance in both tests (eyes open and eyes closed). This suggests that improving mobility during aging increase one's standing balance ability. Finally, standing balance is positively associated with mobility, walking speed, mental level, and cognitive status. However, the most effective factor is mobility in the current work. Namely, these results indicated that there was a strong relation between standing balance and mobility level among institutionalized older adults who able to live independently.

It is widely known that decreased physical capacity resulting from of mood symptoms in older people with or without disabilities negatively affects quality of the life. That is why; health care providers should be informed about risk factors of decreased physical function. Indeed they should be encouraged to consult their patients with physical therapists to improve their physical capacity and to increase their morale status by attending in regular physical activity program. For further research, attentions can be paid on comparing elderly people living different residencies by looking differences between males and females elderly subjects.

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Table 1: Sociodemographic data and physical health information at study entry (n=85)

Variables	Mean±SD	n	%
Age (years)	73.13±8.06		
Gender (W/M)		48/37	56.4/43.6
Educational level			
illiterate		63	74.1
read and write		2	2.4
more than read and write		20	23.5
than read and write		20	23.5
Health Conditions			
musculoskeletal		40	47.1
cardiopulmonary		16	18.8
neurological		11	12.9
psychological		4	4.7
other		14	16.5
History of falling			
Yes		37	43.5
No		48	56.5
Reason of falling			
slippery surface		7	18.9
dizziness/sufficient postural control		19	51.3
physical impairments		8	21.6
hypertension		3	8.1
Environment of falling			
at home		24	64.8
outside		13	35.2
Hearing aid usage			
Yes		5	5.9
No		80	94.1
Visual aid usage			
Yes		38	44.7
No		47	55.3
Walking aid usage			
Yes		41	48.2
No		44	51.8

Table 2: Comparison of morale status, mental health, mobility, walking speed, and balance scores by gender (n=85).

Variable	Female (n=48)		Male (n=37)		t*	p-value**
	min-max	Mean±SD	min-max	Mean ±SD		
Morale status score	3-16	8,52±2,93	3-16	10,56±4,01	-2,71	=0,008
Mental health score	0-8	3,16±2,30	2-10	6,94±2,28	-7,51	=0,0001
Mobility score	0-11	7,04±3,56	4-11	9,62±2,38	-3,79	=0,0001
Walking speed (sn)***	5-60	19,68±13,02	3-50	10,52±9,49	3,28	=0,002
Balance Task						
Right limb stance, eyes open	0-26	1,25±3,95	0-34	3,37±6,34	-1,89	=0,061
Right limb stance, eyes closed	0-7	0,33±1,11	0-10	0,89±1,95	-1,66	=0,101

* Independent samples T-test was used

** p≤0,05 was accepted as significant

*** n=34 for females, n=33 for males

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