

Impact of Strengthening and Balance Training Exercise on Fall Risk among Elderly at Assiut Geriatric Clubs

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Abstract: Background: Ageing related decline in muscle mass and strength with subsequent muscle weakness has been associated with increased risk of falls in older adults. Strengthening and balance training are currently recommended for older persons to improve muscle mass, strength, and eventually, independence in daily living activities. **Aim of the study:** to determine the impact of strengthening and balance exercises on postural balance and fall risk among Elderly at Assiut Geriatric clubs, **subject and methods:** Aquasi-experimental pre and post-test research design was utilized in this study. The study sample included 88 elderly selected from Assiut geriatric clubs. **Tools:** Data was collected by utilizing a designed interview questionnaire sheet that included two tools; one for collection of demographic data and medical problems, and the other included Berg Balance Scale (BBS) to assess the balance status of the elderly **Results:** 80.7% of the elderly had high risk for falling in pre-test while this score decreased to 30.7% after exercise. There was statistically significant difference between pre and post-test among participants ($P=0.000$). **Conclusion:** the balance status of the elderly improved after the application of the strengthening and balance training exercises compared to the pre-test results according to berg balance scale. **Recommendation:** Increasing public awareness and educating the elderly and their caregiver about the importance of strengthening and balance training exercise to reduce the risk of falls.

Keywords: Strengthening, Balance, Training, Exercise, Fall Risk, Elderly

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I. Introduction

In the last decade, the world's older population is continuing to grow progressively. The worldwide estimated annual growth rate of elderly persons aged 60 years and older is about 3% (**World population prospects, 2017**). It is expected that the number of elderly persons will expand from 962 million globally in 2017 to 1.4 billion in 2030. Egyptian elderly population aged 60 years and older is 5.95 million and will increase in 2050 to 18.1 million according to **Central Intelligence Agency, 2018**.

Ageing is associated with gradual accumulation of a wide variety of molecular and cellular damage. Over time this damage leads to gradual decrease in physiological reserves, an increased risk of many diseases with a general decline in the capacity of the individual and ultimately it will result in death (**Steves et al., 2012**).

Furthermore, the growing elderly segment of the population is more susceptible to a decline in health and increased risk for falls, which today constitute one of the most widespread and serious public problems (**Gschwind et al., 2013**). So that it is necessary to address declines in function and subsequently increases in falls that occur with ageing (**Center for Disease Prevention, 2013 and Tarver, 2013**).

With ageing, multiple physiological changes occur in the sensory system which provides the central nervous system with information about the body position and movement in space through tactile stimuli, proprioception, vision, vestibular input and reaction time. These changes could affect postural control and balance (**Gillespie et al., 2012**).

In addition, normal aging process is associated with reductions and limitations in skeletal muscle function resulting in poor balance, incorrect gait and reduction in strength or endurance of the muscles. These changes may affect the individual's ability to respond to situations in which it is necessary to recover balance because of a reduced ability to develop rapid torque in the joints as well as slowed effectors responses, and a decreased functional capacity (**Sayer et al., 2013 and Viña et al., 2016**).

Balance control is the foundation of a person's ability to move, maintaining postural equilibrium and function independently. Impaired balance and deficits of postural control are major risk factors for falls among older people (**Beauchet et al., 2009 and Granacher et al., 2012**).

A fall can result in severe injuries, such as fractures, causing lower quality of life, disability, and even death. Moreover, fear of falling, with or without an actual previous fall, can lead to physical inactivity

accompanied by further physical decline and impaired balance, as well as to an increased risk of many lifestyle-related diseases (Nelson et al., 2007 and Tudor-Locke et al., 2013).

Several factors contribute to an adequate balance confidence and control, which consequently promote mobility and prevent falls. These factors are sensory function, a well-functioning central nervous system (CNS) with feedback and feed forward loops able to withstand external and internal volitions; as well as adequate musculoskeletal strength and sufficient range of motion in the joints for adequate movement (Horak, 2006).

However, other factors that can impair balance control as; pain, cognitive impairment, fear of falling, age-related degeneration and a variety of diseases are more common with older age. These factors can affect all functions and systems involved in balance control (Howe et al., 2011 and Li et al., 2015).

Since many older people can be physically weak, frail and not strong enough to move their own body weight, balance and strength training are important components of their exercise program. Balance training is important to decrease the risk of falls, while strengthening exercises which utilize weights or resistance to increase the muscle strength are vital in restoring independence and functionality (Lee and Park, 2014).

Nurses and physicians have essential role to minimizing the risk of falls in elderly people through education, increasing physical activity, reducing the risk factors, and advising for practical environmental modifications. Nurses should also know how to evaluate balance status and helps in implementing interventions aiming at increased safety and improving the balance status (WHO, 2016).

Significance of the study:

Elders had a variety of medical problems that can interfere with their steadiness. According to the U.S. Centers for Disease Control and Prevention, more than one-third of people age 60 or older are exposed to falling each year and up to 30 percent of them suffer moderate to severe injuries, as hip fractures, and increase their risk of early death. Falls and related injuries can extremely affect the elder's life, restrict his daily activities or even make him dependent on others. (National Council on Aging, 2015).

In Egypt, the falling rate among elder population is unrecognized and unrecorded; few studies were applied to explore the prevalence of falling. In upper Egypt at Sohag Governorate, a study conducted by (Hamed et al, 2016) reported that 33.3% of 1034 older people aged 60 years and older had exposed to falling in one year and 88.9% of them were having impaired balance status.

Based on the knowledge that strengthening and balance exercises are essential to help reducing the fall risk by enhancing the persons' ability to control their body, the current study was conducted to investigate the effect of strengthening and balance exercises program on older people balance and fall risk.

Aim of the study

To determine the impact of strengthening and balance training exercise on postural balance and fall risk among elderly at Assiut Geriatric clubs-Assiut City.

Research Hypothesis:

Hypothesis: Strengthening and balance training exercises will improve balance among elderly and reduce the fall risk among them.

Null Hypotheses: Strengthening and balance training exercises will not improve the balance among elderly nor reduce their risk of falling.

II. Subjects and methods

Research design

A Quasi-experimental pre- and post-test research design was utilized in this study.

Settings:

The study was conducted in two geriatric clubs that provide social and health care services for elderly participants at Assiut city. They were the Legitimacy Assembly and the Islamic Cultural center.

Sample size:

The total number of elderlies in the chosen geriatric clubs was 200. The study sample included ambulating elderlies without significant medical, neurological, musculoskeletal or cognitive problems that could interfere with their abilities to perform the exercises. According to these inclusion criteria, 88 elderlies were ineligible for the study.

Tools for data collection:

Two main tools were used in the study:

Tool (I): Structured interview sheet which was prepared by the researchers based on review of pertinent literatures to elicit information from the elderly.

Two groups of data were collected:

- a) Demographic data which included the age, gender, educational level, occupation, and marital status.
- b) Medical problems of the elderly which included the presence of any systemic disease as hypertension, Diabetes Mellitus (DM), Thyroid malfunction, renal disease or others.

Tool (II): Berg Balance Scale (BBS): this developed at 1989 to provide standardized measurement tool for assessing balance in elderly (Berg et al, 1989). It consists of 14 items which challenge individuals' balance in a variety of functional positions, ranging from sitting to standing, and static to dynamic. Each item is scored according to a five-point ordinal scale ranging from 0 to 4, where 0 indicates the lowest level of function and 4 the highest level of function.

The total score of the scale is 56 points. Persons scored (41-56) are considered independent those who scored (21-40) are considered walking with assistance and those scored (0-20) are wheelchair bound.

To use Berg scale for fall risk assessment, the following Cut-off score was chosen: A score of 56 indicates functional balance; a score of < 45 indicates individuals may be at greater risk of falling (Berg et al, 1992)

This scale was performed twice on each participating elderly, the first was at the entry time to the study and the second was at week 12.

This scale widely used valid and reliable tool by (Berg et al, 1992 and Berg et al, 1995). Also; the Arabic version of BBS appears to be a reliable and valid instrument with high internal consistency with Cronbach's α of the total scale of 0.91 by El-Gilany et al., 2013 among elderly in Egypt.

Administrative design:

An official approval letter containing brief explanations of the purpose of study was signed from the Dean of the Faculty of Nursing-Assiut University and sent to the directors of geriatric clubs.

Ethical consideration:

The research proposal was approved by Ethical Committee of the Faculty of Nursing at Assiut University. There was no risk on the study subjects during application of the research. The study followed common ethical principles in research; oral consent was received from the elderly who accepted to participate in the study after explaining the nature and aim of the study. Confidentiality and anonymity were assured, and study subjects had the right to refuse the participation or withdraw from the research at any time without giving reasons.

The pilot study:

A pilot study was done on nearly 10% of the participants in the study sample. The purposes of the pilot study were to ensure the clarity of items, to test for the comprehension, applicability and relevance of the tools, to identify obstacles and problems that could occur during data collection and to estimate the time required for study sample collection.

Procedure

The study proceeded with the following phases;

I) Assessment phase:

In the first contact, the researchers introduced themselves to the participants, explained the nature and purpose of the study and participation approval was obtained. Base line data were collected using tool I (demographic data and medical history) then the researchers conducted the BBS (tool II) for all the elderly to assess their current balance status and fall risk.

II) Implementation phase:

- The researchers began the session with explaining the importance of strengthening and balance training exercises to the participants who were divided into small training groups of 5-6 elderly. Instructions about the components of each exercise were given to them over half an hour; then the researchers distributed illustrating pictures and handouts. The researchers spent another 20 minutes in exercise demonstration which was conducted in geriatric club hall.
- After that each group of elderly started to implement the exercise sessions with 2 sets of exercises:
 - 1- Strengthening exercise in the form of sit to stand, mini squats, calf raises, sideways leg lifts, leg extensions, wall press up and biceps curls.

- 2- Balance exercises including sideway walking, simple grapevine, heel to toe walk, one leg stand and step ups.
- The whole exercise session lasts 50-60 minutes including 10 minutes period of rest between the 2 exercises sets.
- The exercise sessions were done under the observation of a nurse trained in physiotherapy exercises.
- Every participating group performed the supervised exercises twice weekly in the clubs and was instructed to do the same exercises at home at least once daily for two months with the help of the given handouts. The researchers were following the elderly's compliance to do home exercises during the supervised sessions.
- The current study was carried over a period of one year starting from October 2017 until October 2018.

III. Evaluation stage

- In this phase the post-test evaluation was done after two months using BBS to determine the impact of the exercise on the balance status of the participants.

Data analysis

Date entry and data analysis were done using Statistical Package for Social Science version 19 (SPSS Inc., Chicago, Illinois, USA). Numerical data were presented as number, percentage, mean, standard deviation. Chi-square test was used to compare between qualitative variables. Mann-Whitney test was used to compare quantitative variables between two groups and Kruskal Wallis Test for more than two groups in case of non-parametric data. Wilcoxon Signed Rank Test was done to compare quantitative variables between before and after program. The level of statistical significance was set at P-value < 0.05.

III. Results

Table (1): Demographic characteristics of the participants at Assiut Geriatric Clubs.

Demographic characteristics	No. (88)	%
Age: Range (Mean \pmSD) years	60-89 (73.18 \pm 14.52)	
60 -< 70	29	33.0
70 - < 80	41	46.6
80 or more	18	20.5
Gender:		
Male	36	40.9
Female	52	59.1
Educational level:		
Basic education	45	51.1
Secondary	32	36.4
University or more	11	12.5
Marital status:		
Single	4	4.5
Married	32	36.4
Divorced	7	8.0
Widow	45	51.1
Occupation:		
Not working	33	37.5
Farmer	7	8.0
Housewife	33	37.5
Retired	15	17.0
Living alone:		
Yes	56	63.6
No	32	36.4

SD=standard deviation

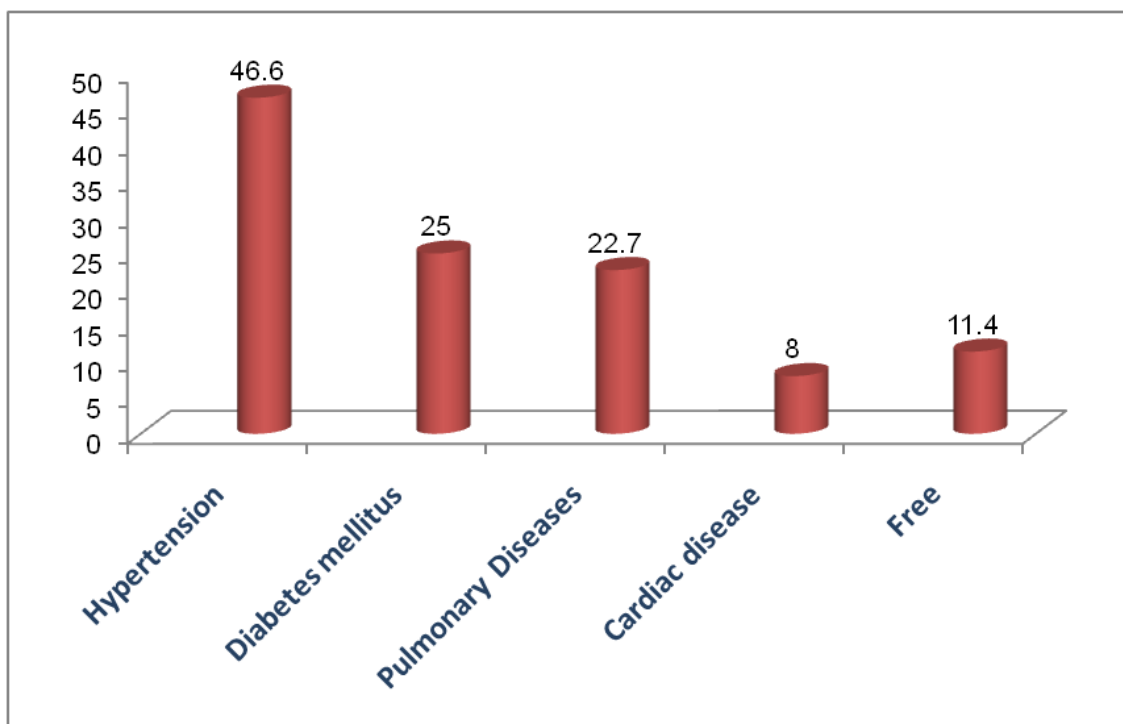


Figure (1): Frequency distribution of medical problems among participants at Assiut Geriatric Clubs (No=88).

Table (2): Berg Balance Scale pre and post-test among participants at Assiut Geriatric Clubs No. (88)

Items	Pre-test	Post-test	P-value
	Mean ± SD	Mean ± SD	
Sitting to standing	2.70 ± 1.01	3.42 ± 0.84	0.000*
Standing unsupported	3.06 ± 1.24	3.64 ± 0.71	0.000*
Sitting with back unsupported but feet supported on floor or on a stool	2.65 ± 1.24	3.47 ± 0.74	0.000*
Standing to sitting	2.76 ± 1.27	3.42 ± 0.77	0.000*
Transfers	2.57 ± 1.21	3.19 ± 0.83	0.000*
Standing unsupported with eyes closed	2.70 ± 1.34	3.10 ± 0.84	0.005*
Standing unsupported with feet together	2.63 ± 1.04	3.10 ± 0.79	0.000*
Reaching forward with outstretched arm while standing	1.73 ± 1.24	2.42 ± 0.98	0.000*
Pick up object from the floor from a standing position	2.56 ± 1.24	3.26 ± 0.93	0.000*
Turning to look behind over left and right shoulders while standing	2.58 ± 1.17	3.07 ± 0.74	0.000*
Turn 360 degrees	2.08 ± 1.29	2.67 ± 0.94	0.000*
Placing alternate foot on step or stool while standing unsupported	2.00 ± 1.14	2.56 ± 0.93	0.000*
Standing unsupported one foot in front	2.00 ± 1.12	2.69 ± 0.93	0.000*
Standing on one leg	1.62 ± 1.32	2.35 ± 1.05	0.000*
Total Berg score	33.64 ± 10.62	42.33 ± 7.72	0.000*

SD=standard deviation, P value <0.05

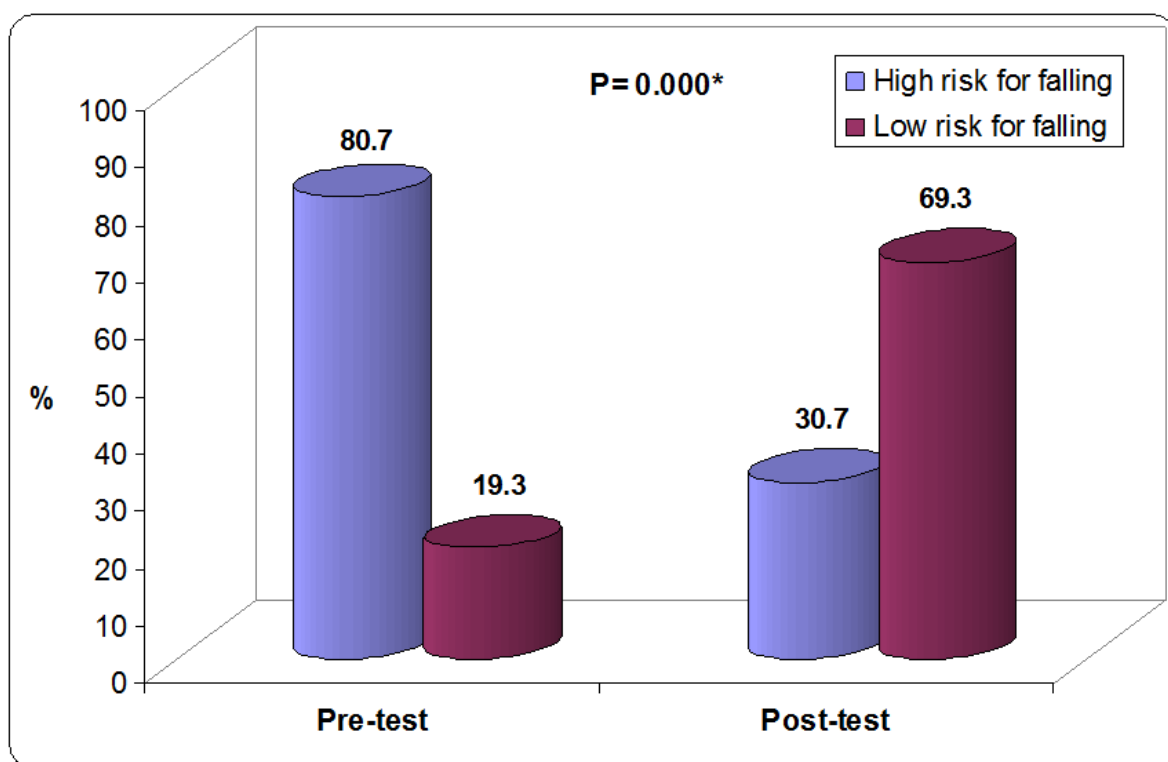


Figure (2): Pre and post-test values of Berg balance scale among participants at Assiut Geriatric Clubs. (No=88)

Table (3): Relation between Berg Balance scale and demographic characteristics among participants at Assiut Geriatric Clubs.

Items	Berg Balance scale			
	Pre-test (n= 88)	P-value	Post-test (n= 88)	P-value
	Mean ± SD		Mean ± SD	
Age: (years)				
60 -< 70	35.00 ± 11.47	0.750	43.00 ± 8.73	0.758
70 - < 80	32.95 ± 10.59		41.95 ± 7.62	
80 or more	33.00 ± 9.60		42.11 ± 6.45	
Gender:				
Male	31.67 ± 11.16	0.143	41.36 ± 7.51	0.226
Female	35.00 ± 10.12		43.00 ± 7.86	
Educational level:				
Basic education	34.16 ± 10.72	0.674	42.93 ± 7.58	0.403
Secondary	33.53 ± 11.37		42.09 ± 8.73	
University or more	31.82 ± 8.40		40.55 ± 4.93	
Marital status:				
Single	32.50 ± 8.10	0.038*	40.50 ± 4.93	0.042*
Married	30.09 ± 12.45		40.19 ± 8.99	
Divorced	31.57 ± 5.38		40.43 ± 4.58	
Widow	36.58 ± 9.31		44.31 ± 6.94	
Occupation:				
Not working	32.82 ± 11.56	0.543	41.48 ± 8.68	0.553
Farmer	37.29 ± 11.16		44.43 ± 7.32	
Housewife	35.15 ± 8.07		43.48 ± 6.34	
Retired	30.40 ± 12.99		40.67 ± 8.56	
Living alone:				
Yes	33.16 ± 12.13	0.788	41.80 ± 8.81	0.366
No	34.47 ± 7.37		43.25 ± 5.32	

SD=standard deviation, P value <0.05

Table (1) shows the demographic data of the participants. The age of the study group ranged from 60 to 89 with mean \pm DS of 73.18 ± 14.52 and female sex predominance (59.1%). Over half of the participants had basic education level and were widows (51.1%) each. Only 12.5% had university level of education and more and 63.6% of participants were living alone.

Figure (1) reveals that hypertension was the highest prevalent medical problem among the participants (46.6%) followed by diabetes mellitus and pulmonary disease (25.0% & 22.7%) respectively and only (11.4%) of them were free from any disease.

Table (2): clears that there were highly significant statistical differences between all items of berg balance scale in pre and post-test among the studied sample.

Figure 2: illustrates that 80.7% of the participating elderly had high risk for falling in pre-test while this score improved after exercise to become only 30.7% post-test, with statistically significant differences between pre and post-test among them.

On the other hand, table 3 shows that among all the demographic data of our subjects, only the marital status had a statistically significant correlation with the total berg score both at the entry of the study and after 12 weeks, in favor of the widowed status and the worst level was between married elderly.

IV. Discussion

Balance disorders represent a major concern among elderly due to its association with falls. It can occur due to a disruption in any of the vision, vestibular sense, proprioception, muscle strength and reaction. (Granacher et al., 2010 and Granacher et al., 2011). Therefore, strengthening exercises and balance training of the elderly can be feasible methods in improving their balance ability, preventing falls and maintaining physical independence.

This study aimed to investigate the impact of strengthening and balance exercises on postural balance and fall risk among elderly at Assiut Geriatrics clubs.

The current study reveals that the age of the study group ranged from 60 to 89 with mean \pm DS of 73.18 ± 14.52 ; this may be attributed to this range of age is the beginning of deterioration in balance status and high risk for fall accidents; also the result cleared that about three fifths of them were female, while regarding to educational level of studied sample, the results revealed that more than half had basic education.

These results similar with study in Egypt by El-Gilany et al., 2013 about prevention of recurrent falls in elderly: a pre-post intervention study in a rural community, Egypt; who showed that the age of elderly participated in their study ranged from 60 to 91 years and two thirds of participants are females; while disagrees with the result of educational level who stated that (58.7%) of study group were illiterate.

In addition to the finding of present study observed that three fifths of participants are live alone; this result inconsistent with El-Gilany et al., 2013 who indicated that three fifths of participants live with the family.

According to the total BBS score, 80.7 % of the study subjects had high risk for falling with mean \pm SD (33.64 ± 10.62) at the entry point of the study while after the exercise program, their number was reduced to 30.7% with BBS mean \pm SD (42.33 ± 7.72) post-test. This may suggest that simple balance training and strengthening exercises have an empower effect on fall prevention among older participants.

Several studies reported the beneficial effect of exercise programs in improving the balance of elderly Alfieri et al., 2010 and Ansai et al. 2015

The results of this study are comparable to the results of a randomized clinical trial done by Tomicki et al., 2016, who studied the effect of a physical exercise program done three times weekly for 12 weeks on institutionalized elderly persons and pointed that, at the end point of the study, members of the intervention group showed an improved performance in both the time up\go test (TUG) and BBS compared with their initial results and compared with control, non-interventional group.

A similar finding also was presented in the study which was carried out by Kuptniratsaikul et al., (2011) who documented that simply-designed balancing exercises used by the elderly who have a history of frequent falls can decrease fall rate, and significantly increase balancing abilities including Berg balance scores. The improved outcomes were thought to be due to the encouragement of the elderly to be aware of falls and to perform regular exercise at home.

Another compatible study was carried by Thiamwong & Suwanno, (2013) in Thailand, who measured the Effects of Simple Balance Training on Balance Performance and Fear of Falling in Rural Older Adults and stated that, after 12 weeks of balance training, the participants in the exercise group showed a significant difference when compared to baselines for both the functional reach test and timed up\go test.

This also agrees with previous findings in an Egyptian study by **El-Gilany et al., 2013** who studied the effect of education and exercise sessions on reducing the fall recurrence in elderly and mentioned that a significant improvement in the balance, strength and performance of activities of daily living were noted at week 8 and 12 whereas the recurrence of falls was significantly reduced and maintained during the one year follow-up period.

Likewise, **Buranello et al., 2011** studied the effect of regular physical exercises on the balance and risk of falls of 40 elderly women. They stated that balance and risk of falls are closely related, this risk is reduced with greater maintenance of balance.

In this respect, **Keeratithaworn et al., 2015** in their study of the effect of 4-week simple balance exercise on balance ability in 42 elderly pointed that the designed balance training program was successful in improving balance ability for the elderly which may prevent falls.

Lastly, **Gschwind, et al., 2013** mentioned that, their trial would add valuable information to the knowledge of dose response relations for exercise in older adults. Particularly the use of two different interventions (extensive supervised group exercise program vs. short home-based exercise program) and would give some indication of the minimal amount of exercise needed to stimulate physical performance adaptations.

It is interesting to note that berg balance score was better in widowed elderly than in the married ones, this may be explained by the fact that loss of the partners' support forces the elderly to rely on himself and become physically more active. This consecutively improves the balance status of the more active persons.

V. Conclusions

The present study concluded that strengthening and balance training exercises can improve postural balance and reducing the fall risk among elderly.

VI. Recommendations

- Increasing public awareness and educating the elderly and their caregiver about the importance of strengthening and balance training exercise to reduce the risk of falls.
- Further multicenter studies on larger number of elderly are recommended for the development of customized elderly-friendly exercise programs that are both easy and effective to improve the power and balance in elder population.

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