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The Effectiveness of Remote Exercise (tele-exercise) on Static Equilibrium Parameters of the Elderly Man

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Abstract: Objectives: The rate of growth of the elderly population is very high due to lower birth rates and increased health and medical progress, especially in developing countries, and should seek new technology-based solutions for the community, especially the elderly. The aim of this study was to improve the equilibrium parameters in the elderly and the effectiveness of the telex training program.

Materials and Methods: In this semi-experimental study in Isfahan, in 2017, 40 healthy elderly men with the ability to perform exercise activities were selected by random sampling and randomly assigned to the experimental group and one control group Divided. The experimental exercise group (Tele-Exercise) was given as a training intervention for 8 weeks, 3 sessions per week, and 90 minutes each session. The equilibrium parameters were performed through a motion analyzer with seven cameras and a power plate connected to it. Descriptive statistics were used for data analysis and their homogeneity and ANOVA for repeated measurements for data analysis.

Results: The use of a sports program as a tele-exercise significantly increased the equilibrium of parameters relative to the pre-exercise program ($P < 0.05$), while in the same period, in the group that received the exercise program There was no significant change in the parameters of the correlation with equilibrium ($P > 0.05$).

Conclusion: According to the findings of the research, it can be concluded that the use of a regular and continuous trapezoidal training program can be due to the improvement of equilibrium parameters as a suitable alternative for field training programs with direct supervision. In addition, tele-exercise exercises seem to be more effective in the elderly age group because of the reduction of dangers outside the home and placement in matched groups, and pave the way for healthy aging and good health in this life span.

Keywords: Equilibrium, Successful Elderly, Therapeutic Exercise, Elderly Rehabilitation, Tele-Exercise

INTRODUCTION

On the most sensitive period of human's life is old ages and considering sanitation and safety principles has been led to increase in average longevity (Bashiri G. et al., 2010). Spending a healthy life is every human being's right during the old ages, and this issue emphasizes the importance of aging phenomenon and avoiding its problems. Nowadays, nearly 31 countries each have more than 2 million old people over 60 years old that every

day the number of these countries is increasing (Goldfried et al., 1991). In Iran, analyses and economical indexes indicate a rapid growth of old people, so that it is anticipated that in the year 2031 there will be an aging explosion and 25-30 percent of population will be in the ages above 50 (Mirmoezzi et al., 2016), more than half (59%) of the world old population are living in developing countries and it has been estimated that until the year 2030, this number will reach up to 71% (Schneider G et al., 2004). Among the most important reasons, reducing the mortality rate due to advances in medical sciences, health, and education and as a result increasing the life expectancy and longevity are so important that lack of attention to them will make problems, intricate and almost unsolvable issues.for human society

With this regard, the study of Barry shows that about 60 percent of health care costs, 35 percent of hospital clearance and 47 percent of hospital admissions are related to old people. Given the rapid increase in the number of old people, the issue of hygiene, health, and providing comfort and welfare in community is becoming more and more widespread every day (Kozaki K. et al., 2008). The thing that modern science pays attention to,is not just extending longevity, but we should have this in mind that the extra years of human life should be spent in the ultimate calmness and physical and mental health, in a case that this situation is not supplied, the scientific advances will be fruitless and endangered, for longer life (Von Wichert, 2008). By entering the old ages and with aging, various changes in the physiological and structural functions of body will occur (Bernier et al., 1998), that the most important issue is maintaining independence in daily activities and continuing life actively (McArdle et al., 1998). Falling is considered as one of the most important problems of aging period that is caused by the disruption of various mechanisms such as musculoskeletal system, atrium, proprioception, vision and physiological devices involved in equilibrium and as a result, aging will disrupt the equilibrium and condition control system and it will provide a context for old people falling (Sonn et al., 1995). Consequently, it will have many physical consequences (hip fracture, disability, loss of physical ability and death), and psychological issues (loss of self-esteem, self-regard, and loss of life expectancy) (Lopes K et al., 2009 and Sereshti et al., 2006). Disability in maintaining the equilibrium is one of the main factors of falling, and each year, one third of the elderly people (65 years and above) experience it, that the main reason of this problem is the weakness of the lower limb in the old people (Payne et al., 2017). Some researchers believe that loss of equilibrium is considered as the main factor in the elderly people falling problem. That is why equilibrium and its rehabilitation factor in this age group have been considered by many other researchers (Carter et al., 2001). Physiologically, equilibrium is defined as the interaction between the equilibrium control mechanisms levels and biomechanically it is defined as the ability to maintain and turn the center of gravity of the body within the stability range by reliance (Carter et al., 2001 and Darvishi, 2012). Thus, the individual's ability to maintain the body in a static or dynamic state is called equilibrium that is usually evaluated in two forms, static equilibrium and dynamic equilibrium. In static equilibrium, an old person should be able to keep his body in a steady state, such as stork test and gymnastics equilibrium (Carter et al., 2001).

The combinational equilibrium is related to the coordination between equilibrium systems, including vision system, atrium and proprioception system (Bernier et al., 1998). Losing the equilibrium and falling, either primary or secondary (causing or increasing diseases and disabilities) is the sixth cause of mortality in the elderly population (Norouzi et al., 2012), though researchers, especially physiologists, believe that just doing physical activity in young ages can help endurance in old age, but today research results have shown that physical activities are beneficial for individuals at any age (Schlicht J. et al., 2001).

One of the issues that may have contributed significantly to the health and well-being of the elderly is regular and continuous physical activity (Hosseini, et al., 2011 and Garatachea et al., 2009). Regular and group physical activity in adults and young adults prevent cardiovascular diseases, diabetes and other systemic diseases and improve equilibrium and increase life expectancy in individuals. The aim of this method in line with old people is coping with weaknesses, vulnerability caused by lack of exercise, the biological changes caused by aging, chronic diseases, mental health, and the rehabilitation from acute and chronic diseases (Brown WJ et al., 2000 and Lee. 2011). Shimada et al. (2003) in a study in order to examine the special effect of equilibrium exercises and walking on the physical function of elderly people with a history of falling, concluded that equilibrium

exercises could lead to improvements in static equilibrium performance, and walking exercises can lead to improvements in dynamic equilibrium and walking performance in these old people (Shimada et al., 2003). Also, Cowper et al. (2003) examined the effect of the exercise program on old people's health f and concluded that a regular exercise program would increase the physical performance of individuals (Cowper et al., 2003). Physical activity and exercise are among the methods used to prevent, delay, and treat problems caused by the aging process and their positive impact has been well proven on people's lives (Bellew et al., 2003). Active lifestyle and physical activity empower individuals and improve the physical condition of old people because most elderly people voluntarily adopt sedentary lifestyles that ultimately leads to reduction in individual autonomy (independence) and self-sufficiency (Iwamoto et al., 2003). Bischoff et al. (2001) reported that elderly people who use a regular exercise program in their lifestyle, compared with other elderly people, will benefit from better physical and mental conditions, longer lifespan and muscle strength and the danger of falling does not threaten them that much (Bischoff et al., 2001). Since the quality of life in older ages is reduced for many reasons, such as inactivity and sedentary activity, the proper use of sports programs will lead to significant improvements in the physical and mental conditions of old people (Hashemi et al., 2012). In the following, the effectiveness of tele-training (tele-exercise) on back pain, neck pain and other musculoskeletal disorders can be mentioned that they are also considered as common problems in old people. But according to research conducted by the researcher, so far, no research has been done to investigate the tele-exercising on the old people's equilibrium. According to the above mentioned facts, the aim of current study was to investigate and compare tele-exercise on static equilibrium parameters in the old men group.

Research method

The present study is semi-experimental, applied and prospective research and it has a two-group design with training intervention in the experimental group and the control group and it is also tested by the mans of pre-test and post-test process. It should be noted that this study was designed for random allocation of samples to an experimental group and one control group and according to the training intervention on old people; it has also a randomized controlled trial (RCT) design. The statistical population of this study included all old men (55 years old and above) of Isfahan city that among them, after public and targeted calls for screening, 160 people were selected (initial examinations and tests through general health questionnaires, short form of mental status and physical activity readiness, interviews and expression of the advantages and disadvantages of the research) and finally, ccording to the results and volume of the previous studies 40 people a were selected, as targeted and available, and randomly they were divided into two groups of 20 people (all participants filled the consent form and individual information questionnaire) and in this study, as much as possible, we tried to use subjects who were homogeneous in terms of age, height, body mass, and body mass index.

Inclusion criteria were a man over the 55 years old with functional autonomy and ability to walk and do daily activities without using auxiliary equipment, as well as lack of regular physical activity and exclusion criteria were, getting score below 24 from short form mental status questionnaire, lack of general health questionnaire requirements and physical activity readiness, presence of acute cardio-respiratory diseases and hypertension, history of sensory-motor disorders or severe visual problems, existence pathologic signs, history of fracture, surgery and arthritis in the lower extremity, use of sedative and analgesic drugs 48 hours before the test, any observable abnormality in the lower extremity, having a history of falling over the past year, the inability to doing tests or training programs, and participating in a regular exercise program out of study. Independent variable in this study included intergroup factor, or doing field exercises with direct supervision and tele-exercising for 8 weeks and the dependent variable in this study is the quality of life and its related indicators. In this study, the researchers tried to prevent participants from being exposed to other exercises and also background variables with random allocation of samples among the three groups and using statistical tests to be controlled. The tools used in this study to record the basic information were consent form, demographic information form, general health questionnaire, physical activity readiness questionnaire, and short form

mental status questionnaire, and to record the equilibrium information, Qualysis motion analyzing system with 7 cameras and a frequency of 120 Hz with a synced power plate was used at the Muscle Research Center of Isfahan University of Medical Sciences. Required information was extracted by the skeletal models derived from Open Sim version 3.3. There are various parameters for assessing standing stability; two of the most common ones are COP excursion the range of changes in the center of pressure on the mediolateral plate and on the antitrust plate. Kistler force platform with piezoelectric force converters are used to measure COP, which is a good approximation of oscillation. The oscillation is defined during the relaxed stand by the motion of the gravity line on the horizontally plate. These movements are due to the small deviation of the gravity line relative to the vertical reaction force of the ground. Many researchers have done the oscillation by measuring the center of pressure on the force platform (Murray et al., 1975, Swanenburg et al., 2008). The reliability of the force plate is calculated based on changes in the pressure center by many researchers (Swanenburg et al., 2008- Hall et al., 1996). The results of these studies have shown that the COP reliability in both sagittal and coronal plates is more than 0.75 and it can be used to indicate stability during standing position (if the test is repeated 5 times and data is collected for 60 seconds).

With regard to the exercise program that has been used as an intervention in this study, it was attempted to design completely similar training patterns on the basis of the pattern of work designed by Martini and Dignau (2014) for old people in the ultimate fit[1] style for both the training groups. In this training program, warm-up period of 5-10 minutes, with 15-30 minutes of resistance training, and 15-30 minutes of aerobic training, and 15-30 minutes of equilibrium exercises and 5 minutes of cooling were used, these exercises based on the ability of the participants were increased weekly.

Tele-exercises were done at home by anyone, via the Internet and using Google's HangOuts software in this study only one theraband was used to perform resistance training and its color and strength were also selected based on the body type of the participants.

In order to analyze the data, descriptive statistics were used for data organizing and data analysis was done by analysis of variance for repeated measures. The used statistical software was SPSS version 22.

Findings

After analyzing the data in the descriptive section and analysis of variance as is shown in Table 1, it was found that both experimental groups with tele-exercise and control group were similar to each other in terms of age, height, body mass, and body mass index.

Table 1: Comparing the consistency of the two groups of intervention and control in terms of demographic variables

	Control group (Mean ± SD)	Tele-exercise Experimental group (Mean ± SD)	Sig. level
Age (year)	62.85 ± 2.34	63.72 ± 2.86	0.263
Height (m)	1.72 ± 0.05	1.72 ± 0.04	0.683
Body mass (kg)	72.83 ± 9.28	72.89 ± 8.63	0.926
Body mass index (kg / m^2)	24.85 ± 2.52	24.74 ± 2.48	0.956
PAR-Q index	0.796 ± 0.32	0.861 ± 0.28	0.431
MMSE index	21.34 ± 1.22	21.74 ± 1.25	0.548
GHQ index	18.68 ± 10.31	18.41 ± 10.21	0.637

[1]Ultimate fit, is a training style invented by Abarqouyan and developed by him and Babaei Khorzoghi

Then, the results of the information related to the static equilibrium parameters in both groups (experimental tele-exercise and control) are shown in Table 2. There is no significant difference between mean and standard deviation of equilibrium parameters before intervention and also in control group after exercise intervention (p> 0.05) but, in the tele-exercise intervention group there is a significant difference between the mean of equilibrium parameters after training intervention

Table 2: Describing the equilibrium parameters among the groups in two stages of pre-test and post-test

Group		Pretest	Posttest
Tele-exercise experimental group	COP Excursion AP[2] (mm)	20.13±4.23	15.12±4.16
	COP Excursion ML[3] (mm)	16.44±5.86	12.31±3.92
	COP path length AP[4] (mm)	579.324±134.27	523.098±118.24
	COP path length ML[5] (mm/sec)	479.231±91.23	418.126±90.17
	COP velocity AP (mm/sec)	8.278±1.31	6.993±1.04
	COP velocity ML (mm/sec)	6.146±1.98	4.755±0.96
Control group	COP Excursion AP (mm)	17.64±4.02	19.76±3.62
	COP Excursion ML (mm)	15.23±3.14	16.63±4.03
	COP path length AP (mm)	595.184±133.44	582.159±134.69
	COP path length ML (mm/sec)	474.042±90.54	471.293±90.54
	COP velocity AP[6] (mm/sec)	8.412±1.23	8.302±1.23
	COP velocity ML[7] (mm/sec)	6.234±1.56	6.135±1.62

Table 3: Paired comparison results of parameters related to equilibrium in different stages

Variable	Groups	Pretest		Posttest	
COP Excursion AP	Tele-exercise - Control	Mean difference	Sig. level	Mean difference	Sig. level
		2.49	0.354	-4.64	0.017*
COP Excursion ML	Tele-exercise - Control	1.21	0.274	-4.32	0.016*
Path Length AP	Tele-exercise - Control	-15.86	0.302	-59.061	0.001*
Path Length ML	Tele-exercise - Control	5.189	331	-53.167	0.001*
COP Velocity AP	Tele-exercise - Control	-0.134	0.342	-1.409	0.001*
COP Velocity ML	Tele-exercise - Control	-0.088	0.258	-1.380	0.003*

The values presented in Table 3 indicate that: 1) there is no significant difference between the experimental group and the control group in terms of the mean of static equilibrium in each of the parameters related to equilibrium in the pretest stage (p> 0.05), in other words, the small difference between experimental and control group in the pre-test phase is estimated due to an accident. 2) There is a significant difference between the experimental group and the control group in terms of the mean of equilibrium variable in each of the parameters

2The excursion of the body pressure center in the anterior-posterior plane

3 The excursion of the body pressure center in the internal-external plane

4 The total length of the path traversed by the body pressure center of in the anterior-posterior plane

5 The total length of the path traversed by the body pressure center in the inner-outer plane

6 The oscillation velocity of the body pressure center in the anterior-posterior plane

7 The oscillation velocity of the body pressure center in the inner-outer plate

related to equilibrium in the post-test stages (p> 0.05), in other words, the mean of equilibrium between the experimental group (tele-exercise) in the post test was estimated significantly higher than the control group.

Chart 1: Changes of the equilibrium related parameters separately in each of the equilibrium related parameters

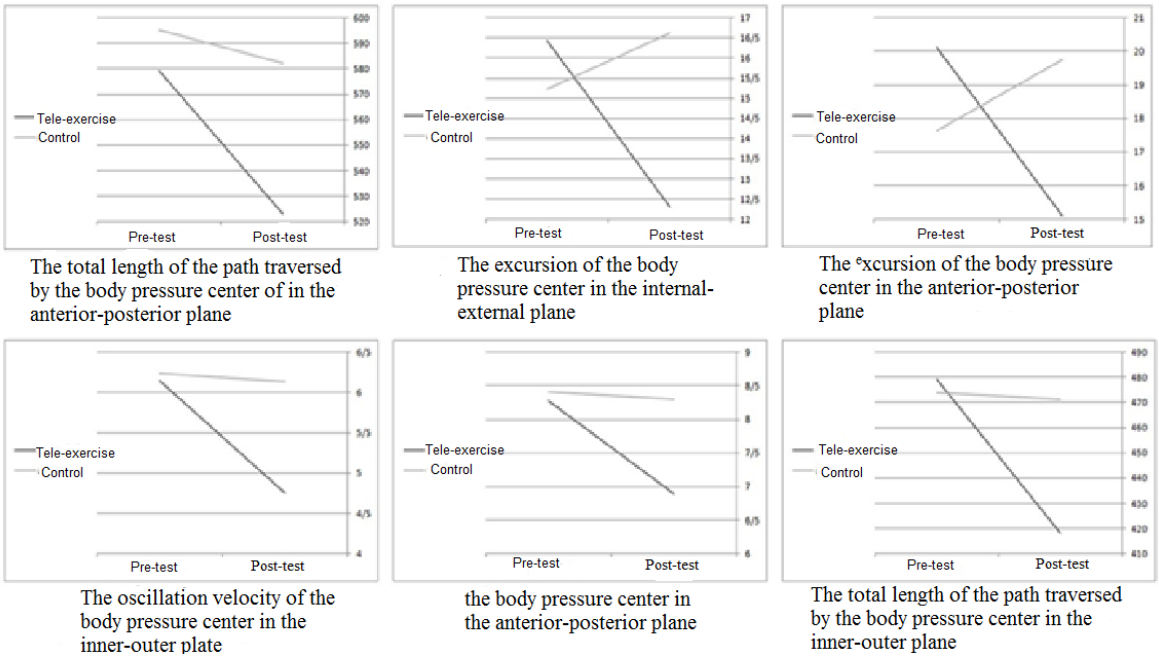

Chart 1 shows the relative stability of the parameters related to static equilibrium in the dual steps in the control group. Also Chart 1 shows an increase in the parameters related to static equilibrium in the tele-exercise experimental group at the post-test stage.

Discussion and conclusion

According to the results of current study, the implementation of a tele-exercise training program with direct monitoring, improves the parameters related to static equilibrium in old people. The results of this study have many points in common with several studies, some of which are referred here.

In a study by Mir Mozamani et al. (2015) on old people, they concluded that an 8-week training program for possible reasons such as increasing exercise-induced neuro-adjustment, increased physical fitness and improved strength and range of motion, improved aerobic condition, reaction time and dystonia, improved neuromuscular control, including decreased flexibility in use movement units and timing improvement of motor units can improve equilibrium and related parameters (Mirmoezzi et al., 2016), and these results are in line with the results of this study. In addition, in a study that Norouzi et al. (2016) conducted on old people, they found that an 8-week training program can significantly improve the static and dynamic equilibrium of old people (Norouzi et al., 2012). In another study by Safari Beck et al. (2011) on elderly people with knee osteoarthritis, they found that eight weeks of selected exercises can significantly improve the equilibrium indices (overall equilibrium, anterior-posterior equilibrium, and internal-external equilibrium) in old people and these exercises are possible to be recommended to improve equilibrium and avoid falling in old people with knee osteoarthritis (Safaribak et al., 2017). In addition, it has been shown in various studies, that the exercise and its associated elements can improve the equilibrium of old people and other age groups in order to improve their physical function (Chou et al., 2012). In this regard, Schulz et al. (2001) reported that lower limb strength

exercise had an effect on improving equilibrium and thus reducing the risk of falling in old people (Schulz et al., 2002) and a meta-analysis study by Robertson et al. in 2002-2004it was shown in that sport programs can have different effects on muscle strength, and the ability of a person to do daily work without being dependent on others (Robertson et al., 2004).

Also, due to numerous problems in line with studying about old people, especially in terms of physical and sports activities, it is suggested that comprehensive studies with a larger number of samples be conducted in order to examine the results of other studies. In the present study, it has been shown that doing regular sport exercises during eight weeks as tele-exercise increases physical performance and improves the static equilibrium in individuals and this indicates the positive effect of the exercise program on the physical and psychological dimensions of old people.

Although many studies have analyzed the role of physical activity in various dimensions of health and well-being in old people with various illnesses but, only a small number of these studies study the effects of exercise on parameters related to elderly equilibrium and, in particular, exercise at home (Chander, et al., 1998 and Matsuzawa et al., 2017). Also according to researches that have been conducted by the researcher, so far, no study has been done on tele-training (tele-exercise) and the improvement of equilibrium parameters. However, due to saving more money and time, reducing the risks in line with not leaving the home, being in interactive virtual groups, feeling of being useful and creating motivation by the use of technology, tele-exercise can be a good alternative to field training with direct monitoring for this age group and other age groups is different from physical conditions.

Although improving the independence is one of the primary goals of health promotion in old people, but there are still some doubts in this field that does the development of physical ability and muscle strength increase the independence and improve the equilibrium or not that in this study we were analyzing this issue. In the present study, it has been shown that regular exercise program increases the person's ability to do daily tasks without being dependent on others and this factor is effective on equilibrium, so that the implementation of the tele-exercise exercise program, which is equal to increasing physical performance and independence in daily activities, has led to an development in the parameters related to equilibrium in the individual and thus has led to an improvement in the risk of falling in people. While in the group that its members did not practice exercise, the equilibrium did not change in any of its associated parameters.

Conclusion

By using a regular exercise program and physical activity as tele-exercise and at people's home we can increase the parameters related to equilibrium in individuals and make the elderly more autonomous in doing daily work and we can help to a successful elderly a lot, and also, a tele-exercise training program may be a good alternative to a field training program with direct monitoring.

It is hoped that this research will guide researchers and students in line with doing researches to improve old people's living statue and it will lead to increased efforts by health authorities of community to improve the well-being of these loved ones. It also helps health care providers to provide health promotion programs to facilitate a healthy and active life for the elderly population and ultimately it helps these people to achieve the highest levels of health, with this wish that old people of our community can experience the sweetness of aging period.

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