

The Effect of Strength and Core Stabilization Training on Physical Fitness Factors Among Elderly People

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Abstract: the aim of this study was to survey the effect of strength and core stabilization training on physical fitness factors among elderly people. In order to carry out this study, 90 individuals from elderly adults of Zanjan Province (Iran) whose health had been verified in accordance with health assessment measures were chosen and studied upon. Using functional tests, gait ability (DGI), balance (Y) and strength in the upper (Bench press) and lower limbs (Legg press) of subjects were analyzed. Prior to performing the pretest, subjects were randomly divided into three groups. The classification of these groups was as follows: strength training group, core stabilization training group and control group with no training (per group: n= 30). Regarding the strength training group, the program lasted for six weeks, each week with three one-hour sessions corresponding to previous studies carried out in this regard. Regarding the core stabilization group, the training were performed with a similar program to that of the previous group different in that the training protocol included core stabilization training. After performing training, posttest data was obtained from all three groups similar to the pretest. Descriptive statistics tests, one-way ANOVA (F) and Tukey's post hoc test ($\alpha = 0.05$) were applied for data analysis using SPSS software. Results showed significant difference in the assessed data of the experimental groups (strength training core stabilization) in the posttest level in comparison with the pretest level. Considering the results of the present research we can say that conducting a period of core stabilization training improves life independence of geriatric population and will ultimately result in their more contribution in the society. Therefore, we can recommend core stabilization training to be included in designing training programs for this group of society.

Key words: Balance • Upper and Lower Limb Strength • Dynamic Gait

INTRODUCTION

Ageing is a biological process which involves all living organisms including human beings. This period is the result of complex interactions between genetic, metabolic, hormonal, immunological and structural factors which affect cellular and tissue levels and bodily systems as well as their function, consequently leading to oldness [1]. The increasing decline of physiological capacities and deterioration of ability to respond to stress in this period, increases vulnerability of the elderly to diseases and increases fatality due to ageing process [1]. Considering the explosive growth of geriatric population in recent years and increase of life expectancy among this group, diagnosis and prognosis of their difficulties are of utmost

importance in enhancing their independent quality of life and the scientific community, specifically scholars of movement sciences, psychology and rehabilitation, must show more care and sensitivity to resolving their needs and difficulties. On the other hand, deterioration of factors related to physical fitness, mental health and quality of life is a problem threatening the health of elderly people which affects quality of life and increases their sustenance costs, while resulting in physical, mental, social and economic difficulties and even death [3]. Although the increasing number of elderly people suggests quality of life, hygiene and fitness among this group of society [4], difficulties and limitations related to maintaining the desired quality of life in old age still remains. Thus, recognizing difficulties of elderly people

and trying to resolve them have attracted researchers' attention. Muscle atrophy, deterioration of endurance capacity and muscle weakness during aging process all lead to decrease of physical activity and consequently to diseases such as cardiovascular diseases [5]. Researches have documented the positive effects of physical activity on decreasing osteoporosis, cardiovascular diseases, arteritis, gait disorders, diabetes, obesity, stroke, cancer and retaining mental abilities and preventing Alzheimer's disease [6]. Theresa (2004) believes that by effectively improving physiological weaknesses such as poor balance, muscle weakness and low reaction speed, training can decrease factors jeopardizing health. Paying attention to quality of life, the effect of various psychological considerations and correcting the way of life can, to a large extent, increase efficiency and independence in elderly people and help them in controlling various complications of old age as well as diverse treatments of such complications [7]. Research has shown that regular participation in physical activities and sports can help elderly people maintain their independence and mobility, decrease the frequency of injuries due to collapsing and falling down, improve their balance and coordination and help them manage to retain muscle power and endurance and consequently enjoy a desirable quality of life [7]. For instance, Rodrigo *et al.*, (2010), in a research on the effect of using Pilates method on balance, autonomy and quality of life in elderly females, reported that elderly people who use assistive devices for performing physical training have a high static balance. It was also reported that elderly people who use assistive devices have more independence in doing their daily matters of life in comparison to those who live without assistive devices. They noted that physical activity without assistive devices has no significant effect on quality of life [8]. Amatachaya *et al.*, (2010) reported in their research that by conducting a period of training, balance of elderly subjects improved and falls decreased [9]. Aragão *et al.*, (2011), in a research on the effects of mini-trampoline training on balance, reported an improvement in regaining balance among elderly people after conducting an training period [10]. In a meta-analytic research titled "the effect of physical training interventions on health-related quality of life", Gilson *et al.*, (2009) reported that training and physical activity affects both mental and physical aspects of quality of life. They also reported a consistent relationship between medical interventions through sports and physical activity and health-related quality of life. Further, reviewing the literature of quality of life, they reported

that female athletes have a higher quality of life than male athletes [11]. Different medical programs have been introduced and conducted in order to improve physical ability and living independence of elderly adults; for example, maintaining and improving the function of cardiovascular system, recovering muscle atrophy and strength deterioration due to ageing process, healthy bones, balance improvement, increase of flexibility [12], increase of life expectancy, retaining mental ability and increasing self-confidence [13] are of the effects of regular sports and physical training on elderly adults. However, there has not been any study investigating an training procedure consistent with initial physical fitness of this group, examining such physical factors as balance, gait and muscle strength. On the other hand, core stabilization training as a modern training procedure highly affect abdominal and lumbar muscles and the results of various studies signify that conducting these training decreases back pain. Nonetheless, the effect of these training on general physical fitness, especially in elderly adults, has not yet been analyzed and since performing these training do not cost much, they can be substituted with traditional training providing that they are effective in improving general factors of physical fitness and quality of life of the elderly, so that elderly adults will perform training in a safe environment which will increase their life independence as well as providing them with a variety of training levels. Since physical training and sports are of methods for prevention, inhibition and treatment of difficulties due to aging process and its positive effect on the quality of life of elderly adults has been documented, the objective of the present research is a comparative analysis of the effect of a period of strength and core stabilization training on some factors of physical fitness such as balance, gait and strength among elderly adults.

MATERIALS AND METHODS

Participants: The present research is semi-empirical with pretest-posttest pattern and with two groups of training intervention and a control group. In order to carry out this study, 90 individuals from elderly adults of Zanjan Province (Iran) whose health had been verified in accordance with health assessment measures (corresponding to awareness and vestibular function tests) were chosen and studied upon. Health assessment measures included cognitive and vestibular function tests (Romberg's test and vestibular stepping test), vision assessment test (Snellen eye chart) and MMSE (Mini-mental state examination). Each participant was asked to

fully explain any record of possible joint dislocations and falls. Participants who had experienced falls, any joint displacement or dislocation, or had chronic arteritis or dizziness during the past 12 months were excluded from the study. Using functional tests explained below, gait ability, balance and strength in the upper and lower limbs of subjects were analyzed. Prior to performing the pretest, subjects were randomly divided into three groups. The classification of these groups was as follows: strength training group (30 subjects), core stabilization training group (30 subjects) and control group with no training (30 subjects). Regarding the strength training group, the program lasted for six weeks, each week with three one-hour sessions corresponding to previous studies carried out in this regard. Each training session started and ended with 10 minutes of warming-up and cooling-down respectively. Regarding the core stabilization group, the training were performed with a similar program to that of the previous group different in that the training protocol included core stabilization training. After performing training, posttest data was obtained from all three groups similar to the pretest.

Y-Balance Test: Y-balance test in three directions was used to measure subjects' balance. In this test, three directions (anterior, posteromedial and posterolateral) are set in a central plateau. The angles of these three directions are specified with graded bars which are fixed on the sides of the plateau in three directions and an indicator is installed on each of the bars. Before starting the test, the preferred Leg of the subjects is determined so that if the right Leg is the preferred member, the test is performed counterclockwise and clockwise if otherwise. The subject stands with their preferred Leg (single-Legged) on the plateau where the three directions meet and performs the act of reaching by moving the indicators - with their other Leg in a direction that the examiner randomly chooses- as long as there is no error (does not move the Leg from the plateau, does not rely on the reach Leg, or does not fall down); then returns to the normal stance on both feet and amount they have moved the indicator is recorded as their reach distance. Each subject performs three trials for each of the directions and finally their average is calculated, divided by Leg length (in centimeters) and then multiplied by 100 to obtain their reach distance.

Gait Dynamics: Dynamic gait index (DGI) questionnaire was used to assess gait dynamics of the subjects. The said questionnaire has 8 questions each of which having maximum of 3 points and minimum of 0. In each question,

considering the way subjects perform an assigned task, a certain score is provided and the researcher scores each of the questions about their gait ability by observing subjects' walking. Generally, if the total score of the subject is less than 19, the possibility of falling is high [15].

Strength Assessment Tests: Bench press and Leg press tests were used to assess the strength of upper and lower limbs of subjects. To perform the tests and in order to prevent the risk of possible injuries, subjects were asked to use light weights with more repetitions until exhaustion; then using the following formula, their maximum repetition was calculated:

$$1RM = \frac{\text{WEIGHT}}{1.0278 - (\text{REPETITION} \times 0.0278)}$$

Core Stabilization Training: The procedure for performing choice core stabilization training involves five training: semi sit-ups, sit-ups with rotation, lateral bridge, prone bridge and four levels of lower back strength training and in the present research, some movements that could expose elderly adults to injuries were removed from the protocol. The protocol in the previous researches was as follows:

- Sit-ups with rotation: sit-ups along with rotation of the waist so that each elbow moves toward the opposite knee.
- Semi sit-ups: in the supine position, chin toward the Bench, as the underpart of the shoulder is separated from the ground, the subject leans forward. In this condition, hands are placed on the Bench and feet are on the pad.
- Lateral bridge: with body sideways against the pad, one hand is placed under the body and body is separated from the ground using trunk muscles.
- Prone bridge: lying prostrate on the pad, forearm and the palms of hands are placed beneath the body. With the help of the arm and trunk muscles, body is separated from the ground so that only the palms of the hands and Leg digits are touching the ground; this level was removed from the training protocol of the present research.
- Lower body training: these training involve five levels. Four of these levels were performed in eight weeks. Considering physical conditions of the subjects and the result of the previous research [17], the third level was omitted. The purpose of these training is to strengthen abdominal muscles.

Of course it must be noted that some movements in the core stabilization training group which are potentially deleterious were omitted from the training protocol of the present research.

Strength Training: The strength training group performed six strength training (squats, step with dumbbells, Leg press, deadlift, jackknife sit-ups and knee flexion) in a six-week training program and with three sessions in each week. The intensity of strength training, similar to that of the previous groups, increased up to the fifth week and the decreased on the sixth week [18]. In performing strength training, first the maximum repetition of subjects for each move was recorded and then training were performed with a certain percentage of 1RM.

Statistical Analysis: Descriptive statistics tests, one-way ANOVA (F) and Tukey's post hoc test ($\alpha = 0.05$) were applied for data analysis using SPSS software.

RESULTS

Using F test did not reveal any significant difference between personal specifications of subjects in the three groups ($p > 0.05$), verifying variance homogeneity of the three groups in influential factors (Table 1).

Using F test, it was revealed that regarding the strength of upper limbs in the pretest period, the difference was not significant ($p > 0.05$); yet in the posttest period, there was a significant difference between the data of the three groups ($p = 0.0032$). Using Tukey's post hoc

test revealed that the difference is between the strength training group and the other two groups, signifying that conducting a period of strength training has led to an increase in the strength of upper limbs of subjects (Table 2).

Using F test, it was revealed that regarding the strength of lower limbs in the pretest period, the difference was not significant ($p > 0.05$); yet in the posttest period, there was a significant difference between the data of the three groups ($p = 0.004$). Using Tukey's post hoc test revealed that the difference is between the strength training group and the other two groups, signifying that conducting a strength training period has led to an increase in the strength of lowerlimbs of subjects (Table 3).

In the pretest period, the ability of subjects of the three groups to maintain balance was not significantly different ($p > 0.05$). One-way ANOVA and Tukey's post hoc test revealed that the in the posttest period, the ability of subjects of the two experimental groups to maintain balance has increased ($p = 0.0001$) and this increase has been more in the core stabilization training group (Table 4).

In the pretest level, no significant difference was observed between dynamic gait index data of subjects in the three groups ($p > 0.05$). Yet using F test and Tukey's post hoc test it was revealed that conducting core stabilization training has increased gait dynamics score ($p = 0.001$), of the subjects and that strength training had made no changes to subjects' gait dynamics (Table 5).

Table 1: Personal specifications of subjects in the three groups

Index	M±SD				P
	Age (Yr)	Height (Cm)	Mass (Kg)	BMI	
Strength training	65.3±4.800	167.4±5.30	66.7±5.40	22.4±2.60	0.083
Core Stabilization	63.7±4.230	164.2±4.54	62.2±5.20	21.2±3.32	0.061
Control group	60.76±5.09	166.1±6.09	67.7±4.65	23.1±4.47	0.38

Table 2: Strength of upper limbs in the pre-test & post-test period in three groups

Group	M±SD			P
	Strength training	Control group	Core Stabilization	
Pre	28.32±4.1	30.7±3.60	31.2±4.10	0.1310
Post	38.4±2.70	28.4±5.13	35.6±6.31	0.0032

Table 3: Strength of lower limbs in the pre-test & post-test period in three groups

Group	M±SD			P
	Strength training	Control group	Core Stabilization	
Pre	73.42±8.53	69.24±5.73	72.17±7.41	0.657
Post	97.31±3.61	71.41±6.29	79.56±4.06	0.004

Table 4: Balance data of subjects in the pre-test & post-test period in three groups

M±SD				
Group	Strength training	Control group	Core Stabilization	P
Pre	58.31±8.43	61.64±7.09	55.32±8.01	0.0780
Post	76.23±8.09	63.08±8.22	80.72±6.56	0.0001

Table 5: Dynamic gait index data of subjects in the pre-test & post-test period in three groups

M±SD				
Group	Strength training	Control group	Core Stabilization	P
Pre	16.02±2.26	17.04±2.69	16.16±2.65	0.092
Post	18.26±1.32	17.98±2.39	23.01±0.06	0.001

By the way, no significant difference was observed in the assessed data of the control group in the posttest level in comparison with the pretest period.

DISCUSSION

The goal of the present research was a comparative analysis of the effect of a period of strength and core stabilization training on some factors of physical fitness such as balance, gait and strength among elderly adults. The results of the present research are consistent with previous findings indicating an improvement of some physical fitness factors in elderly adults after conducting a training period. Conducting a strength training period increased the strength of upper and lower limbs of subjects and improved their balance but had no significant effect on their gait ability. Regarding the increase in strength of subjects, the core stabilization training group experienced a less increase in comparison with the strength training group and this increase was not significant, but better improvement of balance was observed in this group. By the way, core stabilization training had also improved subjects' gait ability.

Regarding the effect of strength training of maximum strength of subjects we can briefly say that performing traditional training using free weights has led to an increase in neuromuscular coordination and muscle hypertrophy and consequently has led to the improvement of subjects' strength [19]. Regarding the improvement of subjects' maintaining balance after conducting a period of strength training, we can consider the increase in subjects' strength as the main cause of these changes since muscle strength, especially in lower limbs, plays an important role in maintaining and controlling stature and posture [20]. Yet, regarding the lack of improvement in gait ability of the subjects of the

said group, we can say that perhaps the intensity of training has not been enough to influence subjects' gait ability and the second and the more important reason is that trunk, lumbar and femoral muscles play an important role in walking, while in the strength training program, not much stress was put on these muscle; of course in most strength training protocols, there are no proper, safe simple movements for strength muscles in the said areas [18].

Subjects in the core stabilization training group did not experience a significant change in the muscle strength of upper and lower limbs; considering the training protocol of this group, conducting these training did not put much stress on body parts; thus, considering the fact that the effect of an training depends on the stress it induces [21], lack of change in the limb strength of subjects after core stabilization training can be justified. However, since core stabilization training put much stress on lumbar and abdominal muscles, these training has improved balance, since the postural muscles in this area play the most important role in balance and orientation [22]. Improvement of strength in lumbar and femoral muscles as well as the increase of coordination in these muscles has improved gait ability and balance of subjects.

CONCLUSION

Considering the results of the present research and the fact that independence of elderly adults is affected by the ability to maintain balance and to walk, we can say that conducting a period of core stabilization training improves life independence of geriatric population and will ultimately result in their more contribution in the society. Therefore, we can recommend core stabilization training to be included in designing training programs for this group of society.

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