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Research Paper: The Effects of Hand Exercise Program on Activities of Daily Living of People Older Than 60 Years

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ABSTRACT

Introduction: Aging is a dynamic and progressive process characterized by morphological, functional, and psychological changes, which restricts adaption to the environment and reduces the quality of life. Maintaining the ability of performing activities of daily living (ADL) is vital to the elderly and poor motor function is associated with higher dependency. Thus, this study aimed to evaluate the efficacy of hand resistance training and dexterity as a treatment package on the performance of ADL in the elderly.

Material and Methods: A total of 20 senior adults were randomly (picking up by coded envelopes) assigned to intervention and control groups. We used Barthel test to evaluate the performance of ADL, and Box and Block test to evaluate the hand function.

Results: According to results, changes in ADL were not statistically significant over time (P=0.583). However, the results of Box and Block test showed that right- and left-hand performance changes over time was statistically significant (P=0.002).

Conclusion: Based on the results, 6 weeks training could improve hand function and dexterity and maintain the ability to perform ADL in the elderly.

1. Introduction

Aging and its consequences aremajor concern of societies in many countries [1]. People aged 60 and older are regarded as the elderly, who are further subdivided into two groups: 60-75 years who are called “young old”, and people over 75 years of age who are called “older old” [2]. The aging phenomenon, due to increasing growth of elderly population in some countries is one of the subjects that has drawn growing attention [3]. The most important factors affecting aging population are reduced mortality, infant mortality, and decreased fertility, which consequently reduce the

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population growth and may lead to fundamental changes in the age structure of the population in most countries, including Iran [1].

In 2000, the World Health Organization (WHO) declared that there are 600 million people aged above 60 years. This figure is expected to reach 2.1 billion in 2025 and 9.1 billion in 2050 [4]. Statistical indicators show that the same aging process is at work in Iran and it is predicted that within 20 years from 2005 to 2025, the median age of population increases by 10 years (United Nation, 2007) [1].

Aging is a dynamic and progressive process characterized by morphological, functional, and psychological changes, which restricts adaption to the environment and reduces the quality of life [5]. Some studies have shown that aging is associated with the loss of strength in the muscle groups of the upper and lower limbs and the proximal and distal muscle groups. The number of muscle fibers and muscle cross-sectional area decreases with age. Also, aging decreases the grip strength and hand coordination [6-8].

The elderly often report increased difficulties in performing daily tasks such as tying shoelaces, fastening and unfastening buttons and earrings, picking items from bags and writing notes [6]. The upper limb motor function, particularly hand motor function, including fine and gross movements are closely associated with reduced ability to perform Activities of Daily Living (ADL) and thus lowering the quality of life. The appreciation of the fact that poor motor function is associated with higher functional dependence can explain the increasing number of people with low motor function in nursing homes [7].

One way of dealing with muscle weakness is doing exercises such as aerobic training, resistance training, strengthening, balance training, and task-oriented training. Exercise programs, including a combination of above exercises could be helpful for this purpose, too. Strengthening programs often engage large muscle groups of the upper and lower extremities. Ades et al. provided evidence that resistance training increases the strength of upper and lower extremities [8]. Another study by Bagheri et al. showed that progressive resistance training of upper and lower extremities could improve ADL in older people [3]. Most studies have focused on evaluating the efficacy of upper and lower extremities exercises but scant attention has been paid to resistance training of distal area of upper extremity (hand). Thus, the purpose of this study is to evaluate the efficacy of hand resistance training and dexterity as a treatment package on the performance of ADL in the elderly.

2. Materials and Methods

This study was a single-blind randomized clinical trial undertaken in elderly care centers of Tehran. After obtaining the approval of the Ethics Committee of Tehran University of Medical Sciences (No. IR TUMS.REC.1394.1645) and Iran's Clinical Trial Registry (No. IRCT201608213551N), 20 senior adults were selected based on inclusion criteria using convenience sampling method. Participants were selected after studying the medical records of senior residents in nursing homes and completing demographic questionnaire. Then, they were randomly (picking up by coded envelopes) assigned to intervention and control groups. The inclusion criteria were as follows: aged 60 and older, willingness to participate in the study (filling out a consent form), lack of vision and hearing problems, MMSE score above 21 points [9], minimum level of education (fifth-grade), ability to communicate and respond to questions in Farsi, lack of cardiovascular diseases, lack of acute orthopedic problems, neurological and rheumatological disorders that leads to pain in hand, and lack of depression and anxiety disorders based on medical records. The exclusion criteria were lack of cooperation and willingness of subjects to drop out of study and intervention sessions.

Interventions were conducted by an occupational therapist, who was in charge of the project. The sessions were 60 minutes long and conducted 3 times a week for 6 weeks. Each session consisted of 3 parts, each including 24 minutes (12 minutes for each hand) resistance exercises of small muscle groups for the thenar and hypothenar muscles using putty which covered mass grasp, thumb flexion, key pinch, palmar pinch, tip pinch, adductor pinch, hook fist, two-handed key pinch, two-handed grasp, two-handed palmar grasp, finger extension, thumb extension, finger adduction, finger abduction, thumb abduction, wrist rotation, and wrist extension. It also included 12 minutes rest and 24 minutes of dexterity exercises as task oriented activities, including fastening and undoing buttons of different sizes , tying shoelaces, doing up and undoing zips, turning pages, picking up small items (coins, keys, bottle) and putting them on the table, threading beads on the basis of visual and auditory instructions, moving fingers dependently as throwing a small ball at the target, and writing text. To make dexterity exercises more attractive for each activity, time, and number factors were considered.

To evaluate the performance of daily activities, Barthel test and Box and Block test were used. In both groups, tests were performed four times (before interventions, immediately after treatment, three weeks after treatment,

and one month after the treatment) by the occupational therapists who was familiar with the assessment tools. It should be noted that test scores were not significantly different between two groups before the intervention and groups were perfectly compatible in terms of these two variables. In this study, the assessor was completely blind to the kind of intervention and groups.

Standard Box and Block is a reliable and simple tool to assess subjects with severe problems in daily activities, coordination, and dexterity. The reliability of this instrument was evaluated by the test-retest method in healthy elderly (r=0.97-0.89) [10]. The scoring is based on the number of blocks transmitted from one side to the other side over one minute. It is conducted for each hand separately [11]. The number of transferred cubes in a minute is recorded three times and the mean is recorded.

Barthel test was used to assess the status of independence in daily activities. This test was used to evaluate the quality of life, effectiveness of therapeutic interventions, care and rehabilitation, mitigation of falling risk in the elderly, planning for discharge, predicting the length of stay in hospital, the risk of staying in nursing homes, and the recovery process. Validity and reliability of this instrument in the nursing home was approved (ICC=0.998) [12]. In this questionnaire, depending on individual conditions and the nature of each item, each case was assigned a score of 0 to 15. Overall, this tool determines the ability of an individual in all aspects of daily functioning on a scale of 0 to 100 with higher scores indicating more efficient function. Accordingly, a score of 2 to 20 is considered as full dependency, 20 to 60 as severe dependency, 61 to 90 as moderate dependency, 91to 99 as partial dependency and a score of 100 as complete independence [12]. The validity and reliability of this questionnaire has been proved [13].

3. Results

Participants were divided into two groups of intervention (n=10) and control (n=10). In the intervention group, there were 6 women and 4 men with the mean age of 89.2 years and in the control group there were 5 women and 5 men with the mean age of 88.8 years. To investigate daily activities based on Barthel index as well as the performance of right and left hands by the Box and Block test at different times, the statistical model with repeated measures was used.

The results of Mauchly's sphericity test was significant (P<0.05). Thus, the modified margin of error was evaluated by Greenhouse-Geisser test. According to results, changes in ADL was not statistically significant over time (P=0.583). The results showed that right-hand performance change over time was statistically significant (P=0.002). According to results, the left-hand performance change over time was statistically significant (P=0.002).

4. Discussion

The results of this study showed that the exercise program was effective in maintaining and improving the ability to perform ADL of the elderly. In this study, the performance of the elderly was evaluated by the Barthel index and Box and Block test before and after the intervention. The exercises included activities of the thenar and hypothenar muscles. Dexterity activities were designed as functional activities for the elderly. These exercises were implemented for 6 weeks under the supervision of the therapist. After 6 weeks intervention, these scales were used to measure study variables. The assessment of ADL using Barthel test showed an increase in Barthel scores of the intervention group 3 and 6 weeks after the intervention, but this increase was not statistically significant. After one-month follow-up, despite decline in Barthel scores, the scores in the intervention group was higher than the control group and initial scores of the intervention group (Figure 1).

The results related to ADL were consistent with the findings of Dechamps who showed in their 12 months randomized clinical trial that exercise intervention focused on the upper and lower extremities could improve the scores of health-related quality of life test in older adults, even in those with severe neurological problems. Dechamps study showed that while the ADL scores measured by the Katz scales had dropped significantly

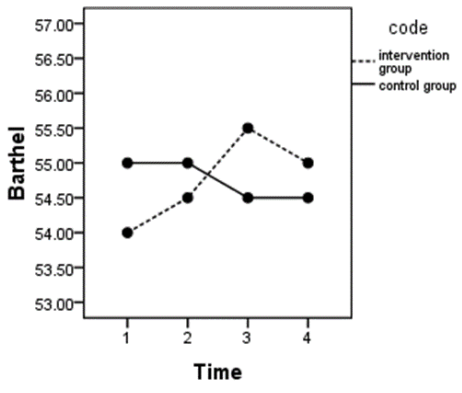

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Figure 1. Comparison of Barthel scores at four different times between intervention group and control group (1: before interventions, 2: three weeks after treatment, 3: immediately after treatment, and 4: one month after the treatment)

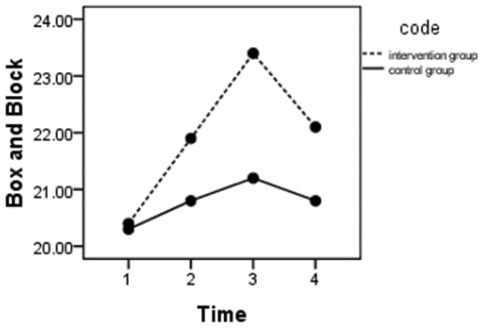

Figure 2. Comparison of performance scores related to right hand in the Box and Block test at four different times between intervention group and control group (1: before interventions, 2: three weeks after treatment, 3: immediately after treatment and 4: one month after the treatment)

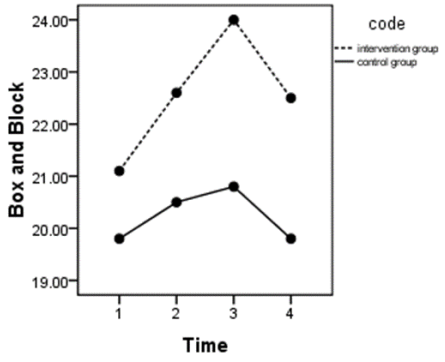

Figure 3. Comparison of performance scores related to left hand in Box and Block test at four different times between intervention group and control group (1: before interventions, 2: three weeks after treatment, 3: immediately after treatment and 4: one month after the treatment)

in the control group, participants in the intervention group displayed less performance degradation, though ADL scores of the two groups were not clinically significant [14].

The results of 10 weeks clinical trial by Singh et al. on depressed older adults showed that exercise intervention did not have any significant effect on ADL. Katz scale was also adopted in this study [15]. The results of the present study was inconsistent with the findings of Bagheri et al. who examined the effect of progressive resistance training on ADL in the elderly. In a clinical trial, Bagheri et al. showed that progressive resistance training improved muscle strength and there was also a direct relationship between strength and independence in ADL [3]. This discrepancy can be due to larger sample size and type of exercises. In the study of Bagheri, exercises included the upper and lower extremities.

In this study, due to small sample size and short duration of interventions, the results of Barthel test scores before and after the intervention, were not statistically significant. Unfortunately, the elderly living in care centers are not motivated to be active due to their lifestyle and limited communication with other people. This may explain their performance deterioration one month after the intervention. Prevention of the performance deterioration and maintaining the ability of the elderly is vital to Geriatric Rehabilitation due to the aging process that causes progressive decline in the physical performance.

The results of hand function assessment by Box and Block test showed that performance scores for the right and left hand in the third and sixth weeks were significantly higher in the intervention group compared to the control group. The higher scores were statistically significant and the results persisted in one-month follow-up (Figures 2 & 3). There seems to be a paucity of studies on the effectiveness of resistance training in improving hand function in the elderly. The aging process is associated with muscle fibers atrophy, decreased muscle physiological cross-sectional area, maximum force of muscle contraction, and power generation. In addition, age-related changes in the function of the nervous system reduce the maximum strength and power of muscles [16].

Studies indicate that resistance training can contribute to regain of a significant part of muscle mass and function, which is deteriorated with increasing age. Furthermore, adaptive changes may develop in the nervous system in response to exercises. Thus, increased maximum power and force contraction could be provoked by changes in muscle morphology, and changes in the nervous system. This nervous adaptation in response to resistance training may include improved motor neuron excitability, down regulation of inhibitory neural pathways, and decreased presynaptic inhibition [16, 17].

Improvement in Box and Block test may be due to the effects of resistance training on muscle morphology and central nervous system. This study had some limitations, including weak cooperation of authorities in elderly care centers and severe depression and demotivation of older adults. Moreover, since the results of the study are based on a small sample, more studies with larger samples are needed to confirm the results.

The results of this study showed that the 6 weeks training could improve hand function and dexterity and main-

tain the ability to perform ADL in the elderly. In general, resistance training is a safe, effective, and inexpensive method to maintain and improve functional ability of the elderly, which can be used to empower the elderly and reduce the cost of care in this population.

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Conflict of Interest

The authors declared no conflicts of interest.

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