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Effects of Motor Imagery and Maximal Isometric Action on Grip Strength of Elderly Men

[1]*Mohammad Darvishi,* [1]*Shirkoo Ahmadi,* [1]*Ali Hierani and* [2]*Nahid Jabari*
[1]Department of Physical Education, Razi University, Kermanshah, Iran
[2]Department of Physical Education, Tabriz Branch, Islamic Azad University, Tabriz, Iran

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Abstract: The purpose of this study was to see if motor imagery and maximal isometric action would increase grip strength in elderly men. Thirty elderly men were randomly assigned to either a control group, motor imagery group or isometric action group. The study was conducted over a three-week period using a pretest, posttest and control group design. The motor imagery group was instructed to cognitively practice isometric contractions of their non-preferred hand. During these sessions, isometric action group actively practiced isometric contractions of their non-preferred hand. Control group did neither motor imagery nor isometric action. Maximal isometric action was measured by dynamometer before and after the protocol period. The data were analyzed using a one-way analysis of variance, Tukey's Post Hoc test and paired t-test. The results showed that the motor imagery group and isometric action group significantly increased their grip strength compared to the control group ($p<0.05$). Moreover, it was significant different in pretest and posttest of the motor imagery group and isometric action group ($p<0.05$). Exercise increased the grip strength. It is optimistic to use mental imagery in absence of physical exercise condition to increase or preserve muscular strength especially for the elderly experiencing retrograde trends in nervo-muscular system due to senility.

Key words: Motor imagery · Isometric action · Grip Strength · Elderly Men

INTRODUCTION

In recent years, health and medical facilities has increased life expectancy. In 2006, UN announced 687,923,000 elderly people in the world. Up to 2050, 1,968,153,000 elderly people have been estimated consequently it needs to bring attention to this age group [1]. World Health Organization defines aging over than 60 years old survived from the events followed by youth and the middle-aged [2,3]. Annually followed by 65 years old, 10 percent of the elderly usually lose independence in some daily activities and a lot of body organs and systems including nervo-muscular system is changing regressively It causes to decrease muscle strength [4,5]. Desrosiers *et al.* (1995) found that grip strength of the elderly is related to the age linearly. Also, gender, environment and height predicted the grip strength [6]. Nevitt *et al.* (1991) studied risk factors for injurious falls between 325 subjects. Risk of minor injuries is more in the elderly with low grip strength and slower reaction time [7]. Jette *et al.* (1990) studied many abilities such as coordination, finger and grip strength, health, clothing, working in the kitchen and society and performing common tasks including the use of cell phone and money. It showed reduced manual skill, strength and performance in the tests of coordination and performance [8]. Sonn (1996) also found that the elderly who are dependent on daily activities (in addition to other factors) have lower grip strength than those independent on the skills [7]. Wolf *et al.* (1996) aimed to evaluate the effects of two exercise approaches, Tai Chi and computerized balance training on occurrence of falls. Grip strength declined in all groups and lower extremity range of motion showed limited but statistically significant changes. A moderate Thai Chi intervention can prevent favorably the occurrence of falls [10]. Shiffman (1992) studied the effects of aging on prehension and grip strength at various ages. The aging decreases prehension and grip strength and increase time of activities [11]. Exercise and physical activities are current methods for solving these problems. Expensive therapies to improve strength are exercises done by resistance training with weights, elastic

Corresponding Author: Shirkoo Ahmadi, Department of Physical Education, Razi University, Kermanshah, Iran.
Tel: +989187703211.

bands, isokinetic or isotonic training machine and neuromuscular electrical stimulation. But, difficult or impossible activities are not practical by previous methods. In some orthopedic and neurological injuries, muscle contractions can be painful or even impossible. Also, using weights or resistance machines may lead to hypertension in some respiratory or cardiovascular diseases especially when training with upper limbs. In addition, improper use of equipment and training, particularly in the elderly, may cause musculoskeletal injuries. Although isometric exercise is safe and easy, the monopoly of exercises done to a certain degree can not conserve muscle strength in the range of performance [11-15]. Hence, other methods are crucial to be found. Imagery exercise has recently been proposed as a solution [16]. Mental practice is an internal representation of a movement and the repeats of it in the mind without any physical activity in a given situation [17]. Richardson (1967) presents a standard definition of imagery exercise as symbolic repeat of physical activity without any apparent muscle movement [18]. Magill (2004) explains mental practice as a cognitive training of a skill in the absence of physical movement. Mental practice can be a form of thinking on cognitive dimensions of motor skills or visual imagery of skill performance or a piece of skill [19]. Some studies prove the improvement of motor skills due to mental exercise similar to physical exercise [20,21]. Nervous mechanism is involved in mental exercise as much as physical exercise [22,14]. A activity is based on output of data stored in memory (previous experiences). Movement is presented in the moment of decision. It can be changed, modified then saved through the specific cognitive processes [23,24]. Mental practice includes all the stages of cognitive-controlling motion that are planning and motion preparation in the real movement but implementation phase of mental practice is controlled [23-26]. Moreover, event related potential as a function of movement parameter is not varied during motor imagery and isometric action [27]. Brain oxygenation is also similar between movement execution and imagery [28]. Imagery provides cerebral blood flow especially in the areas related to movement planning [29-32]. Since 1930, the studies have been conducted on the effects of mental practice on the strength which results are inconsistent. The effect of mental exercise on the elderly has been considered in some studies and founding is unclear. Razor *et al.* (1966) showed that mental practice has little impact on the grip strength [33]. Herbert *et al.* (1998) investigated the effects of real and imagined training on voluntary muscle activation during maximal isometric contraction. They concluded that the changes were not significant [34]. But, several research showed that the mental practice has a significant impact on the strength [35-40].

Mental exercise creates vast benefits although the results of research are contradictory. The elderly also have not been studied in the research population considerably. Due to muscular atrophy of the elderly, we aimed to see if motor imagery and maximal isometric action would increase grip strength in elderly men.

MATERIALS AND METHODS

Subjects: Thirty elderly, healthy, right-handed, previously untrained subjects from care centers for elderly people (age, 70.93 years; weight, 58.30 kg; height, 168.93 cm) voluntarily participated in this study in Kermanshah, a city in west of Iran. They were asked to fill two questionnaires entitled "vividness of movement imagery questionnaire (VMIQ)" and " vividness of visual imagery questionnaire (VVIQ)". The mean rank of two questionnaires was lower than 3.50. They must not be injured and mentally or physically sick. Also, they must not use anti-epileptic drugs, psychiatric drugs with a high dose and elderly auxiliary device. Moreover, they were asked to do their routine daily activities. Subjects were randomly assigned to either a control group, motor imagery group or isometric action group.

Procedure: The subject of isometric action group holds the dynamometer (SH5005) in the non-preferred hand to be tested, with the arm at right angles and the elbow by the side of the body while the handle should rest on middle of four fingers. When ready the subject squeezes the dynamometer with maximum isometric effort, which is maintained for about 5 seconds. No other body movement is allowed. The subject should be strongly encouraged to give a maximum effort. In the protocol, 3 maximum voluntary contractions were performed each one with 2-min rest. Maximal isometric action was measured by dynamometer before and after the exercise. The subjects were verbally encouraged.

In motor imagery group, they sit on the chair. The non-preferred hand is relaxed and eyes are closed. They take a deep breath and relax muscles for two minutes. Subjects were instructed to imagine that they were contracting their hand muscles. The imaginary contraction was carried out with non-preferred hand, lasted 10 s and was followed by a 20-s rest in a set. The contraction was repeated three sets of ten times followed by a 2-min rest between sets in a session. During the three-week, five exercise sessions were carried out every week [33]. Test was done individually.

Control group did neither motor imagery nor isometric action. They did daily activities and only participated in the measurement of grip strength.

The data were analyzed using a one-way analysis of variance, Tukey's Post Hoc test and paired t-test by SPSS software.

RESULTS

The results showed that the motor imagery group and isometric action group significantly increased their grip strength compared to the control group ($p<0.05$). Moreover, it was significant different in pretest and posttest of the motor imagery group and isometric action group ($p<0.05$). Exercise increased the grip strength.

DISCUSSION

The purpose of this study was to see if motor imagery and maximal isometric action would increase grip strength in elderly men. The results showed that the motor imagery group and isometric action group significantly increased their grip strength. It is in consistent with some research [32,33,35-37,41,40] and in contradictory with others [33,34]. The contradictory results can be on account of external imagery or not proper imagery by the subjects in the research. First time, Corbin (1972) stated that there is a close relationship between muscle size and its force. Strength is related to the muscular hypertrophy. Although a limited number of studies investigated the muscular strength and size of its following strength training, the results are amazing. Muscular strength increases more than muscular size. In cases, a significant increase of muscular strength has been reported without any change in muscular size. In the first weeks of strength training, lack of agreement between muscular strength and hypertrophy can be observed. Moritani, Kombi and Narici believe that adaptation of the central nervous system increase strength. It is called neural training hypothesis. Thus, the increase of strength in the first weeks (2-5 weeks) followed by strength training is related to the nervous mechanism not muscular size or fibers. Person is capable to use more motor units with greater frequency [42]. Studies showed that increase of rapid voluntary strength is associated with IEMG activity [43,44]. It is due to nervous messages. It means that trained individuals learn to activate the muscles more.

Table 1: Grip strength between groups

		Mean	Std. deviation	F	df	Sig
Pretest	Control	49.17	6.08	1.30	2	
	Imagery	52.63	1.56		27	0.289
	Physically active	50.01	5.97			
Posttest	Control	50.56	6.46	13.19	2	
	Imagery	58.57	4.73		27	0.000
	Physically active	62.62	4.63			

Table 2: Tukey's Post Hoc test in posttest

	Control	Imagery	Physically active
Control	*	0.007	0.000
Imagery	0.007	*	0.226
Physically active	0.000	0.226	*

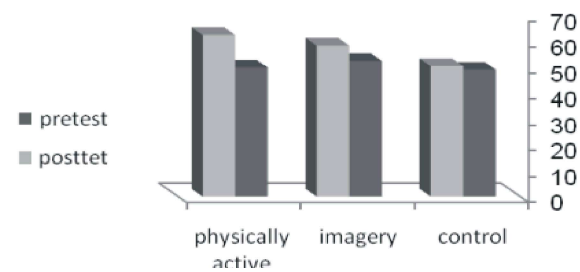

Fig. 1: Grip Strength of three groups

Increase of primary strength is ascribed to the trained skill. Moreover, strength is limited in the specific joint angle under the training. Sometimes, strength training on a limb goes along with strength on the opposite limb. All are resulted from activation of more motor units that untrained people are not capable to do [42]. Muscular strength achieved by isometric strength training as a result of two factors. Because muscular hypertrophy is provided in the final stages of strength training, strength is on account of nervous changes and central planning of muscular contraction in the initial weeks. It is probably possible to change the central planning of muscular contraction through mental exercise of maximum voluntary contraction [31]. Each motion is based on the information stored in the motor memory (previous experiences of motion). In the moment of decision for the motion, it can be emerged as a central activity and it can be changed, modified and finally stored through specific cognitive processes [23,24]. Motor imagery directly influences processing of motor information. It calls the processes involved in the plan and motor program. It is possible to manipulate the information so it changes the central planning of muscular contraction through mental exercise of maximum voluntary contraction [26]. Imagery assists the brain to make a motor schema. In other words, mental activity is a kind of weakened physical activity [21,30,45]. In fact, mental exercise orders the motor units to make force consequently increase the muscular strength [17,29,34,40].

CONCLUSION

Mental exercise is a hopeful way to increase or conserve muscular strength of the elderly who can not do strength exercise due to aging. Aging also decreases the muscular strength. It is suggested to use mental exercise in the program of rehabilitation especially devoted to the elderly.

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