The Influence of Physical Activity on Handgrip Strength of Elderly

Bilajac, Lovorka; Juraga, Denis; Žuljević, Hela: Marinović Glavić; Vasiljev, Vanja; Rukavina, Tomislav

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Lovorka Bilajac[1,2], Denis Juraga[1]*, Hela Žuljević[3], Mihaela Marinović Glavić[1], Vanja Vasiljev[1,3] and Tomislav Rukavina[1,3,4]

[1]University of Rijeka, Faculty of Medicine, Department of Social Medicine and Epidemiology, Rijeka, Croatia
[2]Teaching Institute of Public Health of Primorje – Gorski Kotar County, Rijeka, Croatia
[3]University of Rijeka, Faculty of Health Studies, Rijeka, Croatia
[4]University of Rijeka, Faculty of Health Studies, Department of Public Health, Rijeka, Croatia

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***Corresponding author:** Denis Juraga, MSc, Department of Social Medicine and Epidemiology, Faculty of Medicine, University of Rijeka, Rijeka, Croatia, Tel: +38551651220; E-mail: denis.juraga@medri.uniri.hr

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Research Article

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Abstract

The global population aged 60 years and over will reach nearly 2.1 billion by 2050. During the aging process, the strength of the musculoskeletal system decreases and it is essential to be moderately physically action to prevent negative changes in muscle cells. Because the handgrip strength test is a robust predictor of the overall state of strength and physical frailty, it was used in this study to demonstrate physical functionality and muscle weakness related to physical activity. Examinees who participated in the study were elderly people aged 60 years and older who regularly performed exercises twice a week under the guidance of physiotherapy students. This research aims to present the results of the measurement of the handgrip regarding regular physical activity. Data were analyzed by paired sample t-test and p-value <0.05 was considered significant. Handgrip strength test results (for a total of 47 subjects) show a statistically significant difference in both hands before and after the exercise period (right hand: p= 0.0085, left hand: p= 0.0001), suggesting that regular exercise affects grip strength as a predictor of older people's physical functioning and improvement of their quality of life.

Abbreviations

WHO: World Health Organization

Introduction

Aging is a dynamic and irreversible physiological process that occurs during the individual development of living organisms throughout life [1]. The global population aged 60 years and over numbered 962 million in 2017, more than twice as large as in 1980. The number of older persons is expected to double again by 2050, when it is projected to reach nearly 2.1 billion [2]. Significantly increased life expectancy is one of humanity's major achievements. However, the world's ageing population affects public spending on health and social care that are considered a threat to global economic stability in the 21st century [3]. According to the World Health Organization (WHO), health is a state of complete physical, mental and social well – being and not merely the absence of disease or infirmity [4]. In order to achieve a complete state of health among the elderly and consequently reduce the costs of health care systems, governments and societies started to develop policies for healthy ageing, aiming not only at prolonging the life, but as well as to improving it [5]. It has been proven to be a difficult task to reach a consensus on how healthy ageing should be defined [6]. But, after WHO published the *World report on ageing and health*, healthy ageing was defined as "functional ability to be and do what an older person has reason to value" [7]. The functional abilities include being able to have a role or identity in the community, to have relationships and to have the possibility of autonomy, enjoyment, potential for personal growth and security [8]. The absence of certain diseases or the inability to perform daily activities is not the only factor determining healthy aging because many older people have one or more medical conditions that, if it's under controll, have little effect on their well-being [9].

One of the most important indicators of healthy aging is muscle strength [10]. During the aging process, the strength of the musculoskeletal system decreases [11]. Deregulation of hormones, neuromuscular system changes, degradation of proteins, inflammatory processes in different parts of the body increase muscle turnover as well as myostatin level that cause apoptosis and reduced number of muscle cells [12]. All those physiological changes lead to consequent decrease in quality and musculoskeletal performance, frailty syndrome, disability, dependency, frequent falls and hospitalizations [13]. One way to prevent negative changes in musculoskeletal performance in elderly is to be moderately physical active at least 30 minutes on most, if not all, days of the week [14].

Handgrip strength, an easy and cost – effective test, has been found to be a robust predictor of overall state of strength, disability, physical frailty and mortality among different age

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groups [13,15-17]. The association between handgrip strength and mortality has been observed in multiple populations ranging from hospitalized female geriatric patients to healthy middle-aged men followed for 30 years [18]. According to the recent research, the handgrip strength is an useful tool to predict the risk for development of cardiovascular diseases [19]. In general, the risk of low handgrip strength increases as age increases in both men and women [20]. Because of postmenopause as well as structural and mechanical changes at the molecular and cellular level [21], there is an increased tissue degeneration and reduction of bones density of joints, because of which women have a significantly lower handgrip strength than men [22]. Therefore, the parameters that determine the strength of the handgrip are defined by age (60 to 64; 65 to 69; 70 and over) and gender as well as by groups which are below, within and above the reference value [23].

The aim of the study is to present the strength of handgrip in elderly as a predictor of physical functionality and muscle weakness in relation to regular physical activity.

Materials and Methods

A total of 47 examinees (95.74% women and 4.26% men) aged 60 years and over participated in the study. The intervention phase included regular exercise for 8 months, twice a week for 60 minutes. The exercises were conducted by undergraduate students of physiotherapy, and the exercises were adapted to elderly. The exercises were divided into 3 parts. In the first part, a warm-up was conducted for 10 minutes. The second part of the exercise lasted between 35-40 minutes, and consisted of exercises in order to increase the range of motion, balance, coordination, and proprioception and strengthen muscles. The last part of the exercise included the last 10-15 minutes during which relaxation and stretching were performed. All examinees participated in group excercise for 8 months. For the purposes of this study, the values of the measurement of the handgrip were obtained by standard dynamometry using Jamar Hydraulic Hand Dynamometer manufactured by Patterson Medical [formerly Sammons Preston], Warrenville, IL, USA [23]. Measurements were carried out with the respondents standing, shoulders neutrally rotated and adducted, elbow flexed at 90° and with the forearm in neutral position. Each respondent carried out two measurements and the mean value for both hands was used for further statistical analysis. Dynamometry reference values by age group and gender are shown in Table 1.

Descriptive statistics ware used and results are expressed as arithmetic means, minimum and maximum values, and standard deviations. In order to test the normality of the distribution of data, Kolmogorov-Smirnov test was used. The paired samples t-test was also performed to determine whether there was a statistically significant difference in strength of the left and right handgrip at the beginning and at the end of the exercises. For statistical analysis, the p-value less than 0.05 was considered significant ($p < 0.05$). Data were processed in Statistica (Version 13, TIBCO Software Inc., 2017).

Table 1: Reference values for dynamometry by age group and gender.

	Age group		
	60–64	65 –69	70+
Male right hand	41	41	32
Male left hand	33	33	30
Female right hand	25	23	20
Female left hand	20	20	19

All respondents voluntarily participated in the study and were able to withdraw at any time. The study was approved by the Ethics Committee of the Faculty of Medicine in Rijeka in April 2014.

Results

Handgrip strength of the left and right hand of all examinees

The arithmetic mean value for the handgrip strength of the right hand on first measurement was 23.22kg ±7.00 (min. value=5.00kg; max. value=40.00kg). On the second measurement, the mean value increased to 25.59kg ±5.21 (min. value=14.00kg; max. value=40.00kg). According to the obtained results, there is a statistically significant difference in the strength of the hand grip of the right hand before and after the exercises ($p = 0.0085$). As for the left hand, on the first measurement the mean value was 21.30kg ±6.01, the minimum value was 8.00 kg and the maximum value was 34.00 kg. On the second measurement, the mean value was 24.40kg ±4.99 (min. value=14.00kg; max. value=36.00kg). There is a statistically significant difference in the strength of the handgrip of the left hand before and after the exercises ($p = 0.0001$). Data are summarized in Table 2.

Table 2: Handgrip strength test of all examinees (right and left hand; before and after the 8 – month exercise program).

	N	Mean value (kg)	Minimum (kg)	Maximum (kg)	Std. dev. (kg)	*P* - value
Right hand (first measurement)	47	23.22	5.00	40.00	7.00	0.0085
Right hand (second measurement)	47	25.59	14.00	40.00	5.21	
Left hand (first measurement)	47	21.30	8.00	34.00	6.01	0.0001
Left hand (second measurement)	47	24.40	14.00	36.00	4.99	

Handgrip strength of the left and right hand of women

There were 12 women in the age group between 60 and 64. The mean value for the right handgrip was 26.04kg ±3.96 (min. value=20.50kg; max. value=30.50kg). On the second measurement, the mean value increased to 28.04kg ±3.14 with the minimum value of 23.00kg and the maximum of 33.00kg. For both measurements, the mean value for the right hand is above the reference value for this age group. There were also 12 women in the age group between 65 and 69. The mean value on the first measurement was 25.42kg ±4.41 (min. value=16.50kg; max. value=34.00kg). After the second measurement, the mean value increased to 27.08kg ±3.77 (min. value=20.50kg; max.

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value=34.00kg). As in the previous age group, the mean values of the initial and final measurement were above the reference value. The age group of 70 and over consisted of 21 women. The mean value of the first measurement was 19.90kg ±7.59 which is below the reference value for this age group. The minimum and maximum value were 5.00kg and 35.50kg. In the second measurement, the mean value was 22.29kg ±4.44 and, compared to the first measurement, this value is above the reference value for that age group (min. value=14.00kg; max. value=30.00kg). Data are summarized in Table 3.

In the age group 60-64, the mean value for the left handgrip on first measurement was 23.42kg ±4.61 (min. value=15.00kg; max. value=31.00kg). In the second measurement, the mean value was 27.08kg ±3.46 with a minimum value of 24.00kg and a maximum value of 36.00kg. For the before mentioned age group, the mean values on the first and second measurement were above the reference value. In the following age group, comprised of women between 65 and 69, the mean value for the left handgrip was 22.92kg ±3.90. The minimum value was 17.00kg and the maximum was 32.00kg. In the second measurement, the mean value was 25.42kg ±3.88 (min. value=20.00kg; max. value=32.00kg). Both mean values are above the reference value. Women from the age group of 70 years and older had the mean value of the left handgrip 19.07kg ±6.88 in the first measurement (min. value=8.00kg; max. value=34.00kg). The mean value on the first measurement is nearly the same as the reference value for this age group. On the second measurement, the mean was 21.48kg ±4.50 with a minimum value of 14.00kg and a maximum value of 29.50kg. The mean value of the left handgrip strength test on the second measurement for this age group is above the reference value. Data are summarized in Table 4.

Handgrip strength of the left and right hand of men

Both male examinees were in the age group of 70 and over. On the first measurement, the mean value for the handgrip of the right hand was 28.00kg ±16.97 (min. value=16.00kg; max. value=40.00kg). In the second measurement, the mean value was lower (22.25kg ±10.96), with a minimum value of 14.50kg and a maximum value of 30.00kg. In both measurements, the right handgrip was below the reference value for this age group. The mean value, on the first measurement, for the left handgrip was 36.50kg ±4.95 with a minimum value of 33.00kg and a maximum value of 40.00kg. In the second measurement, the mean value was also lower, 33.00kg ±4.24 (min. value=30.00kg; max. value=36.00kg). The mean values on both measurements of the left hand were above the reference value for that age group. Data are summarized in Table 5.

Discussion

The loss of skeletal muscle mass can lead to sarcopenic obesity, reduced exercise capacity, chronic heart failure and disability [24,25]. All of the above describes the importance of muscle strength as a potential predictor for the development of chronic conditions and diseases in elderly. Therefore, measuring muscle strength may be helpful in determining which elderly people are most at risk of developing various diseases [26].

Table 3: Right handgrip strength test of women in regard to age group (before and after the 8-month exercise program).

	N	Mean value (kg)	Minimum (kg)	Maximum (kg)	Std. dev. (kg)
First measurement (60–64)	12	26.04	20.50	30.50	3.96
Second measurement (60–64)	12	28.04	23.00	33.00	3.14
First measurement (65–69)	12	25.42	16.50	34.00	4.41
Second measurement (65–69)	12	27.08	20.50	34.00	3.77
First measurement (70+)	21	19.90	5.00	35.50	7.59
Second measurement (70+)	21	22.29	14.00	30.00	4.44

Table 4: Left handgrip strength test of women in regard to age group (before and after the 8 – month exercise program).

	N	Mean value (kg)	Minimum (kg)	Maximum (kg)	Std. dev. (kg)
First measurement (60–64)	12	23.42	15.00	31.00	4.61
Second measurement (60–64)	12	27.08	24.00	36.00	3.46
First measurement (65–69)	12	22.92	17.00	32.00	3.90
Second measurement (65–69)	12	25.42	20.00	32.00	3.88
First measurement (70+)	21	19.07	8.00	34.00	6.88
Second measurement (70+)	21	21.48	14.00	29.50	4.50

Table 5: Left and right handgrip strength test of men in regard to age group (before and after the 8-month exercise program).

	N	Mean value (kg)	Minimum (kg)	Maximum (kg)	Std. dev. (kg)
Right hand; first measurement (70+)	2	28.00	16.00	40.00	16.97
Right hand; second measurement (70+)	2	22.25	14.50	30.00	10.96
Left hand; first measurement (70+)	2	36.50	33.00	40.00	4.95
Left hand; second measurement (70+)	2	33.00	30.00	36.00	4.24

Handgrip strength is also known as arm strength, and it is an anthropometric measurement that indicates the health of the arm muscles. Measuring the strength of the handgrip is one of the indicators of the overall well – being of elderly [27]. The handgrip becomes weaker as we age, which eventually affects the quality of life. Everyday activities such as opening jars, carrying grocery bags, pushing the doors and turning the doorknob become very difficult. That can lead to activity restriction and decrease the frequency with which an individual leaves his or her home affecting functional, psychological, and social health [26,28]. The summary of the study conducted by Vagetti and al indicated that physical activity is associated with many domains that define the quality of life. Those domains are related to functional capacity, mental health, vitality and psychological processes. Further more, physical activity may affect individual independence as well as essential mental aspects of quality of life [29]. Studies have also shown an association between physical activity/inactivity and cognitive abilities in elderly [30-32]. Measurement of the handgrip strength is easy to perform and it is precise enough to identify the slightest changes in the handgrip strength, especially in elderly who exercise regularly. It is important to emphasize that lower strength does not necessarily mean that a person is

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in poor health, but his or her quality of life is certainly impaired. However, even the smallest recommended daily amount of physical activity reduces the risk of disability development, improves joint mobility and muscle strength, and contributes to a better quality of life [29,33].

The majority of respondents in this research were in the age group of 70 and over, which is not the case in some studies that examined the association of handgrip strength, age, chronic illnesses and physical activity in elderly [13,34].

Based on the results, the handgrip strength of the right hand of all examinees increased (from 23.22kg to 25.59kg) and the minimum value in the second measurement increased; none of participants had the right handgrip strength below 14kg. There was also an increase in the mean and minimum value in the second measurement of the left handgrip strength (21.30kg versus 24.40kg; 8.0kg versus 14.00kg). A British study found that there is a significant association between physical activity and handgrip strength, respectively physical inactivity in the elderly was significantly associated with low handgrip strength [35]. Bohannon et al. have shown that handgrip strength differs between men and women and that the average handgrip strength value is higher in men than in women [36]. In this study, the strength of the handgrip increased in women in all age groups, while the mean value for men after eight months of excercises was lower. No positive change was observed among the male examinees, but this could be attributed to the possible irregular attendance of the exercises or because of their age (over 70 years). Also, another point is that there are more women included in excercise group and in research.

According to one study conducted in Australia, the average handgrip strength of men aged ≥70 was 33kg, while in this study the average handgrip strength of men was a bit lower (29.94kg). The mean value of handgrip for women, in the ≥70 age group, was 20kg, while in this study the value of the handgrip was almost similar (20.69kg) [37]. A study conducted in Japan indicates that the mean handgrip strength in the age group 65-74 was 35.70kg for men which is higher than in this study (29.94kg) and 22.60kg for women (the mean handgrip strength for women in this study was 22.95kg) [38].

Conclusion

The impact of physical activity on the handgrip strength of elderly was examined in this study. It has been shown that during regular exercise, the strength of the handgrip increases. Among all the examinees there was no deterioration in handgrip strength of both hands which contributes to a better quality of life. Regular physical activity is the key to maintain the strength of muscles and prevent further injuries. Reduced handgrip strength is considered as one of the main predictors of disability, physical frailty and mortality and therefore elderly have to be encouraged to change their lifestyle and to be more aware of the importance of physical activity.

Practical implications of the findings are connected with benefits that elderly get from physical activity. We all know that recommendations for healthy ageing and fall prevention are directed on balance and strengthening the muscles of the entire body. On the other hand, this study shows that is necessary to promote physical activity in the old age as well as in the younger age in order to improve the quality of life. The measure that is defined as one of the main predictors of healthy ageing and whose value is directly affected by physical activity is the hand grip strength whose results are shown in this research.

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