SENIOR FITNESS TEST TO EVALUATE MUSCLE STRENGTH OF WOMEN AGED 50-80 IN KUJAWSKO-POMORSKIE VOIVODESHIP, POLAND

OCENA SIŁY MIĘŚNIOWEJ KOBIET W WIEKU OD 50 DO 80 LAT W WOJEWÓDZTWIE KUJAWSKO-POMORSKIM TESTEM SPRAWNOŚCI FIZYCZNEJ SENIORÓW

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ABSTRACT

Introduction. It is commonly known that the process of aging causes numerous barriers as far as social activity routines are concerned. **Aim.** The purpose of this study is to evaluate muscle strength on a sample of a chosen group of women above 50 years of age in Kujawsko-Pomorskie Voivodeship.

Material and methods. 3413 women, aged 50-80 years participated and were analyzed. They were divided into six age groups. Results and conclusions. All women were subjected to three muscle strength tests. The results of the "30-second Chair Stand", "Arm Curl" and "8-foot Up and Go" tests showed the decrease of muscle strength in women, depending on age from 18.3 repetitions to 15.3 repetitions ("30-second Chair Stand") and from 21.6 repetitions to 17.1 repetitions ("Arm Curl"). In the "8-foot Up and Go", which is a complicated test evaluating both explosive muscle strength and coordination, the time necessary for performing it elongates from 5.3 seconds in the youngest group to 6.3 seconds in the oldest group. Test results indicate unmistakably that muscle strength diminishes with age. Secondly, muscle strength reduction is equally related to both upper and lower limbs. 8-foot Up and Go test, which may also be used to evaluate the risk of falling, shows that it is of great importance to shape this ability since it declines in the quickest way.

KEYWORDS: muscle power, physical activity, Senior Fitness Test, elderly women.

STRESZCZENIE

Wstęp. Powszechnie wiadomo, że proces starzenia jest przyczyną wielu barier w aktywności społecznej i budzi on zainteresowanie badaczy. Cel. Celem tego badania była ocena siły mięśniowej grupy kobiet powyżej 50. roku życia w województwie kujawsko-pomorskim. Materiał i metody. Badaniu zostało poddane 3413 kobiet między 50 a 80 rokiem życia, które podzielono na sześć grup wiekowych. Wyniki i wnioski. Wyniki trzech przeprowadzonych testów: "30sekundowy test wstawania z krzesła", "test zginania stawu łokciowego z obciażeniem" i test "wstań i idź 2,5 m" pokazuja spadek siły mięśniowej kobiet zależny od wieku. W "30-sekundowym teście wstawania z krzesła" średnia ilość powtórzeń zmniejszyła się z 18,3 w najmłodszej grupie wiekowej do 15,3 w najstarszej wiekowo grupie. Spadek ilości wykonywanych powtórzeń wystąpił również w teście "zginania w stawie łokciowym" z 21,6 powtórzeń do 17,1 powtórzeń. W teście "wstań i idź 2,5 m", który jest złożonym testem oceniajacym siłe eksplozywną kończyn dolnych i koordynacje, czas potrzebny na wykonanie tego zadania wydłużył się między najmłodszą a najstarsza grupa wiekowa z 5,3 sekundy do 6,3 sekundy. Przeprowadzone badania wyraźnie pokazuja, że pogorszenie się wyników testów jest skorelowane z wiekiem i w iednakowym stopniu dotyczy grupy mieśni kończyn górnych jak i dolnych. Test "wstań i idź 2,5 m", który może być również wykorzystywany do oceny ryzyka upadków pokazuje, że bardzo ważne jest kształtowanie tej zdolności, gdyż zanika ona najszybciej.

SŁOWA KLUCZOWE: siła mięśniowa, aktywność fizyczna, test sprawności seniorów, kobiety w wieku starszym.

Introduction

Aging of any society, either Polish or from any European country, draws our attention to physical limitations derived from this process. Due to this fact, it is crucial to determine the physical efficiency level since it is the primary indicator of elderly people's independent functioning level. According to the statistics forecasts, the number of people at post-productive age in Poland will increase from currently 6.5 million in 2011 to 9.5 million in 2030, and to 11.5 million in 2050 [1]. Supposedly, the lifespan in the simulation made by the Central Statistical Office [2] will elongate between 2010 and 2035 for men

from currently 71.4 years to 77.1 years and for women from currently 79.8 years to 82.9 years. The tatistically longer women's lifespan arouses the general interest in the problem of physical fitness of this sex [2, 3]. The process of aging is inevitable. Involution changes occurring within each individual frequently concur with diseases leading to even more limitations, therefore familiarizing with elderly people's physical fitness levels seems so vital. Knowledge gained while conducting the research will allow for a longer time to appropriately predict the most frequently appearing problems concerning general functioning and it will be a beneficial assistance while counteracting the ongoing disability. Research indicates that muscle strength is one of the most paramount elements affecting the elderly people's functioning efficiency [4, 5], and for this reason it is the subject matter of this study. Thanks to proper muscle strength maintenance, we are increasing our independence and we are decreasing the risk of falling [6, 7, 8].

Material and method

The subject population consisted of the Senior Physical Activity Regional Program participants. Testing was conducted in thirty four towns of Kujawsko-Pomorskie Voivodeship: Aleksandrów, Barcin, Brodnica, Brzoza, Bydgoszcz, Dąbrowa, Gąsawa, Gniewkowo, Grudziądz, Inowrocław, Kcynia, Koronowo, Lisewo, Lubicz, Łabiszyn, Mrocza, Nakło, Nowa Wieś Wielka, Nowe, Radzyń, Rogowo, Rynarzewo, Rypin, Sławęcinek, Służewo, Szubin, Świecie upon Osa, Tłuchów, Tupadły, Unisław, Włocławek, Zamość and Żnin. The sample of participants was chosen from a population of women aged 50-80. All people taking part in the study were obliged to provide the informed consent prior to participation as well as undergoing qualification tests conducted by a medical practitioner accompanied by the Master of Nursing. The purpose of the medical examination was to evaluate the subject's general health condition and also to eliminate those who, due to health problems, were not able to participate in physical exercises not typical for rehabilitation ones. The examination included an interview; blood pressure and heart rate measurement; ECG; lung auscultation; reflex, balance and color vision examining, followed by measurement of height, body mass, waist and hips. On this surface, the factor most specifically taken into consideration was the circulatory system and musculoskeletal efficiency. Chronic circulatory, respiratory and skeletal system diseases as well as neurological diseases were the criterion for exclusion from the physical fitness examination. Having consulted the specialists, women with pharmacologically settled hypertension and diabetes were allowed to participate in the study. After functional fitness levels

were assessed for all subjects, they were required to attend testing sessions conducted by the Master of Physical Therapy in order to measure their physical fitness. Each functional testing was performed in the afternoon, in the same order for every individual subject. Prior to testing, each subject was given instructions and shown how each exercise should be performed by a tester. Testing was conducted in rooms which were up to safety standards, with temperature 18-22°C, with a nurse present in the room. Three tests were used to evaluate the muscle strength of women participating in the study. These tests originate from the Fullerton test battery created by Roberta Rikli and Jessie Jones [9]. They included: 30-second Chair Stand, Up and Go for 2.5m as well as elbow joint bend with weight which was modified in comparison to the American version by introducing 2 kg dumbbell.

The subject population consisted of 3413 women, tested in 2007-2011. The whole group was divided into six age groups: 50-54, 55-59, 60-64, 65-69, 70-74 and 74-79 years. The average age in all age groups was 52.05 ± 1.59 in the first age group; 57.1 ± 1.39 in the second; 61.72 ± 1.39 in the third; 66.65 ± 1.42 in the fourth; 71.58 ± 1.37 in the fifth and 76.58 ± 1.44 in the last one (**Table 1**).

 Table 1. Characteristics of the subjects

	Age Group	Number of subjects	Age (year)		Body height (cm)		Body weight: (kg)		BMI	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	50-54	853	52.0	±1.6	162.1	±5.6	73.6	±13.5	28.0	±4.9
2	55-59	1131	57.1	±1.4	160.6	±6.1	73.2	±12.6	28.4	±4.6
3	60-64	884	61.7	±1.4	160.4	±5.4	73.0	±12.8	28.4	±4.7
4	65-69	350	66.6	±1.4	159.4	±5.9	74.0	±12.7	29.1	±4.9
5	70-74	145	71.6	±1.4	159.2	±5.7	72.2	±11.2	28.3	±3.9
6	75-79	50	76.6	±1.4	157.6	±7.0	69.6	±9.2	28.1	±3.8

Source: author's own analysis

Results

All participants of the study performed all three tests. In 30-second Chair Stand test, which evaluates lower limbs global muscle strength and specifically one related to quadriceps, the most repetitions 18.3 ± 3.9 were performed by women from the youngest group (50-54 years). In the second age group (55-59 years) the result was 17.8 ± 3.7 repetitions. In the next age group, 60-64 years, the result was only a little worse: 17.6 ± 3.7 . The result of the fourth age group (65-69 years) was also a little worse than in the third age group and it was 17.2 ± 3.6 repetitions. In the last two age groups the results

were also weaker than in the previous ones and were, respectively, for a 7-74 years group 16.2 ± 3.6 repetitions and for a 75-79 years group 15.3 ± 3.8 repetitions.



Figure 1. The data show the level of muscle power in six age groups with division into: \blacklozenge -10 percentage, \blacktriangle - 50 percentage, \blacksquare - 90 percentage. The trend line shows decreased muscle power with the following age groups, occurring one after another

Source: author's own analysis

The percentile ranks for the "30-second Chair Stand" test for the subjects can be seen in **Table 2**.

Table 2. Percentile Ranks for the "30-second Chair Stand"

30-second Chair Stand							
	% Rank	50-54	55-59	60-64	65-69	70-74	75-79
	90	24	23	22	22	20,7	19,1
	80	22	21	20	20	19	18
	70	20	20	20	19	18	17
	60	19	19	19	18	17	15,4
	50	18	18	18	17	16	15
	40	17	17	16	16	15	14
	30	16	16	15	15	14	13
	20	15	14	14	14	13	12,8
	10	14	13	13	13	12	11
	\overline{x}	18,3	17,8	17,6	17,2	16,2	15,3
	SD	3,9	3,7	3,7	3,6	3,6	3,8
	n	853	1131	884	350	145	50

Source: author's own analysis

In the Arm Curl test, which evaluates the upper limb muscle strength and especially one of the biceps of the arm and brachioradialis, the results were as follows. In the first age group (50-54 years) the outcome was the best, namely 21.6 \pm 3.6 repetitions. In the second age group (60-64 years) the result was a little worse, giving 20.4 \pm 3.4 repetitions. For women in a 65-69 years group the average result was also a little worse than in the previous group, namely 20.1 \pm 3.7 repetitions. In the result was worse by on average 1 repetition and was 19.2 \pm 3.8.

In the oldest age group (75-79 years) the result was on average worse by 2 repetitions in comparison to the previous age group, giving 17.1 ± 4.3 repetitions.



Figure 2. The data show the level of muscle power in six age groups with division into: ◆ -10 percentage, ▲ - 50 percentage, ■ - 90 percentage. The trend line shows decrease muscle power with the following age groups, occurring one after another Source: author's own analysis

The percentile ranks for the "Arm Curl" test for the subjects can be seen in **Table 3**.

Arm Curl (2 kg)							
% Rank	50-54	55-59	60-64	65-69	70-74	75-79	
90	26	25	25	24	25	22	
80	24	24	23	23	22	20	
70	23	22	22	22	21	19	
60	22	21	21	21	20	18	
50	21	20	20	20	19	17	
40	20,6	20	20	19	18	16	
30	20	19	19	18	17	16	
20	19	18	18	17	16	14,6	
10	17	16,2	16	16	15	11,8	
\overline{x}	21,6	20,8	20,4	20,1	19,2	17,1	
SD	3,6	3,5	3,4	3,7	3,8	4,3	
Ν	853	1131	884	350	145	50	

Source: author's own analysis

In the last test of this study – 8-foot Up and Go – the following data were obtained. The best result was achieved by women from the first group (50-54 years): 5.3 ± 3.7 seconds. The weakest result, although worse only by a second in comparison to the best result, was achieved by women from the oldest group (75-79 years), namely 6.3 ± 1.4 s. The other results were, respectively, for the second group (55-59 years) 5.5 ± 2.2 s; for the third group of women (60-64 years) 5.6 ± 0.7 s. For women in a 65-69 years age group the result was 5.9 ± 0.9 s and for women aged 70-74 years 6 ± 1.8 s.



Figure 3. The data show the level of coordination in six age groups with division into: \blacklozenge -10 percentage, \blacktriangle - 50 percentage, \blacksquare - 90 percentage. The trend line shows decrease coordination with the following age groups, occurring one after another Source: author's own analysis

The percentile ranks for the "8-Foot Up and Go" test for the subjects can be seen in **Table 4**.

Table 4. Percentile Ranks for the "8-Foot Up and Go"

8-Foot Up and Go							
	% Rank	50-54	55-59	60-64	65-69	70-74	75-79
	90	6,1	6,3	6,5	7	7,2	7,7
	80	5,8	6	6,1	6,5	6,6	7,3
	70	5,5	5,8	5,9	6,3	6,4	6,8
	60	5,4	5,5	5,7	6,1	6,1	6,6
	50	5,2	5,3	5,5	5,9	5,9	6,3
	40	5	5,2	5,3	5,7	5,8	5,9
	30	4,9	5	5,2	5,4	5,5	5,6
	20	4,7	4,8	5	5,2	5,3	5,4
	10	4,4	4,5	4,7	4,9	5,1	5,2
	\overline{x}	5,3	5,5	5,6	5,9	6	6,3
	SD	1,6	2,2	0,7	0,9	1,8	1,4
	n	853	1131	884	350	145	50

Source: author's own analysis

Discussion

Elderly people's physical fitness deterioration is facilitated mainly by changes occurring in the muscular system. The most crucial factor for functional limitations development is sarcopenia [10], i.e. muscle mass atrophy happening with passing time and affecting, at the same time, generated muscle strength diminishing. These degenerative changes, which happen within motoneurons together with lowering of their number and lowering neurotransmitters activity, contribute to elderly people's fitness limitation [11, 12]. The outcome of involution changes of the muscular system, which is additionally empowered by the lack of activity, is a loss of the possibility to generate by muscles the strength big enough to control posture and keep balance. This

is directly linked to everyday fitness. It is demonstrated by slowing down movements, difficulties while walking and going down the stairs, a problem while getting up from a chair, difficulties with lifting objects off the floor; the feeling of weakness, balance disorders and falling while walking. Numerous studies confirm a connection between lower physical fitness and occurring of everyday functioning limitations [13]. The results of two vast studies, one European and the other American [14, 15] indicate that low muscle strength directly influencing the correct walking pattern disturbance as well as having an impact on limiting activities, such as moving heavy objects, kneeling, squatting, bending are the most crucial factors causing the very functional disability to happen. Along this line, it is of paramount importance to take action to improve fitness, which will result in everyday functioning improvement [16, 17].

In the study conducted by our team, a very big group of women aged 50-80 years was evaluated. The whole group was divided into 5-year intervals, which makes it possible to compare two out of three tests with Rikli and Jones's American findings. In our Arm Curl test the results in age groups 60-64 years, 65-69 years, 70-74 years and 75-79 years fall within the upper ranges of American norms created by Jones and Rikli [18]. The results obtained in 8-foot Up and Go from the same four groups also fall within the upper ranges of American norm. In relation to a comparable group of women examined in the studies conducted by Jones & Rikli and our team, fitness of both these populations seems to be on a similar level as far as this parameter is concerned. It means that both populations are faced with similar challenges to improve these parameters and find possibilities to put into action the same program aiming at improving these parameters in order to make life better.

In a 30-second Chair Stand test it is easy to notice that in a population of women with the best results there is a clear downslide tendency with passing age. In the population of women with the weakest results a downslide tendency is also noticeable. It proves that together with passing age the difference between women with best results and those with the weakest ones is getting smaller. There is a probability that this situation is partly caused by women getting less active with age, which is generated by them being less willing to exercise – both in the stronger group and, the more, in the case of the weaker one – as well as by limitations concerning each individual's age-generated ailments.

In the Arm Curl test the outcome indicates that in the group of women with the weakest results the downslide tendency is big with passing age, whereas in the group of women with the best results the downslide of values is not so big anymore. Supposedly, women who achieve good test results in the younger age groups, continue this activity while getting older through everyday activities, such as carrying shopping or lifting objects off the floor. It is also alleged that women who in the youngest groups had already achieved the weakest results, with passing time probably took advantage of other people's assistance more and more often as far as activities demanding more strength than the necessary functional minimum is concerned. Consequently, they continued on making their muscle strength deteriorate. The submitted assumptions coincide with the interview with the participants during the test.

In the 8-foot Up and Go test the findings show that, both in groups of women obtaining the best results and in groups of women obtaining the weakest results in comparison to the whole studied population, there was a deterioration of results with progressive age of the studied groups. The differences in results in successive age groups were not big, which demonstrates that diminishing of explosive strength within lower limbs muscles as well as movements coordination occurs at an early stage of aging of all studied individuals. It also demonstrates that special emphasis should be placed upon this element of fitness, which was under scrutiny in this sophisticated coordination test, while creating preventive programs.

Grześkowiak and Weliński [19] in their study compared both calibrated tests: 8-foot Up and Go and Tinetti test, creating a measuring scale for them and evaluating them statistically. It turned out that there was a strong dependence between them, which allowed for using the 8-foot Up an Go test to evaluate the risk of falling for women after 65 years of age.

In Europe there were several studies on fitness using Fullerton test, but none of them embraced such a big group of women divided into age groups. One of those studies was performed on a sample of elderly people, whose average age was 74 years, in the capital of Portugal. 405 persons participated, out of whom 70% were women. Tests applied to evaluate lower limbs strength were performed: 30-second Chair Stand, in which the average result was 15.55 repetitions and 8-foot Up and Go, in which the average obtained time was 6.22s [20]. Another study was conducted in Serbia by Kostić on 694 women in two age groups. The first age group was 60-69 years where average age was 64 years and the test results were, respectively, for the Arm Curl 13.67 repetitions, for the 30-second Chair Stand 13.75 repetitions and for the 8-foot Up and Go 6.67s. In the second age group: 70-80 years, in which the average age was 74 years, the test results were as follows: for the Arm Curl 15.76 repetitions, for the 30-second Chair Stand 12.51 repetitions and for the 8-foot Up and Go 7.46s [21].

In Poland, during the last ten years not many studies on elderly people's fitness were conducted with the use of the Fullerton test. Usually, there are studies conducted by the same study groups on small samples of people. Strength of populations examined in these studies shows guite a significant diversity of them in comparison with American created by Rikli and Jones. In one of the studies by Ignasiak and the team in 2011 on a population of 31 women with the average age of 67 years, the results were definitely better for the population of Polish women as compared to American women in the case of both upper and lower limbs [22]. Other studies by Ignasiak and the team in 2011 on a group of 134 women between 55 and 70 years of age, with the average of 62.54 years, show the average results for this group; for the Arm Curl test 21.24 repetitions and for the 30-second Chair Stand test 17.47 repetitions [23]. In turn, the study by Ignasiak and the team in 2013 conducted on a group of 37 women between 55 and 64 years of age, with the average age 59.46 years for this population, staying at that time in the sanatorium, also demonstrated the results for the Arm Curl test: 17.46 repetitions, for the 30-second Chair Stand 14.32 repetitions and for the 8-foot Up and Go 7.33s [24].

Studies conducted by Zdrodowska in 2012 on a population of 40 women in two age groups 60-64 and 65-70 years, in which the average age was for the first group 62 years and for the second one 68, also showed better results of Polish participants in comparison to American ones [25]. The findings of Dziubek and the team in 2014 studies, conducted on a group of 53 women divided into two groups with the average age 69.5, showed the difference between these study groups in which the procedure was performed in accordance with the Fullerton test in the aspect of lower limbs muscle strength. This study demonstrated that the results of both groups were within American norms [26].

There were also a few studies conducted on a bigger population of people. However, there was no division into age groups in five-year intervals. The researchers from Wrocław conducted a study on a group of 216 women between 50 and 84 years of age, with the average 65.2 years and presented the following results: for the Arm Curl 16.8 repetitions, for 30-second the Chair Stand 20.43 repetitions and for the 8-foot Up and Go 5.46s [37].

However, the study conducted by Król and the team in 2006 on a sample of 125 women, with the average age of 74 years, comparing Polish results with American ones indicated that in the tested groups of 60-69 years and above 80, Polish women achieved better results than American ones within upper and lower limbs strength. But in the age group 70-79 years the results were more beneficial for Americans, the differences in both studies being on average one repetition per test, however, a 30 times smaller Polish study group did not allow to certify whether the differences between the results would be similar, as in the case of this study with a bigger population of participants [28].

In 2009 there was a study in Żoliborz and Bielany, Warsaw on a sample of 236 women aged 65, also with the assistance of the Fullerton test and the results were as follows: for the 30-second Chair Stand 14.29, for the Arm Curl 17.89 repetitions and for the 8-foot Up and Go 6.26s [29].

The biggest study was conducted by Zieliński in 2002-2005 on a group of 1017 women living in the whole of Poland, in which the average age was 73.2 years. They performed tests: 30-second Chair Stand and 8-foot Up and Go and they were compared with an American group from the study by Rikli and Jones with a division into age groups between 65 and 94 years of age in 5-year intervals. It turned out that the population of Polish women was worse in both tests than the American one, out of which in the standing test this difference was smaller – 2 repetitions on average [30].

Szczepaniak's team conducted an interesting study depicting how the disease process and structural disorders influence the elderly people's fitness. He examined 30 women suffering from osteoporosis, with the average age 69.9 years and he demonstrated that the muscle strength test resulted in comparison to other Polish researchers' studies performed on the healthy people population as well as American norms, were worse by half [31]. This study showed how any physiological processes disorders were reflected in the physical tests. Nevertheless, it also presented another important aspect, namely, a big utility of upper and lower limbs muscle strength tests. Those tests may also be performed on patients apart from everyday activity tests, such as ADL or IADL, for people who undergo the process of rehabilitation [32].

In numerous studies on physiology of exertion and gerontology focusing on organism aging processes [33] and limitations resulting from them, the role of physical activity is being accentuated, especially the role of strength training in the longer run of functional independence upkeeping [34, 35].

Thanks to our study as well as other researchers' work, we can get familiarized with elderly people's fitness, especially their abilities to generate muscle strength as an ability of a muscle to overcome a certain resistance. It depends on numerous factors: physiological muscle section surface, quantitative relation of fast twitch muscle cells to slow twitch, intermuscular and intramuscular coordination and neuromuscular coordination [36, 37].

Therefore, it is of great importance to create activity programs for this age group so that this will not cause injuries and complications due to activity being taken up. One needs to remember that elderly people's movement possibilities are smaller than those of middle-aged people. However, health training must become an inevitable element of this population's life. For this reason, it is crucial to adjust the appropriate method of increasing which will be at the same time applicable to those people's possibilities. This kind of training will not only ensure mobility which allows to do a lot of sophisticated everyday life activities and, thus, will avert the time of the need for other people's assistance, but it will also at the same time influence other health factors improvement, which is demonstrated by many studies [38]. In relation to that, elderly people's programmed activity must be introduced into preventive programs which are destined for this age group in order to make this phase of life a functionally safer and more satisfactory one.

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