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ASSESSMENT OF PHYSICAL FITNESS AMONG PEOPLE OVER 60 YEARS OF AGE

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Abstract:

Introduction: An ageing of population is becoming more and more common. With age, the functionality and efficiency of the body decreases. As a result, the time spent by seniors on physical activity is shortened and physical fitness decreases. For this reason, the physical fitness of seniors should be regularly checked and they should be encouraged to take up physical activity. There are many proven and reliable tests used to assess physical fitness.

Materials and methods: The study group consisted of 40 people (31 women and 9 men), aged 60-78 years. The tests used in following study were: the SPPB questionnaire, handgrip strength test, and arm and calf circumference measurements. An attempt was made to find sociodemographic factors that could influence the level of physical fitness. It was

checked whether physical fitness and physical activity depend on age, gender and BMI. It was checked how much time older people spend on physical activity during the day and week. The study confirmed that physical fitness decreases with age.

Results: Tests and interviews have shown that people who spend more than 60 minutes a day on physical activity achieve higher scores on the SPPB questionnaire. These results were applicable to both women and men. Studies in a larger and more diverse population would need to be repeated in order to further confirm these results and draw more conclusions.

Key words: older adults, physical fitness, physical activity

Introduction:

Life expectancy is increasing in many countries. It is the main cause of population ageing [1]. The great success, which is undoubtedly the extension of the average human life span, also has the other side of the coin – social, economic and health dilemmas. The increase in life expectancy is faster than the increase in the number of years of life spent in good health [2]. Inevitable processes that intensify with age include: decrease in the body's functionality – decrease in efficiency – decrease in muscle mass and strength (the most common cause is sarcopenia), deterioration of the endocrine system, as well as prolongation of reaction time [3]. In addition to strength, muscle flexibility and the ability to maintain balance are also impaired [4]. Which ultimately has an impact on the deterioration of quality of life (QOL) [5].

Senility is a time when the occurence of many diseases increases. This fact is inextricably linked to lower levels of physical fitness in the elderly [4]. Reduced self-reliance in activities of daily living and mobility is the most common symptom of low health in this population [6]. Physical inactivity is the cause of 9% of all deaths among elderly [7]. Reducing the amount of time spent sitting is one of the goals of global public health care [8]. It is a fact that regular exercise improve the efficiency of the circulatory system. Moreover, they have a beneficial effect on the prevention of falls, and have a good effect on muscle strength [3]. Undertaking physical activity has a positive effect on physical fitness (PF) [1], [9], [10], [11]. Maintaining PF at an appropriate level leads to maintaining the physical well-being of seniors. PF is made up of several components: muscle strength, muscular endurance, flexibility, ratio of body fat volume to lean tissue, and cardiorespiratory fitness [9], [12], [13].

Besides, PF includes: static and dynamic balance and gait speed [13]. Both regular physical activity and physical fitness are among the most important factors indicating health well-being [11], [14].

Recommendations for older people highlight the need of achieving a higher level of physical activity than the suggested minimum activity for adults. Following the guidelines helps maintaining independence from others and staying in good health. Unfortunately, it is still common to see a decrease in the level of exercise intensity and physical fitness in this population [9]. The higher the physical fitness, the more energy the body has to cope with everyday activities, work or other tasks that we set for ourselves. What's more, physical fitness and cardiorespiratory fitness trained even in a moderate way can contribute to reducing the risk of certain cancers, cardiovascular events, civilization diseases, metabolic syndromes, and even mortality in general [12].

The use of appropriate fitness tests (adapted to the elderly) allows for a reliable assessment of physical fitness and the level of independence [1]. The aim of the study was to assess physical activity and fitness levels among people over 60 years of age.

Materials and methods:

The participants of the study were 40 people (31 women and 9 men), aged 60-78, with a high degree of independence.

Inclusion criteria: written consent to participate in the study, 60 years of age or older, physical and mental condition enabling independent functioning, no impediments to communication.

Study exclusion criteria: severe cognitive impairment, history of stroke event, advanced Parkinson's disease, advanced osteoporosis.

The consent of the Bioethics Committee (nr: KB 483/2023) was obtained to conduct the research.

The tested people were subjected to an original questionnaire. Basic anthropometric features were measured: height [cm] and body weight [kg]. On their basis, the BMI indices of the respondents were calculated.

Clinical fitness tests used in the study:

a) SPPB (Short Physical Performance Battery) test – performed according to commonly used principles. Time was measured when was needed.

   The start of each part of the study took place at the voice command of the researcher, after making sure that the tested person was ready. For each of the three stages of the

SPPB test, the subject could accumulate from 0 to 4 points – the bigger score, the more efficiently he coped with the task. The total maximum score is 12 points, with a higher number indicating better physical fitness [6], [14], [15].

b) Handgrip strength test – the test is performed in a sitting position, using a dynamometer. Before proceeding, we make sure that there are no dysfunctions of the patient's wrist and hand. The patient places their hand in a neutral position, with their thumb aiming up to the ceiling. The researcher demonstrates the correct use of the device. We check if the indicator needle shows "0" and pass the dynamometer to the participant. The test subject squeezes the tool using maximum force for a few seconds. During the test, we encourage and motivate them verbally to achieve the highest possible result. The subject performs the task separately with both the left and right hand. The test can be repeated several times, the highest score achieved is recorded. The better the result, the higher the physical fitness [6], [16], [17].

c) Arm and calf circumference measurements – arm circumference is tested with a tape measure. The subject is placed in a standing position, with the upper limbs freely lowered. The measurement is made at the thickest point of the arm, then we check the circumference in the other upper limb [18], [19].

   The calf circumference is also examined using a tailor's tape measure. The subject is placed in a sitting position. The measurement is made at the thickest point of the calf, then we check the circumference in the other lower limb [18], [20].

Statistical tools:

The relationships between the variables were verified using:

Test X2 Pearson: A nonparametric test used to examine the relationship between two variables measured on a qualitative scale. Statistically significant result $p < 0.05$ indicates that the relationship between the variables was present and the strength of the relationship is measured by the coefficient V Cramer.

U Mann-Whitney test: a nonparametric test used to compare the average level of the dependent variable between two independent groups of observations. Statistically significant result $p < 0.05$ indicates differences between the groups. The magnitude of the differences between the groups is determined by the r.

Spearman's rho correlation analysis: a nonparametric test used to examine the relationship between two variables measured on a quantitative or ordinal scale. Statistically significant result $p < 0.05$ indicates that there was a relationship between the variables. Rho Value can be in the range of -1 to 1 where values closer to -1 indicate a strong negative correlation and values closer to 1 indicate a strong positive correlation.

Results:

Characteristics of the study group (Table I):

The study group consisted of $N = 40$ people, of which 77.5% were women and 22.5% men. The subjects were between 60 and 78 years old, with the mean age being 68.53 years with a deviation of 4.52 years. On the basis of the height and body weight of the subjects, their BMI index was calculated, which was between 19.38 – 40.40 kg/m2, and the average was 27.14 kg/m2 with a deviation of 5.02 kg/m2. 40% of people had a normal body weight, 32.5% of people were overweight, 20% were obese of the first degree, 5% of them were obese of the second degree, and 1 person (2.5%) was obese of the third degree. In terms of education, the study group was dominated by people with vocational education (35%) and secondary education (30%), and a smaller percentage were people with higher education (22.5%) and primary education (12.5%). The respondents tended to live in small towns (72.5%), and a smaller percentage lived in rural areas (25%) or large cities (2.5%). Slightly more than half of the respondents (52.5%) worked physically, and another 25% did white-collar work, 20% did office work, and 1 person ran their own business. During the day, the respondents usually spent more than 60 minutes (65%) on physical activity, and less often between 46-60 minutes (7.5%), between 31-45 minutes (17.5%), and a small percentage spent only 16-30 minutes (7.5%) or up to 15 minutes (2.5%) on activity during the day. In the past, the subjects were usually physically active 6-7 days a week (67.5%), and less often between 4-5 days (10%), between 2-3 days (20%) or less (2.5%, 1 person). Currently, 57.5% of the respondents practiced sports, and these were usually Nordic walking, Zumba, swimming and team games. One of the respondents practiced competitive sports, while the others exercised recreationally. The characteristics of the group are shown in Table I.

Table I. *Characteristics of the study group*

	N	*%*		*N*	*%*
Sex			**Professional group**		
Woman	31	77,5%	Blue-collar worker	21	52,5%
Man	9	22,5%	White-collar worker	10	25,0%
Age			Office Worker	8	20,0%
60-65 years	13	32,5%	Own activity	1	2,5%
66-70 years	15	37,5%	**How much time do you spend on physical activity per day?**		
71-75 years	9	22,5%	0-15 min	1	2,5%
76-80 years	3	7,5%	16-30 min	3	7,5%
BMI index			31-45 min	7	17,5%
Norm	16	40,0%	46-60 min	3	7,5%
Overweight	13	32,5%	Over 60 min	26	65,0%
First degree of obesity	8	20,0%	**How often have you been physically active in the past?**		
Obesity of the second and third degree	3	7,5%	0-1 days a week	1	2,5%
Education			2-3 days a week	8	20,0%
Basic	5	12,5%	4-5 days a week	4	10,0%
Vocational	14	35,0%	6-7 days a week	27	67,5%
Secondary	12	30,0%	**Have you played any sport?**		
Higher	9	22,5%	No	17	42,5%
Domicile			Yes	23	57,5%
Village	10	25,0%	**Have you practiced this sport(s) professionally or recreationally?**		
City up to 100,000 inhabitants	29	72,5%	Recreationally	22	55,0%
A city with more than 100,000 inhabitants	1	2,5%	Competitive	1	2,5%

The surveyed seniors assessed their health status between 5-9 points (on a scale of 1-10 points), and the average was 7.80 points. In the SPPB test (Table II) on the lower limb endurance and strength scale, 82.5% received 4 points, and 17.5% received 3 points, with the time between

7.09-13.3 seconds with an average of 9.93 seconds and a deviation of 1.55 seconds. On the gait speed scale, 95% received 4 points and 5% received 3 points, with a time between 2.8 – 5.9 seconds with an average of 3.73 seconds and a deviation of 0.62 seconds. On the static balance rating scale, 90% of people scored 4 points and 10% received 3 points. In total, the respondents obtained between 9 and 12 points in the SPPB questionnaire, with as many as 82.5% receiving the maximum number of points, 7.5% receiving 11 points, 7.5% receiving 10 points, and one person (2.5%) receiving 9 points. Therefore, 97.5% of people had results indicating no restrictions, and one person (2.55) had SPPB questionnaire results indicating slight limitations.

Table II. *Results of the SPPB questionnaire*

	N	*%*		*N*	*%*
Assessment of endurance and strength of lower limbs [pts]			**SPPB questionnaire [pts]**		
3 points	7	17,5%	9 points	1	2,5%
4 points	33	82,5%	10 points	3	7,5%
Gait speed assessment [pts]			11 pts	3	7,5%
3 points	2	5,0%	12 points	33	82,5%
4 points	38	95,0%	**SPPB questionnaire**		
Static equilibrium assessment [pts]			No restrictions	39	97,5%
3 points	4	10,0%	Slight limitations	1	2,5%
4 points	36	90,0%			

Table III below provides descriptive statistics for the handgrip strength test. Overall, in the handgrip strength test, the test subjects had between 14.5 – 39 kg with an average of 25.28 kg and a deviation of ± 6.99 kg. In the right hand, the subjects obtained maximum results between 15 – 38 kg with an average of 25.49 kg and a deviation of ± 6.69 kg, and in the left hand between 13 – 41 kg with an average deviation of 25.06 kg ± 7.47 kg. In the handgrip strength test, 2 people (5%) had a poor score, 28 people (70%) had an average score, and 10 people (25%) had a high score.

Table III. *Descriptive Statistics for the Handgrip Strength Test*

Handgrip strength Test	*Min*	*Max*	*M*	*SD*	*Me*
Right Hand	15	38	25,49	6,69	25
Left hand	13	41	25,06	7,47	25
Total	14,5	39	25,28	6,99	24,25

Min – minimum, *Max* – maximum, *M* – mean, *SD* – standard deviation, *Me* – median

The next table IV contains descriptive statistics for limb circumference. Overall, the arm circumference in the study group was 23 – 40 cm with an average of 28.63 cm and a deviation of 4.45 cm.

In the case of the right arm, the subjects had circumferences between 23 – 40 cm with an average of 28.66 cm

and a deviation of 4.33 cm, and in the case of the left arm, the subjects had circumferences between 22 – 40 cm with an average of 28.60 cm and a deviation of 4.61 cm. The calf circumferences of the subjects ranged from 29 to 46 cm with an average of 36.08 cm and a deviation of 3.70 cm. Right calf circumference

in the examined subjects was 29 – 46 cm with an average of 35.94 cm and a deviation of 3.74 cm, and the circumference of the left calf between 29 – 46 cm with an average of 36.321 cm and a deviation of 3.72 cm.

Table IV. *Descriptive statistics for limb circumference*

Limb circumference	*Min*	*Max*	*M*	*SD*	*Me*
Right Arm	23	40	28,66	4,33	28
Left Arm	22	40	28,60	4,61	28
Arm in general	23	40	28,63	4,45	27,75
Right calf	29	46	35,94	3,74	35
Left calf	29	46	36,21	3,72	35
Calf in general	29	46	36,08	3,70	35

Min – minimum, *Max* – maximum, *M* – mean, *SD* – standard deviation, *Me* – median

Analysis of results:

In the first place, it was examined whether there was a relationship between gender, age and BMI of the examined people with the declared physical activity. For this purpose, a serie of analyses with *X2* Pearson test was carried out. Table V presents the results of these analyses for the *X2* Pearson. The results of these analyses turned out to be statistically insignificant $p > 0.05$. Both women and men rated their physical activity highly.

Table V. *The relationship between gender and physical activity in seniors*

		Woman		Man		*V*	*p*
		N	*%*	*N*	*%*		
Time per day to be active	Less than 60 min	11	35,5%	3	33,3%	0,02	0,905
	Over 60 min	20	64,5%	6	66,7%		
Frequency of activity in the past	Up to 5 days	9	29,0%	4	44,4%	0,14	0,385
	6-7 days a week	22	71,0%	5	55,6%		
Playing sports	No	14	45,2%	3	33,3%	0,10	0,527
	Yes	17	54,8%	6	66,7%		
Physical Fitness Assessment	≤ 7 points	8	25,8%	3	33,3%	0,08	0,877
	8 points	14	45,2%	4	44,4%		
	9 points	9	29,0%	2	22,2%		

V - strength of the V Cramer relationship, *p* - level of statistical significance

Similarly, by means of *X2* Pearson analyses were carried out and examined the relationship between age and physical activity in seniors. The results of these analyses are presented in Table VI and can be concluded that there was no statistically significant $p > 0.05$ of the relationship between age and physical activity of seniors. Regardless of age, the majority of seniors declared high physical activity.

Table VI. *The relationship between age and physical activity in seniors*

		Up to 69 years		For 70 years		*V*	*p*
		N	*%*	*N*	*%*		
Time per day to be active	Less than 60 min	8	36,4%	6	33,3%	0,03	0,842
	Over 60 min	14	63,6%	12	66,7%		
Frequency of activity in the past	Up to 5 days	7	31,8%	6	33,3%	0,02	0,919
	6-7 days a week	15	68,2%	12	66,7%		
Playing sports	No	11	50,0%	6	33,3%	0,17	0,289
	Yes	11	50,0%	12	66,7%		
Physical Fitness Assessment	≤ 7 points	7	31,8%	4	22,2%	0,19	0,479
	8 points	8	36,4%	10	55,6%		
	9 points	7	31,8%	4	22,2%		

V - strength of the V Cramer relationship, *p* - level of statistical significance

Also with the help of *X2* Pearson test analyses were carried out and examined the relationship between BMI and physical activity in seniors. The results of these analyses are presented in Table VII and conclude that there was no statistically significant $p > 0.05$ correlation between body mass index (BMI) and physical activity in seniors. Regardless of BMI, the majority of seniors declared high physical activity.

Table VII. *The relationship between BMI and physical activity in seniors*

		Norm		Overweight		Obesity		*V*	*p*
		N	*%*	*N*	*%*	*N*	*%*		
Time per day to be active	Less than 60 min	8	50,0%	3	23,1%	3	27,3%	0,26	0,261
	Over 60 min	8	50,0%	10	76,9%	8	72,7%		
Frequency of activity in the past	Up to 5 days	7	43,8%	3	23,1%	3	27,3%	0,20	0,452
	6-7 days a week	9	56,3%	10	76,9%	8	72,7%		
Playing sports	No	7	43,8%	6	46,2%	4	36,4%	0,08	0,882
	Yes	9	56,3%	7	53,8%	7	63,6%		
Physical Fitness Assessment	≤ 7 points	4	25,0%	5	38,5%	2	18,2%	0,18	0,617
	8 points	6	37,5%	6	46,2%	6	54,5%		
	9 points	6	37,5%	2	15,4%	3	27,3%		

V - strength of the V Cramer relationship, *p* - level of statistical significance

The aim of the study was also to assess the relationship between the sociodemographic characteristics of the respondents and their physical activity with the results of the SPPB questionnaire. These compounds were verified by *X2* Pearson assay analyses and the results are shown in Table VIII. However, these results turned out to be mostly statistically insignificant $p > 0.05$. Only a statistically significant relationship between the SPPB questionnaire score and the assessment of daily activity was demonstrated $V = 0.35$; $p < 0.05$. Higher points in the SPPB questionnaire were obtained by people who declared physical activity for more than 60 minutes a day compared to people who spent up to 60 minutes a day. The relationship was moderately strong.

Table VIII. *The relationship between the sociodemographic characteristics of the surveyed people and their physical activity with the results of the SPPB questionnaire*

		Up to 11 points		12 points		*V*	*p*
		N	*%*	*N*	*%*		
Sex	Woman	6	19,4%	25	80,6%	0,09	0,567
	Man	1	11,1%	8	88,9%		
Age	Up to 69 years	2	9,1%	20	90,9%	0,24	0,122
	70 and more years	5	27,8%	13	72,2%		
BMI	Norm	3	18,8%	13	81,3%	0,14	0,658
	Overweight	3	23,1%	10	76,9%		
	Obesity	1	9,1%	10	90,9%		
Education	Basic	0	0,0%	5	100,0%	0,28	0,378
	Vocational	4	28,6%	10	71,4%		
	Secondary	1	8,3%	11	91,7%		
	Higher	2	22,2%	7	77,8%		
Professional group	Blue-collar worker	4	19,0%	17	81,0%	0,12	0,754
	White-collar worker	1	10,0%	9	90,0%		
	Other	2	22,2%	7	77,8%		
Domicile	Village	3	30,0%	7	70,0%	0,19	0,230
	City	4	13,3%	26	86,7%		
Time per day to be active	Less than 60 min	5	35,7%	9	64,3%	0,35	0,026*
	Over 60 min	2	7,7%	24	92,3%		
Frequency of activity in the past	Up to 5 days	4	30,8%	9	69,2%	0,24	0,125
	6-7 days a week	3	11,1%	24	88,9%		
Playing sports	No	5	29,4%	12	70,6%	0,27	0,088
	Yes	2	8,7%	21	91,3%		
Physical Fitness Assessment	≤ 7 points	2	18,2%	9	81,8%	0,02	0,992
	8 points	3	16,7%	15	83,3%		
	9 points	2	18,2%	9	81,8%		

V - strength of the V Cramer relationship, *p* – level of statistical significance, *$p < 0.05$

Table IX presents the results of analyses using the U Mann-Whitney tests for the comparison of women and men in terms of handgrip strength and limb circumference. These results showed no differences between men and women in terms of limb circumference $p > 0.05$, but such differences in the handgrip strength were shown $p < 0.001$. Taking into account the gender norms, it was shown that 6.5% of women and 0% of men had low strength, 71% of women and 66.7% of men had moderate strength, and 22.6% of women and 33.3% of men had high strength, and the difference in this respect was not statistically significant (*X2* Pearson test $V = 0.15$; $p = 0.631$).

Table IX. *Relationship of the sex of the test subjects with their strength test and limb circumference*

	Women			Men			*Z*	*p*	*r*
	M	*SD*	*Me*	*M*	*SD*	*Me*			
Total handgrip strength test [kg]	22,46	4,81	22	34,97	3,83	36,5	4,21	***	0,67
Right handgrip strength test [kg]	22,79	4,75	22	34,78	2,95	36	4,37	***	0,69
Handgrip strength test left [kg]	22,13	5,15	22	35,17	4,95	35	4,12	***	0,65
Total arm circumference [cm]	28,05	4,34	27,5	30,64	4,49	30	1,53	0,127	0,24
Circumference right arm [cm]	28,06	4,20	27	30,72	4,37	30	1,64	0,100	0,26
Circumference left arm [cm]	28,03	4,53	27	30,56	4,61	30	1,45	0,148	0,23
Total calf circumference [cm]	35,67	3,48	35	37,47	4,29	36	1,12	0,263	0,18
Right calf circumference [cm]	35,47	3,44	35	37,56	4,45	36	1,18	0,240	0,19
Left calf circumference [cm]	35,87	3,55	35	37,39	4,27	36	0,91	0,361	0,14

M – mean, *SD* – standard deviation, *Me* – median, *Z* – U Mann-Whitney statistic, *p* – level of statistical significance, *r* – magnitude of differences, *$p < 0.05$; ***$p < 0.001$

The next step was to investigate the relationship between the subjects' age, BMI and physical activity with their strength test and limb circumference. These relationships were verified by *Rho* Spearman correlation analyses and the results are shown in Table X. It was shown that the age of the respondents was statistically significantly related to the result of the SPPB questionnaire (*Rho* = -0.32; $p < 0.05$) and older people scored lower on this questionnaire. However, there was no relationship between age and strength test and limb circumference. Then, statistically significant relationships between the body mass index (BMI) in the studied people and their limb circumference were found, and these associations were positive, which means that people with a higher BMI had larger limb circumferences. It was also shown that a higher score in the SPPB questionnaire was obtained by people who spent more time during the day on physical activity *Rho* = 0.36; $p < 0.05$ and that people who had been practicing sports in the past had lower overall hand-squeezing force (*Rho* = -0.38; $p < 0.05$) both in the right hand (*rho* = -0.37; $p < 0.05$) and the left (*rho* = -0.35; $p < 0.05$.) There was no correlation between the self-assessment of the physical fitness of the examined subjects and their SPPB questionnaire score, squeezing force and limb circumference.

Table X. *The relationship between age, BMI and physical activity of the test subjects with their strength test and limb circumference*

	Age	BMI	Time per day per activity	Frequency Activity in the past	Assessment Efficiency Physical
SPPB Questionnaire	-0,32*	0,11	0,36*	0,29	0,01
Total handgrip strength test [kg]	0,18	0,01	-0,04	-0,38*	-0,06
Right handgrip strength Test [kg]	0,17	-0,02	-0,04	-0,37*	-0,09
Handgrip strength test left [kg]	0,17	0,04	-0,03	-0,35*	-0,05
Total arm circumference [cm]	-0,03	0,66***	0,05	-0,15	-0,08
Right arm circumference [cm]	-0,07	0,62***	0,04	-0,19	-0,08
Left arm circumference [cm]	0,01	0,70***	0,06	-0,13	-0,09
Total calf circumference [cm]	0,01	0,74***	-0,15	-0,26	-0,22
Right calf circumference [cm]	0,00	0,73***	-0,15	-0,26	-0,25
Left calf circumference [cm]	0,03	0,74***	-0,15	-0,26	-0,19

*$p < 0,05$; ***$p < 0,001$

Then, again by means of comparative analyses using the U Mann-Whitney test, it was examined whether there was a relationship between practicing sports in the past and strength test and limb circumference. The results of the analyses are presented in Table XI, but they were not statistically significant $p > 0.05$. Therefore, it cannot be concluded that in the study group people who practiced sports differ from people who do not practiced sports in terms of the strength of the squeeze or the circumference of the limbs.

Table XI. *The relationship between sports in the study group and their strength test and limb circumference*

	Lack of sport			Playing sports			*Z*	*p*	*r*
	M	*SD*	*Me*	*M*	*SD*	*Me*			
Total handgrip strength test [kg]	23,44	5,49	22	26,63	7,75	25	1,25	0,213	0,20
Right handgrip strength Test [kg]	24,15	5,38	22	26,48	7,48	25	0,89	0,373	0,14
Handgrip strength test left [kg]	22,74	5,68	22	26,78	8,26	25	1,44	0,150	0,23
Total arm circumference [cm]	29,19	5,23	27,5	28,22	3,86	28	0,38	0,701	0,06
Right arm circumference [cm]	29,18	5,13	27	28,28	3,71	28	0,25	0,805	0,04
Left arm circumference [cm]	29,21	5,36	28	28,15	4,04	28	0,47	0,641	0,07
Total calf circumference [cm]	36,29	4,93	35	35,91	2,55	35	0,48	0,631	0,08
Right calf circumference [cm]	36,06	4,87	35	35,85	2,74	35	0,43	0,669	0,07
Left calf circumference [cm]	36,47	5,05	35	36,02	2,42	35	0,54	0,591	0,08

M – mean, *SD* – standard deviation, *Me* – median, *Z* – U Mann-Whitney statistic, *p* – level of statistical significance, *r* – size of differences

It was also checked whether and how in the study group the fitness of people measured by the SPPB questionnaire was related to muscle strength and limb circumference. For this purpose, a *Rho* Spearman correlation analysis was also performed, and the results are shown in Table XII. It was shown that there were no statistically significant associations between the results of the SPPB questionnaire, the strength test and the circumference of the lower and upper limbs.

Table XII. *Relationship of SPPB Questionnaire Score to Their Strength Test and Limb Circumference*

	Questionnaire SPPB	Clamp force test total hands [kg]	Clamp force test right hand [kg]	Clamp force test dłoni lewa [kg]
Total handgrip strength test [kg]	-0,04			
Right handgrip strength test [kg]	0,00			
Left handgrip strength test left [kg]	-0,05			
Total arm circumference [cm]	-0,03	0,25	0,23	0,27
Right arm circumference [cm]	0,00	0,29	0,27	0,31
Left arm circumference [cm]	-0,06	0,22	0,19	0,25
Total calf circumference [cm]	0,02	0,11	0,10	0,11
Right calf circumference [cm]	-0,01	0,14	0,12	0,15
Left calf circumference [cm]	0,04	0,06	0,05	0,06

Discussion:

The aim of the study was to assess the physical fitness of people over 60 years of age. The physical activity of the subjects was also assessed. An attempt was made to investigate whether the level of physical fitness of the respondents depends on factors such as: the amount of time spent on physical activity during the day and week, age, gender, BMI. The

majority of the study group achieved very good results (as many as 82.5% of the respondents obtained the maximum number of 12 points in the SPPB questionnaire, as many as 65% of the respondents devote more than 60 minutes a day to physical activity). The results achieved in the SPPB questionnaire are higher than in other studies involving seniors [15], [21], [22] . Only one person did not achieve a result qualified as no restrictions, the remaining 39 people (97.5%) obtained a result in the range of 10-12 points. In the study of Welch et al., 43.4% of the respondents were in this range, in the study of Lauretani et al. the respondents achieved an average score of 6 points, in the case of Amasene et al. the average score was 5.4 [15], [21], [22] . As a result, the outcomes achieved in the individual components of the SPPB questionnaire - lower limb endurance and strength, gait speed and static balance - are also significantly different compared to other studies [15], [21], [22] . In the above study, the participants achieved mean results: the test of standing up and sitting on the chair five times – 9.93 seconds ± 1.55 seconds, the gait speed test: 3.73 seconds ± 0.62 seconds, the static balance test: 90% of the participants scored 4 points, 10% scored 3 points. These results contrast with the results of Amasene et al., where the average time achieved by the subjects in the test of standing up and sitting down in a chair five times was 19.6 seconds, walking speed – 8 seconds [22] . Results closer to this study were achieved by Lauretani et al. – a test of standing up and sitting on a chair five times – 11.24 sec, walking speed – 4.99 sec [15] . The differences in the results above may be caused by significant differences in the size of the study group (40 people to 417 - 604 people), lower average age, as well as too much homogeneity of the study group - most of the respondents came from a small town - as well as a radically different lifestyle and higher level of physical activity.

When it comes to the handgrip strength test, the majority of the test group (95%) achieved a result described as medium or strong. The average value obtained is 25.28 kg ± 6.69 kg. Men scored statistically significantly ($p<0.001$) higher than women. This is probably due to the naturally higher physical strength of the men, as no other statistically significant correlations were found between the results achieved and sociodemographic factors. Also in the gender comparison no significant differences were detected in terms of the level of physical activity or BMI. It is worth noting that the male group was not as numerous as the female group, which may also be the reason for the difference. Compared to other studies that take into account the force of the handgrip, the results obtained are more favorable. In a study by Lauretani et al. (2018), the average score was lower at 18.28 kg [15] . In Amasene et al. (2021), the average result is 19.6 kg [22] . In the study by Chan et al., the mean score was

slightly higher than in the previous examples, but lower than in the above study, with a mean result of 20 kg [23]. Differences in the results may again be caused by the size of the studied populations, the different lifestyles of the respondents, the average level of physical activity, the excessively high uniformity of the study group, as well as the different tool used to conduct the test and differences in the methodology of performing the test. Another factor that may have influenced the results of the test may have been the way the subjects were motivated; a more expressive encouragement by the researcher to exertion during the test could have resulted in a better performance of the subject.

Measurements of arm and calf circumferences were taken. There were no significant differences between the circumferences of the left upper and lower limbs with the right upper and lower limbs. Average results for women: shoulder – 28.05 cm, calf - 35.67 cm; for men: shoulder – 30.64 cm, calf – 37.47 cm. Average results for the whole group: shoulder – 28.63 cm, calf – 36.08 cm. Based on the results, no signs of malnutrition were found in the subjects. For comparison: Ong et al. in 1942 patients not affected by dementia achieved an average arm circumference of 27.51 cm [24] . Mazzini et al. studied 417 people with an average arm circumference score of 27.77 cm [25]. Schaap et al., on the other hand, examined 1307 people and obtained an average score of 30.5 cm [26]. Bricio-Barrios et al. studied 143 people with an average arm circumference of 32,9 cm [27]. The differences may have occured due to a higher average BMI in the study group than in the examples cited [24], [25], [26]. The Bricio-Barrios' group had a higher average BMI, which may have been the reason for the difference [27]. Phenotypic differences depending on geographical location may also be the cause- Ong et al. conducted research in Singapore, Mazzini in Brazil, Schaap in the Netherlands, Bricio-Barrios in Mexico. [24], [25], [26], [27].

A similar situation occurs with the circumference of the calf. The study group achieved a higher or similar average score than the populations studied by other researchers. Mazzini et al. studied 417 people with an average calf circumference of 32,49 cm [25]. Bricio-Barrios et al. studied 143 people with an average calf circumference of 35,8 cm [27]. De Souza Fernandes et al. studied 736 people with a median calf circumference of 35.6 cm (in this study, the median was 35 cm). She also suggested a different cut-off point in the context of an increased mortality risk of 34.5 cm, instead of the 31 cm assumed in the literature [28]. In a study by Rodrigues et al., the average calf circumference of 91 people studied was 32.6 cm [29] . Xu et al., on the other hand, studied 1216 people, whom they divided into two groups: a frail group and a non-frail group. The first group achieved an average calf

circumference of 28.04 cm, while the second group achieved a calf circumference of 31.54 cm. As a result of his research, he was able to determine the best cut-off point for the frailty, which was at the level of 28.5 cm in the calf circumference in women and 29.5 cm in men [30]. Differences in the results may be because of different sizes of the studied population, as well as differences in the average age of the respondents, their level of physical activity on a daily basis or the average BMI. The location of the study may also be important – Mazzini, de Souza Fernandes and Rodrigues conducted tests on Brazilians, Bricio-Barrios on Mexicans, while Xu conducted tests on Chinese, which may suggest different standards of body structure among the studied groups [25], [27], [28], [29], [30]. The reason for the differences may also be too little diversity in the study group.

During the analysis of the results, a highly statistically significant relationship between BMI and the size of arm and calf circumferences was noticed. A higher BMI meant higher circumference values. On the other hand, a higher BMI did not mean a higher handgrip strength, nor did it affect the level of physical activity of the subjects. Those with higher levels of physical activity performed better on the SPPB questionnaire. People over 70 years of age performed worse on the SPPB questionnaire than those in the 60-69 age range. Better scores on the SPPB did not imply higher scores on the handgrip strength test and on arm and calf circumferences. The effect of the subjects' self-esteem on their fitness and physical activity was not noticed. However, no one rated their physical fitness at 10/10, despite many results situated within the upper limits of the norms.

Conclusions:

Older age had a negative impact on the results achieved in the SPPB questionnaire. Daily physical activity, longer than 60 minutes, had a positive effect on the results achieved in the SPPB questionnaire. The male gender had a positive effect on the strength of the handgrip. A higher BMI had a positive effect on the size of the arm and calf circumferences. Practicing sports in past had a negative impact on the strength of the handgrip. There were only a few results that did not meet the generally accepted norms for the tests performed, which supports the idea that physical activity is related to physical fitness. Regular physical activity can reduce the impact of the age on physical fitness.

Limitations of the study:

The study should be repeated in a larger and less homogeneous population. The vast majority of people maintained a high level of physical activity on a daily basis. A group of people whose sociodemographic factors would not be so similar to each other should be studied. The numerical predominance of one sex (women) in the study was not conducive to drawing reliable conclusions. The study lacked people who were less physically active to be able to thoroughly examine the general physical fitness of seniors. Most of the people in the study had previously been beneficiaries of a fall prevention program among older adults, which may have affected their physical fitness and awareness of the need for an active life. It would be necessary to check whether there is an impact of the respondents' education on their activity and physical fitness.

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