



# Functional Physical Fitness and Anthropometric Characteristics of Older Women Living in Different Environments in Southwest Poland

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## Introduction

Demographic and scientific research shows that the percentage of older adults ( $\geq 60$  years of age) is significantly increasing in industrialized countries (Central Statistical Office, 2016; Marques et al., 2014). The percentage of older adults in Poland's population increased from 14.7% in 1989 to 22.2% in 2014, and is projected to further increase to  $>40\%$  by 2050 (Central Statistical Office, 2016). A more complete interpretation of life expectancy data is made possible by analyzing older adults in relation to their health. The average healthy life expectancy index for men and women aged 65 years in Poland is  $\sim 46\%$  (7.2 remaining years of life) and  $\sim 39\%$  (7.8 remaining years of life) respectively. In European Union

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(EU) countries this index is higher, with values of 10.3 remaining years of life for men, and 10.4 remaining years of life for women (Central Statistical Office, 2016). The population structure in Poland is diverse. In the Dolnośląskie and Opolskie provinces, located in southwest Poland, the population is characterized by a greater percentage of elderly people in post-working age, compared to the population of Poland as a whole. Moreover the Opolskie province is characterized by decreasing population (Central Statistical Office, 2021). Based on this previous research, it seems important to analyze the aging process in terms of factors that can affect the maintenance and duration of functional independence and health in older adults. When analyzing the aging process, attention should be paid to the situation of older women. Women live longer than men, but more often suffer from chronic diseases and disabilities (Central Statistical Office, 2016; Gaigaliene, 2006).

An important factor in maintaining independence in older life is functional physical fitness. Functional fitness has been defined as the physiological capacity to perform normal everyday activities safely, independently, and without undue fatigue (Rikli & Jones, 1999). The major components of functional physical fitness are lower and upper body strength, lower and upper body flexibility and mobility, aerobic fitness, and motoric coordination and dynamic balance. These components allow performance of activities required for independent living, such as household chores, walking, climbing steps, and carrying objects (Rikli & Jones, 1999). Deficits in the major components of functional physical fitness are linked to physical disability (Maslow et al., 2011), cognitive decline (Auyeung et al., 2011), and reduced quality of life (Olivares et al., 2011). During the ageing process, a decrease in physical fitness occurs, leading to older adults experiencing difficulties with everyday activities and functioning. Older adults experience decreases in muscular strength and stamina, agility, joint mobility (Milanović et al., 2013), and aerobic capacity. The number of falls in older adults increases as a consequence of reduced muscular strength and decreased balance (São Romão Preto et al., 2015). The decline of physical fitness and performance with age is physiological and inevitable, but it proceeds at different rates in individuals. The level of an individual's physical fitness is influenced by various factors that include physical activity, nutrition, body mass and participation. General life activity and participation in society are very important items. According to International Classification of Impairments, Activities and Participation (ICIA) the term person's functioning involves functioning on three levels: biological, personal and social (Kabsch, 2001). Participation in social life is therefore also one of the factors that maintain seniors' independence. Whereas systematic physical activity in older adults can slow the rate of decline in physical fitness and performance, limit negative health changes, and maintain the ability to perform everyday activities and functions. More specifically, physical activity can help maintain gait speed, healthy body composition, circulatory and respiratory function, and postural stability (Rava et al., 2017; Skrzek et al., 2015). Levels of physical activity and participation in society may vary across country and continents due to different socio-demographic and economic conditions (Karlin & Weil, 2017). Therefore, identifying older adults whose fitness levels are below age-related normative standards, and the recommended fitness standards needed for independent functioning, should be considered as a preventive health strategy.

The purpose of the present study is (1) to evaluate and compare the anthropometric characteristics and functional physical fitness of Polish older women living in social assistance homes (SAH), to that of Polish older women living independently and taking classes with the University of the Third Age (U3A); (2) to compare the functional physical fitness of Polish older women to normative standards from the United States of America (USA) developed by the authors of the test, and to European standards—Portuguese and Polish percentile norms; and (3) to evaluate the functional physical fitness of Polish older women relative to criterion fitness standards associated with maintaining physical independence.

## Materials and Methods

### Study Design and Setting

The study was carried out from 2016 to 2019, and included 142 women from southwest Poland. The women were aged 60 to 84 years ( $70.92 \pm 6.96$  years).

The research was carried out in accordance with the Declaration of Helsinki, and followed good clinical practice guidelines. The Commission of Research of the University School of Physical Education, Wrocław, Poland granted approval for the research (approval date: 2015). All participants gave written informed consent after explanation of the procedures involved.

The study is a part of larger research that was retrospectively registered on the ISRCTN platform under the number 18225729.

### Participants

Participants were resident in SAH in the Dolnośląskie and Opolskie provinces ( $n=70$ ; SAH group), or living independently in Dolnośląskie province and taking classes with the U3A ( $n=72$ ; U3A group).

To be included in the study participants were required to (1) be able to move independently and take the fitness test, (2) not have any medical impediments, (3) be able to communicate verbally, and (4) provide voluntary written consent to participate in the study. In turn, the exclusion criteria comprised (1) acute injuries and infections, (2) cancer, (3) recent myocardial infarction, (4) other medical impediments to research, (5) the lack of verbal contact and (6) lack of written consent to participate in the study.

To compare fitness levels of Polish older women, the SAH and U3A groups were further sub-divided into the following age groups: 60 – 64 years, 65 – 69 years, 70 – 74 years, 75 – 79 years, and 80 – 84 years.

### Measurement Tools

#### Senior Fitness Test

The Senior Fitness Test was used to assess participants' functional physical fitness (Rikli & Jones, 2001). The Senior Fitness Test evaluates upper and lower

body strength, upper and lower body flexibility and mobility, aerobic capacity, motoric coordination, and dynamic balance using the following assessments:

- (1) **Arm curl:** Participants flex and extend the elbow joint for 30 s whilst holding a 5lbs (2.27 kg) dumbbell. The number of repetitions performed in the given time is recorded, and provides an indication of upper body strength.
- (2) **Chair stand:** From seated participants stand and return to seated for 30 s. The number of stands from seated in the given time is recorded, and provides an indication of lower body strength.
- (3) **Back scratch:** Participants reach with their hands behind their back, and attempt to get fingers from opposing hands to touch. The distance between the fingers (to the nearest 0.5 cm) is recorded, and provides an indication of upper body flexibility and mobility.
- (4) **Chair sit and reach:** Participants sit with one leg extended at the knee, and the other leg flexed at the knee with the foot flat on the floor. Participants reach forward and attempt to touch the toes of the extended leg. The distance between the fingers and toes (to the nearest 0.5 cm) is recorded, and provides an indication of lower body flexibility and mobility.
- (5) **8 foot up and go:** From seated participants stand up and walk a distance of 8 feet (2.44 m), turn, and return to seated. The time taken to return to seated is recorded (to the nearest 1/100<sup>th</sup> sec), and provides an indication of coordination and dynamic balance.
- (6) **6-min walk:** Participants walk as far as possible in the given time. The number of meters walked is recorded, and provides an indication of aerobic capacity.

All assessments were performed in the morning (i.e., before 12 noon). The U3A group was assessed in the Biokinetics Research Laboratory of the University School of Physical Education, Wrocław, Poland. Assessment of the SAH group took place in rehabilitation rooms in their SAH. Prior to testing participants received a demonstration of the assessments, and were taken through a warm-up protocol. Participants were instructed to try their best and achieve as good a score as possible in each assessment. The study authors collected all data.

### **Anthropometric Characteristics**

Body height (to the nearest 0.5 cm) and mass (to the nearest 0.5 kg) were measured using an integrated stadiometer and scale (SECA, model 764). Subjects were dressed in light clothing, and stood barefoot, upright, and with eyes directed straight ahead when being measured. Body mass index (BMI) was calculated using participants' height (in meters) and mass measurements ( $\text{mass}/\text{height}^2$ ). Using the World Health Organization (WHO) criteria (2000), BMI was used to categorize participants (underweight:  $< 18.5 \text{ kg}/\text{m}^2$ ; normal:  $18.5 - 24.99 \text{ kg}/\text{m}^2$ ; overweight:  $25 - 29.9 \text{ kg}/\text{m}^2$ ; obese class I:  $30 - 34.99 \text{ kg}/\text{m}^2$ ; obese class II:  $35 - 39.9 \text{ kg}/\text{m}^2$ ; and obese class III:  $\geq 40 \text{ kg}/\text{m}^2$ ).

## Statistical Methods

Descriptive statistics including mean (M), standard deviation (SD), median (Me), minimum (Min), and maximum (Max) were calculated. Normality was assessed using the Shapiro–Wilk test. Parametric methods were used to analyze the anthropometric data, with differences between mean values analyzed using the Student’s t-test. Non-parametric methods were used to analyze age and functional physical fitness, with the Mann–Whitney U test used to analyze between-group differences. Analyses were carried out using Statistica (Version 13.1, StatSoft, USA), with the alpha level set at 0.05.

Participants’ results were compared with normative standards where appropriate comparative data (i.e., same age group and testing protocol) were available (Rikli & Jones, 2002), to the Portuguese percentile norms developed by Marques et al. (2014) in four age groups (65 – 69 years, 70 – 74 years, 75 – 79 years, and 80 – 84 years), and to the Polish percentile norms developed by Ignasiak et al. (2020) in five age groups (65 – 69 years, 70 – 74 years, 75 – 79 years, and 80 – 84 years). In Polish norms, the results below the norm are below the 25th percentile in the 30-s chair stand, arm curl, chair sit and reach, back scratch, and above the 75th percentile in the 8-foot up and go test. The results of four Senior Fitness Test assessments (arm curl, chair stand, 8 foot up and go, and 6 min walk) were compared to the clinically relevant fitness standards developed in the USA by Rikli and Jones (2012). These fitness standards determine the fitness level needed to maintain independence in old age. To compare fitness levels of Polish older women to USA normative standards and clinically relevant fitness standards the yards in the 6-min walk have been converted into meters.

## Results

### Descriptive Data

The statistical profile of age of participants is presented in Table 1. The groups did not differ in age.

The SAH and U3A groups were further sub-divided into the following age groups: 60 – 64 years, 65 – 69 years, 70 – 74 years, 75 – 79 years, and 80 – 84 years. The number of participants in different age groups is presented in Table 2.

**Table 1** The statistical profile of age of participants

Values	Group	M	SD	Me	Min	Max	Z	p
Age	SAH	71.68	8.41	73.00	60.00	84.00	1.0833	0.2786
	U3A	70.18	5.20	69.00	61.00	84.00		

Z—Mann–Whitney U test, p—p value

**Table 2** The number of participants in different age groups

Groups	Age groups				
	60–64	65–69	70–74	75–79	80–84
SAH	21	8	10	14	17
U3A	6	32	20	9	5

### Evaluation of Anthropometric Characteristics and Functional Physical Fitness of Older Women in the SAH and U3A Groups

The older women in the U3A group were significantly heavier and taller than the older women in the SAH group. There was no significant between-group difference for BMI. BMI categorized the participants as overweight (Table 3).

Using BMI, a larger percentage of the SAH group was categorized as normal weight, and a smaller percentage of the SAH group was categorized as overweight compared to the U3A group. The percentage of people categorized as obese was similar in both groups. The number of participants who were categorized as underweight, obese class II, or obese class III was small (Table 4).

In all assessments of functional physical fitness the U3A group performed significantly better than the SAH group (Table 5). The U3A group was characterized by better functional physical fitness compared to the SAH group.

### Comparison of Polish Older Women's Fitness Levels to USA Normative Standards and to European Standards—Portuguese and Polish Percentile Norms

The results obtained from each participant were compared with USA normative standards for their age group. In the SAH group the best performance was achieved in the arm curl, where average results in the three age groups (60–64, 65–69, 74–79 years) were within normal ranges, and the percentage of women achieving scores in the normal ranges was high. In the chair stand, only the average of the 65–69 years group fell within the normal ranges developed by the authors of the Senior Fitness Test. In the other samples, no groups achieved scores in the normal ranges. The weakest trials were in the 8 foot up and go and 6 min

**Table 3** The statistical profile of anthropometric characteristics of participants

Values	Group	M	SD	Me	Min	Max	t	p
Body height [m]	SAH	1.53	0.07	1.54	1.33	1.66	-2.8742	0.0046*
	U3A	1.56	0.06	1.56	1.43	1.72		
Body mass [kg]	SAH	66.30	16.04	66.00	33.50	105.00	-2.3779	0.0187*
	U3A	71.90	11.76	70.50	46.00	105.50		
BMI [kg/m <sup>2</sup> ]	SAH	28.24	6.32	28.35	16.61	43.16	-1.3703	0.1727
	U3A	29.49	4.38	29.12	18.99	43.30		

t—Student's t test, p—p value, \*p ≤ 0.05

**Table 4** BMI classification of participants

BMI classification %	SAH	U3A
Underweight	5.71	0
Normal range	30.00	13.88
Overweight	24.28	47.22
Obesity class I	27.14	27.77
Obesity class II	10	9.72
Obesity class III	2.85	1

walk, where the percentage of participants reaching the normative standards was very low or none. The U3A group performed more favorably. In the U3A group, participants achieved scores within the normal ranges across all age groups in the arm curl, chair stand, chair sit and reach, 8 foot up and go and 6-min walk. The weakest performance in the U3A group was observed in the back scratch, where only the 60–64 years and 75–79 years groups achieved the normative standards (Table 6).

When compared with the Portuguese percentile norms, almost all mean age group scores in the SAH group were below the 50<sup>th</sup> percentile. Only the result of the 80–84 years group in the arm curl was in the 50<sup>th</sup>–75<sup>th</sup> percentile range. The poorest results were in the 8 foot up and go and 6-min walk, where the average scores in the 65–69 years and 70–74 years groups were below the 10<sup>th</sup> percentile, with the scores for the 75–79 years and 80–84 years groups in the 10<sup>th</sup>–25<sup>th</sup> and 25<sup>th</sup>–50<sup>th</sup> percentile ranges respectively. The U3A group performed better. In the arm curl, chair stand, back scratch, and chair sit and reach the mean results for all age groups were above the 50<sup>th</sup> percentile. Poorer performance was observed in the 8 foot up and go and 6-min walk, where the average results of the 75–79 years

**Table 5** The statistical profile of the results of the Senior Fitness Test of the participants and the significance of the differences

Values	Group	M	SD	Me	Min	Max	Z	p
Arm curl [reps]	SAH	12.98	4.04	13.00	3.00	27.00	-9.0239	<0.001*
	U3A	20.77	3.37	21.00	11.00	28.00		
Chair stand [reps]	SAH	9.57	3.26	9.50	1.00	15.00	-8.9619	<0.001*
	U3A	16.56	3.42	16.00	5.00	27.00		
Back scratch [cm]	SAH	-20.77	15.92	-18.50	-56.00	6.00	-6.3708	<0.001*
	U3A	-4.60	8.71	-4.00	-31.00	17.00		
Chair sit-and-reach [cm]	SAH	-9.57	11.70	-10.00	-36.00	10.00	-6.8703	<0.001*
	U3A	3.10	6.15	3.00	-19.00	16.00		
8 ft up-and-go [s]	SAH	13.82	6.73	11.36	5.20	39.00	9.3954	<0.001*
	U3A	6.57	0.93	6.60	4.56	8.75		
6-min walk [m]	SAH	221.51	107.66	206.50	30.00	432.0	-9,7570	<0.001*
	U3A	488.84	77.81	509.50	270.00	670.00		

Z—Mann–Whitney U test, p—p value, \* $p \leq 0.05$

**Table 6** Comparison of the results obtained in different age groups to the normative standards in United States

	Age groups				
	60–64	65–69	70–74	75–79	80–84
<b>Arm curl [reps]</b>					
Normative standards	13–19	12–18	12–17	11–17	10–16
SAH	<b>13.95</b>	<b>15.50</b>	11.60	<b>12.21</b>	12.05
% meeting standard	71.4	100	70,0	71.4	76.4
U3A	<b>20.83</b>	<b>21.53</b>	<b>20.50</b>	<b>20.00</b>	<b>18.20</b>
% meeting standard	100	100	100	100	100
<b>Chair stand [reps]</b>					
Normative standards	12–17	11–16	10–15	10–15	9–14
SAH	10.14	<b>11.25</b>	9.40	8.92	8.70
% meeting standard	33.3	62.5	60.0	35.7	52.9
U3A	<b>19.16</b>	<b>16.84</b>	<b>15.60</b>	<b>14.22</b>	<b>14.80</b>
% meeting standard	100	100	100	88,8	80,0
<b>Back scratch [cm]</b>					
Normative standards	-3–+1.5	-3.5–+1.5	-4.0–+1.0	-5.0–+0.5	-5.5–0.0
SAH	-18.80	-12.25	-17.60	-25.28	-25.35
% meeting standard	14.2	37.5	20.0	7.1	23.5
U3A	<b>-0.70</b>	-5.10	-5.50	<b>-3.20</b>	-6.50
% meeting standard	66,6	50,0	30,0	44,4	60
<b>Chair sit-and-reach [cm]</b>					
Normative standards	-0.5–+5.0	-0.5–+4.5	-1.0–+4.0	-1.5–+3.9	-2.0–+3.0
SAH	-8.14	-10.73	-12.10	-10.21	-8.41
% meeting standard	42.8	37.5	30.0	50.0	52.9
U3A	<b>7.30</b>	<b>2.90</b>	<b>1.40</b>	<b>3.80</b>	<b>4.4</b>
% meeting standard	100	87,5	70,0	100	100
<b>8 ft up-and-go [s]</b>					
Normative standards	6.0–4.4	6.4–4.8	7.1–4.9	7.4–5.2	8.7–5.7
SAH	12.41	12.98	12.69	15.62	15.15
% meeting standard	4.7	0.0	0.0	7.1	11.7
U3A	<b>5.79</b>	<b>6.40</b>	<b>6.57</b>	<b>7.14</b>	<b>7.98</b>
% meeting standard	50	56,2	75,0	66,6	80
<b>6-min walk [m]</b>					
Normative standards	498.3–603.5	457.2–580.6	438.9–562.3	393.1–534.9	352–493.7
SAH	240.47	225.62	253.30	193.78	208.52
% meeting standard	0.0	0.0	0.0	7.1	0.0
U3A	<b>571.41</b>	<b>507.21</b>	<b>465.57</b>	<b>476.38</b>	<b>387.6</b>
% meeting standard	83.3	87.5	75.0	100.0	80.0

Results within the normative standard ranges denoted in bold



and 80 – 84 years groups were above the 50<sup>th</sup> percentile, whilst the results of the 65 – 69 years and 70 – 74 years groups were in the 25<sup>th</sup> – 50<sup>th</sup> percentile range (Table 7).

When compared with the Polish percentile norms, almost all mean age group scores in the SAH group were below the norms. Only the result of the 65 – 69 years group in the arm curl was in the 25<sup>th</sup> – 50<sup>th</sup> percentile range. The poorest results were in the 6-min walk, where the average scores in all age groups were below the 10<sup>th</sup> percentile and in the 8 foot up and go where the average scores in all age groups were above the 90<sup>th</sup> percentile. The U3A group performed better. In the arm curl, chair stand and 6-min walk the mean results for all age groups were above the 50<sup>th</sup> percentile. Poorer performance was observed in the 8 foot up, where the average results of the 60 – 64 years was in the 50<sup>th</sup> percentile range, whilst the results of the another age groups were in the 50<sup>th</sup> – 75<sup>th</sup> percentile range (Table 8).

### Evaluation of Polish Older Women's Fitness Levels Relative to Criterion Fitness Standards Associated with Maintaining Physical Independence

Results of the four Senior Fitness Test assessments used (arm curl, chair stand, 8 foot up and go, and 6-min walk) were compared to the clinically relevant fitness standards that determine the fitness level needed to maintain independence in old age. The SAH group's mean scores did not meet the standards for any of the assessments, and the percentage of women meeting the standards was low. The poorest results were observed for the 8 foot up and go, where the percentage of participants meeting the standards did not exceed 8%, and for the 6 min walk, where no participants met

**Table 7** Comparison of the results obtained in different age groups to Portuguese percentile norms

SFT Tests	Age groups								
	65–69		70–74		75–79		80–84		
	M	Percentil	M	Percentil	M	Percentil	M	Percentil	
<b>Arm curl [reps]</b>	SAH	15.5	25–50	11.60	10–25	12.21	25–50	12.05	50–75
	U3A	21.53	75–90	20.60	50–75	20.00	75–90	18.20	75–90
<b>Chair stand [reps]</b>	SAH	11.25	10–25	9.40	10–25	8.92	10–25	8.70	25–50
	U3A	16.84	50–75	15.60	50–75	14.22	50–75	14.80	75–90
<b>Back scratch [cm]</b>	SAH	-12.25	25–50	-17.60	10–25	-25.28	10–25	-25.35	10–25
	U3A	-5.10	50–75	-5.50	50–75	-3.20	50–75	-6.5	75–90
<b>Chair sit-and-reach [cm]</b>	SAH	-10.73	10–25	-12.10	10–25	-10.21	25–50	-8.41	50–75
	U3A	2.90	75–90	1.4	50–75	3.8	>90	4.4	>90
<b>8 ft up-and-go [s]</b>	SAH	12.98	<10	12.69	<10	15.62	10–25	15.15	25–50
	U3A	6.40	25–50	6.57	25–50	7.14	50–75	7.98	50–75
<b>6-min walk [m]</b>	SAH	225.62	<10	253.30	<10	193.78	10–25	208.52	25–50
	U3A	507.21	25–50	465.57	25–50	476.38	50–75	387.6	75–90

M—results equal to and higher than 50th percentile denoted in bold

**Table 8** Comparison of the results obtained in different age groups to Polish percentile norms

	SFT Tests											
	Age groups											
	60–64		65–69		70–74		75–79		80–84			
	M	Percentil	M	Percentil	M	Percentil	M	Percentil	M	Percentil	M	Percentil
<b>Arm curl [reps]</b>	SAH	13.9	10–25	15.5	25–50	11.6	<10	12.2	10–25	12.0	10–25	10–25
	U3A	20.8	50–75	21.5	75–90	20.6	50–75	20.0	75–90	18.2	75–90	75–90
<b>Chair stand [reps]</b>	SAH	10.1	10–25	11.2	10–25	9.4	<10	8.9	<10	8.7	10–25	10–25
	U3A	19.1	75–90	16.8	50–75	15.6	50–75	14.2	50–75	14.8	50–75	50–75
<b>Back scratch [cm]</b>	SAH	-18.8	<10	-12.2	10–25	-17.6	<10	-25.2	<10	-25.3	<10	<10
	U3A	-0.7	25–50	-5.1	25–50	-5.5	25–50	-3.2	50–75	-6.5	25–50	25–50
<b>Chair sit-and-reach [cm]</b>	SAH	-8.1	<10	-10.7	<10	-12.1	<10	-10.2	<10	-8.4	10–25	10–25
	U3A	7.3	50–75	2.9	25–50	1.4	25–50	3.8	50–75	4.4	50–75	50–75
<b>8 ft up-and-go [s]</b>	SAH	12.4	>90	12.9	>90	12.6	>90	15.6	>90	15.1	>90	>90
	U3A	5.7	50	6.4	50–75	6.5	50–75	7.1	50–75	7.9	50–75	50–75
<b>6-min walk [m]</b>	SAH	240.4	<10	225.6	<10	253.3	<10	193.7	<10	208.5	<10	<10
	U3A	571.4	50–75	507.2	50–75	465.5	50–75	476.3	50–75	387.6	50–75	50–75

M—results equal to and higher than 50th percentile denoted in bold, in the 8ft up- and-go test, results equal to and lower than 50th percentile denoted in bold

the standards. In the U3A group, the average results for all age groups met the standards for the arm curl and chair stand, and the percentage of participants meeting the standards was high. In the 8 foot up and go and 6-min walk no age group within the U3A group met the standards, and the percentage of women meeting the standards was low (Table 9). In conclusion, the SAH group did not achieve the level of fitness necessary to maintain independence in old age. In the U3A group, only upper and lower body strength levels were sufficient to maintain independence. The level of coordination and dynamic balance was too low to maintain independence.

## Discussion

### Key Results and Interpretation

The first aim of this study was to evaluate and compare the anthropometric characteristics and functional physical fitness of Polish older women from SAH, to that of

**Table 9** Comparison with criterion-referenced fitness standards developed by the test authors

	Age groups				
	60–64	65–69	70–74	75–79	80–84
<b>Arm curl [reps]</b>					
Fitness standards	17	17	16	15	14
SAH	13.95	15.50	11.60	12.21	12.05
% meeting standard	19.0	12.5	10.0	7.1	35.2
U3A	<b>20.83</b>	<b>21.53</b>	<b>20.50</b>	<b>20.00</b>	<b>18.20</b>
% meeting standard	100.0	96.8	95.0	100.0	80.0
<b>Chair stand [reps]</b>					
Fitness standards	15	15	14	13	12
SAH	10.14	11.25	9.40	8.92	8.70
% meeting standard	4.7	25.0	30.0	14.2	17.6
U3A	<b>19.16</b>	<b>16.84</b>	<b>15.60</b>	<b>14.22</b>	<b>14.80</b>
% meeting standard	100.0	81.2	75.0	77.7	100
<b>8 ft up-and-go [s]</b>					
Fitness standards	5.0	5.3	5.6	6.0	6.5
SAH	12.41	12.98	12.69	15.62	15.15
% meeting standard	0.0	0.0	0.0	0.0	0.0
U3A	5.79	6.40	6.57	7.14	7.98
% meeting standard	16.6	9.3	15.0	11.1	0.0
<b>6-min walk [m]</b>					
Fitness standards	571.5	553.2	530.3	502.9	466.3
SAH	240.47	225.62	253.30	193.78	208.52
% meeting standard	0.0	0.0	0.0	0.0	0.0
U3A	571.41	507.21	465.57	476.38	387.6
% meeting standard	33.3	9.3	15.0	33.3	20.0

Results within the criterion-referenced fitness standards denoted in bold

Polish older women living independently and taking classes with U3A. The results of the study indicate that the SAH group was characterized by lower physical fitness compared to the U3A group and the women in the SAH group were lighter and shorter than the women in the U3A group. In all assessments that comprise the Senior Fitness Test, the SAH group demonstrated poorer results in comparison to the U3A group. Women living independently, such as those in the U3A group, have to perform their own daily activities. Additionally, the women in the U3A group participated in classes provided by the U3A. In Poland the U3A provides educational and physical activity classes. The most common physical activity classes include gymnastics, swimming, water gymnastics, Nordic walking, and hiking. Living independently and participating in physical activity classes influences the level of older adults' functional fitness. The poorer results obtained by the SAH group may be explained by the lack of participation in everyday activities such as shopping and cooking. Whilst SAH residents participate in rehabilitation classes and occupational therapy, it is possible that not all older adults benefit from such participation, or that participation only provides limited benefits. Consequently, the activity level of older women in SAH is very low. This low level of activity has been confirmed in previous studies. A study by Barber et al. (2015) showed that the physical activity levels of SAH residents were very low and time being sedentary was high. A cross-sectional study conducted in German nursing homes found that exercise instructions were not effectively communicated to residents, and that less than half of residents participated in the activities provided (Kalinowski et al., 2012). Furthermore, living in senior housing was inversely associated with physical activity levels (Fisher et al., 2018).

Findings from the present study suggest that older adults' place of residence and living environment can significantly affect their level of functional physical fitness, and that this level of fitness is an important factor in maintaining independence. Higher levels of strength, motoric coordination, dynamic balance, and aerobic capacity can contribute to efficient everyday functioning, fall prevention, and improved quality of life. To achieve and maintain an appropriate level of functional physical fitness provision of systematic physical activity in SAH, and by the U3A, is necessary. Physical activity programs should include the development of strength, endurance, flexibility, dynamic coordination, and balance, as indicated by previous research. A study by Ogonowska-Słodownik et al. (2016) found that the level of functional fitness of active women, participants of U3A gymnastic classes, remained at similar levels in three different age groups. Systematic motoric rehabilitation classes for older women in SAH improved levels of physical fitness and aerobic capacity compared to SAH residents not attending rehabilitation classes (Fortuna et al., 2017). In addition to improvements in functional physical fitness, physical activity programs for those living in SAH have also increased residents' social engagement [Raynor et al., 2019; Arrieta et al., 2018; Marmeleira et al., 2018].

Other studies investigating the fitness and activity levels of nursing home residents and women living independently in Poland have been carried out. A study by Ignasiak et al. (2009) found that older age and living in an institution significantly lowered older adults' fitness levels. Participants living in an institution demonstrated significantly lower levels of fitness compared to those living independently

(Ignasiak et al., 2009). Another study of SAH female residents found that participants met the USA normative standards for strength and endurance (Kaczorowska et al., 2013). A study by Leś and Gaworska (2011) found that the women living in SAH were characterized by lower functional fitness compared to the women attending daytime homes. Ignasiak et al. (2017) also conducted an extensive study investigating the functional fitness and physical activity of older adults from Dolnośląskie province. The study included 431 women and 125 men, and used the Senior Fitness Test to assess fitness levels. The results of four tests obtained from particular age groups were compared to the USA normative standards. For women, the results of the 8 foot up and go and 6-min walk were similar to normative standards, with 67% and 53% respectively achieving results within the relevant range. Lower percentages were observed for the arm curl and chair stand, with 23% and 28% respectively achieving results within the relevant range. Participants in this study were members of senior clubs, and U3A students. Lower levels of strength were possibly a result of the lack of physical activity in senior clubs.

After the American Senior Fitness Test standards were developed, due to the social, economic, and cultural differences between societies, scientists began to create norms for the peoples of their countries. Such norms were developed in Portugal in 2014 (Marques et al., 2014) and in Poland in 2020 (Ignasiak et al., 2020). When comparing the results of the present study to the USA normative standards and Portuguese percentile norms, it was observed that a large percentage of women in the U3A group met the standards, and that the average results of the U3A group were within the appropriate range of these standards. The U3A group performed well in comparison to Portuguese women. In most tests the mean results of Polish women exceeded the 50<sup>th</sup> percentile of Portuguese norms. When comparing the results the U3A group to Polish percentile norms, main scores of tests assessing upper and lower body strength and aerobic capacity were above the 50<sup>th</sup> percentile. The tests assessing the flexibility of the upper and lower body as well as coordination and dynamic balance were weaker. However, the functional physical fitness of the SAH group was poorer in comparison to American, Portuguese and Polish women. The poorer results observed for coordination and dynamic balance, and aerobic capacity, are concerning. Good coordination and balance, along with a higher aerobic capacity, can help older adults to be self-reliant and live independently. Moreover, good coordination and balance can help reduce the risk of falls. Poor results were also observed for upper body flexibility and mobility. Upper body flexibility and mobility is important for grasping and reaching, and everyday activities such as unassisted dressing. Polish norms have been developed for seniors living independently, so they may be too high for residents of social homes.

In 2012, Rikli and Jones developed clinically relevant fitness standards for older adults, in an attempt to define the level of fitness necessary to maintain independence in old age. These standards utilized four assessments from the Senior Fitness Test (arm curl, chair stand, 8 foot up and go, and 6-min walk) to assess upper and lower body strength, coordination and dynamic balance, and aerobic capacity. Older adults whose results are within the fitness standards can function independently (Rikli & Jones, 2012). A large percentage of the participants in the present study, including those living independently, did not achieve the clinically relevant fitness

standards. Therefore, it is important to assess the fitness of both older adults in SAH and those living independently to identify areas of reduced physical capacity, and to introduce physical activity programs to address these areas. Moreover the fitness standards were developed for American society, and therefore may not be applicable to Polish society.

The participants in the present study came from the Dolnośląskie and Opolskie provinces, and were born between 1931 and 1959 (i.e., between World Wars I and II, during World War II, or during the immediate post World War II period). It is possible that adverse environmental conditions early in life may predispose some individuals to the later development of degenerative diseases (Baker, 2001). Stress connected with living during war, or during challenging and adverse conditions post war, may predispose some people to various diseases. Moreover the USA is a country with completely different economic, social and cultural conditions than Poland. Whilst Poland and Portugal are European countries, there are social and cultural differences between the two countries that may affect older adults' physical fitness. This is why a country's standards are so important in assessing the fitness of its residents, including seniors. Therefore, due to the social, economic, and cultural differences between American and Polish societies, it would be appropriate to develop Polish clinically relevant fitness standards for the Senior Fitness Test.

There are a limited number of studies that have investigated differences in anthropometric characteristics and functional physical fitness between older adults living in different environments in Poland. Therefore, it is appropriate to investigate older adults living in different environments.

## Limitations

The present study has some limitations. Only women were included in the investigation. Men live shorter than women, but are characterized by a greater level of physical activity. Moreover, fewer men than women live in social welfare homes. Perhaps, this is due to the higher male mortality causing more older women to be single and choose or have to live in a social welfare home. Therefore, future research should consider the impact of different living environments on the anthropometric characteristics and functional physical fitness of older men in Poland. Next limitations of the study relate to whether the sample of older adults in SAH group and U3A group represents older adults in the population. The study groups may not be representative of all SAH residents and U3A participants. In addition, the study does not allow conclusions regarding causality. Consideration should be given to longitudinal studies with several points of measurement, as this would allow tracking and correction for changes in functional physical fitness and also allow more insight into the relationship between physical fitness, age and different environments. Additionally, as the research was performed in only two Polish provinces, it would be beneficial for future research to investigate the impact of different living environments on older adults in other Polish provinces.

## Conclusion

- (1) Independent living and the physical activity connected with the classes provided by the U3A influenced older adults' levels of functional physical fitness.
- (2) The level of functional fitness of Polish residents of social assistance homes is insufficient to maintain independence in old age. Various physical activity and occupational therapy programs should be introduced.
- (3) Due to the social, economic, and cultural differences between societies, a country's standards should be used in assessing the functional fitness of its population.

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**Availability of Data and Material** All the data can be assessed by reasonable request from the corresponding author.

## Declarations

**Ethics Approval** The Commission of Research of the University School of Physical Education, Wrocław, Poland granted approval for the research (approval date: 2015).

**Consent to Participate** All participants gave written informed consent to participate in the study after explanation of the procedures involved.

**Conflict of Interest** The authors have no relevant financial or non-financial interests to disclose.

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