SENIOR FITNESS TEST: REFERENCE CURVES FOR POLISH WOMEN OVER 60 YEARS OF AGE

Anna Leś[1], Romuald Stupnicki[2], Ewa Kozdroń [1], Katarzyna Milde[3]

[1] Józef Piłsudski University of Physical Education in Warsaw, Faculty of Physical Education, Chair of Tourism and Recreation
[2] Halina Konopacka Higher School of Physical Culture and Tourism, Pruszków, Poland
[3] Józef Piłsudski University of Physical Education in Warsaw, Faculty of Physical Education, Chair of Human Biology

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Abstract

Background Although population aging is a natural process, it poses many social, economic, and health challenges. It is important for older adults to maintain adequate functional fitness for as long as possible to live independently and autonomously. Presenting reference values of functional fitness on a continuous basis (rather than in 5-year periods as it is the case in the standards for SFT) is a better approach. It provides more insights into changes that occur in functional fitness. The aim of the study was to develop reference curves for fitness tests constituting the Senior Fitness Test for Polish women over 60 years of age who move independently.
Methods The study examined 833 women aged over 60 years (m ± SD; 67.42 ± 6.88). The Senior Fitness Test, consisting of 6 fitness tests, was used to evaluate functional fitness. The entire set of data was sorted by the age of participants, numbered, and assorted into overlapping sets. Finally, 17 sets were obtained. The equations for means and standard deviations vs. age were computed for all sets of variables.
Results Based on the results of the fitness tests and using appropriate equations, 6 percentile grids were developed for women over 60 years of age.
Conclusion The percentile grids developed for individual SFT tests may be an important tool for assessing individual functional fitness in the population of Polish women over 60 years of age. The use of the percentile girds allows for changes in fitness levels over the years to be conveniently illustrated.
Trial registration: ClinicalTrials.gov, ID: NCT05145985, Protocol ID: SFT-2021

Keywords*: reference curves, Senior Fitness Test, SFT, older adults, functional fitness*

Introduction

Population aging is a natural process but changes in age proportions in society have been observed for over 30 years (United Nation, 2019; Active Aging Report Special Eurobarometer 378, 2012), that pose social, economic, and health challenges (Herrmann, 2014; Sander et al., 2015; Berrio Valencia, 2012). It is important for older adults to maintain adequate functional fitness for as long as possible in order enable them to live autonomously as possible (Collins et al., 2004; Tewari et al., 2016; Ramnath et al., 2018). Functional fitness is regarded as the ability to perform daily activities independently and safely, and without fatigue (Rikli & Jones, 1999). Keeping satisfactory functional fitness may increase life expectancy and improve life quality of subjects aged 60+ (Pak-Kwong et al., 2017; Zaccardi et al., 2019). On the other hand, the increasing life expectancy may increase the number of subjects who need support in daily living(United Nations, 2013; Confederation of Family Organizations in the European Union, 2011). Major fitness disorders in that group are related to the cardiorespiratory system and muscle strength, regarded as independent and strong markers of health (Physical Activity Guidelines for Americans, 2008). Furthermore, cardiorespiratory fitness is negatively correlated with the prevalence and severity of coronary heart disease, cardiovascular diseases, various types of cancer, and mortality (Amaro-Gahete et al., 2019; Liu & Latham, 2009; Liu et al., 2019). Decreased levels of functional fitness are positively correlated with the incidence of physical disability in advanced life. The risk of falls, due to reduced muscle strength and flexibility, is increased in people aged over 60 (Dusińska & Banior, 2019). All those factors contribute to a low self-rated life quality of older adults (Silva et al., 2019; Olivares et al., 2011; Maslow et al., 2011).

Fitness tests, used to assess the level of functional fitness, include the Senior Fitness Test, also known as the Fullerton Functional Fitness Test (Rikli & Jones, 2001). One Leg Standing Test (Delaware Physical Therapy Clinic, 2016) - the test assesses static balance to detect motor disability symptoms; Stops Walking When Talking (de Hoon et al., 2003) - the test evaluates the risk of falling and the ability to perform two activities simultaneously (speaking and walking); Berg Balance Scale (Berg et al., 1989) - the test measures the ability to maintain balance while performing predetermined tasks but it does not assess gait; Four Square Step Test (FSST) (Langford, 2015) - the test assesses dynamic stability and coordination; Functional Reach Test (FRT) (Duncan et al., 1990) - the test assesses dynamic balance; Tinetti Test (Tinetti, 1986) - the test assesses balance during simple tasks and gait; Short Physical Performance Battery (Guralnik et al., 1994) - the test evaluates balance and lower limb functioning in subjects aged over 60.

Based on these fitness tests, the levels of selected aspects of functional fitness are rated by converting the scores into points. Among the indicated tools, the Senior Fitness Test seems to be the most universal as it is a comprehensive, multidimensional assessment of physical fitness of subjects aged over 60. The test enables following a gradual decline in functional fitness with age. Furthermore, the simple tests with normal values in the Senior Fitness Test were designed for subjects aged 60 to 94 years. the available standards being set for the American population.

Developing continuous reference values for fitness tests included in the Senior Fitness Test may better visualize changes in functional fitness of elderly subjects than reference values designed for 5-year intervals.

Methods

Study aim

The aim of the study was to develop percentile grids (reference curves) for the Senior Fitness Test as used for women over 60 years of age.

A cohort of 833 women aged over 60 (67.42 ± 6.88 years) was examined. The tests were conducted in 7 locations in Poland by qualified instructors using the same testing procedure. Only those, who could move independently and whose health status enabled them performing the tests, were examined. Study participants were informed about the purpose and procedures of the study, and that they could withdraw from the tests at any stage of the study. Participation in the tests was voluntary. Informed written consent was provided by all participants.

Research tools

The Senior Fitness Test (Rikli & Jones, 2001; Rikli & Jones, 1999; Jones & Rikli, 2002) included 6 test items requiring no specialized equipment, as described by Różańska-Kirschke et al. (2006):.

1. Arm Curl (AC), measuring the upper body muscle endurance.

2. 30-second Chair Stand (30SCS), measuring the lower body strength.

3. Back Scratch Test (BST), measuring upper body flexibility.

4. Chair Sit and Reach Test (CSRT), measuring the lower body flexibility (specifically, hamstring flexibility).

5. 8-Foot Up and Go (TUG), measuring the agility (dynamic balance) and aerobic endurance.

6. 2-Minute Walk Test (2MWT), measuring the aerobic endurance.

Ethical Approval

The research was carried out in accordance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. The project was approved by the Senate Ethics Committee for Scientific Research of the Józef Piłsudski University of Physical Education in Warsaw (agreement SECSR No: SKE 01 - 25/2020 as of 20 November 2020, project No. 1: Determinants of biological condition and physical fitness of adult Poles, and agreement SECSR No: SKE 01-14/2021 as of 16 April 2021, project No. 9: Assessment of the effectiveness of intervention programs for older adults in the prevention of falls and cardiovascular diseases).

Data processing

The data were processed as follows (Stupnicki et al., 2001; Stupnicki et al., 2003): The entire set of data was sorted by age of participants, numbered, and assorted into overlapping sets as follows:1 – 101, 51 – 151, 101 – 201, etc. ., 17 sets in all.

Means and standard deviations were computed for all sets of variables. and presented in Table 1. Those equations were used to construct percentile graphs (Figure 1). The TUG data were converted to velocities (V = 8/s), i.e. to the mean time needed to cover one-foot distance, in order to simplify the equations. The velocity data were reconverted to time (s) as presented in the corresponding graph.

An example of computing equations for the mean and SD vs. age is shown in Figure 2. The equations for all tests were obtained in the same way. All were linear, except the 30SCS test, where quadratic equation had to be applied.

An example of using the equations for computing an individual result expressed as percentile:

Age – 73 years; 2MWT result: 38 steps

$t=(38-(87.6-1.371*73))/(-2.17+0.326*73) = -2.29$

This corresponds to 1.1%, as follows from the statistical table of normal probability integral values.

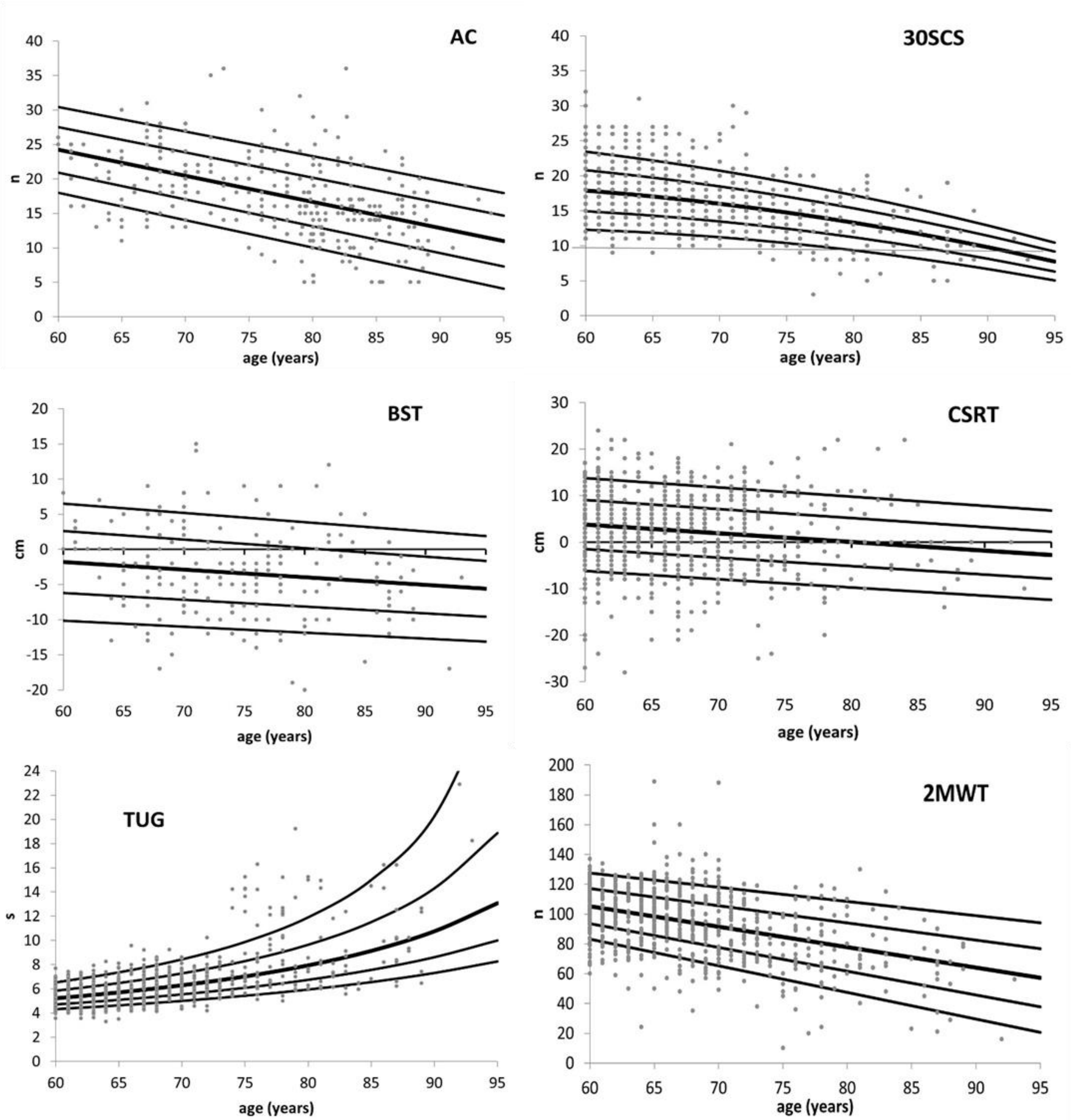

Figure 1. Variable-age relationships with superimposed percentile lines: 90%, 75%, 50%, 25%, and 10%. TUG data: the lower the value, the better result.

Table 1. Equations of means (M) and standard deviations (SD) vs. age (x) used to construct graphs presented in Figure 1

Variable	Mean	Standard deviation
AC (n)	$M = 46.9 – 0.378x$	$SD = 3.86 + 0.0165x$
30SCS (n)	$M = 12.4 + 0.332x – 0.00401x^2$	$SD = 8.2 – 0.064x$
BST (cm)	$M = 4.69 – 0.1084x$	$SD = 7.63 – 0.01866x$
CSRT (cm)	$M = 15.08 – 0.188x$	$SD = 8.39 – 0.00951x$
TUG (s)	$M = 8/(3.12 – 0.0264x)$	$SD = 8/(0.183 + 0.001x)$
2MWT (n)	$M = 187.6 – 1.3714x$	$SD = -2.17 + 0.3255x$

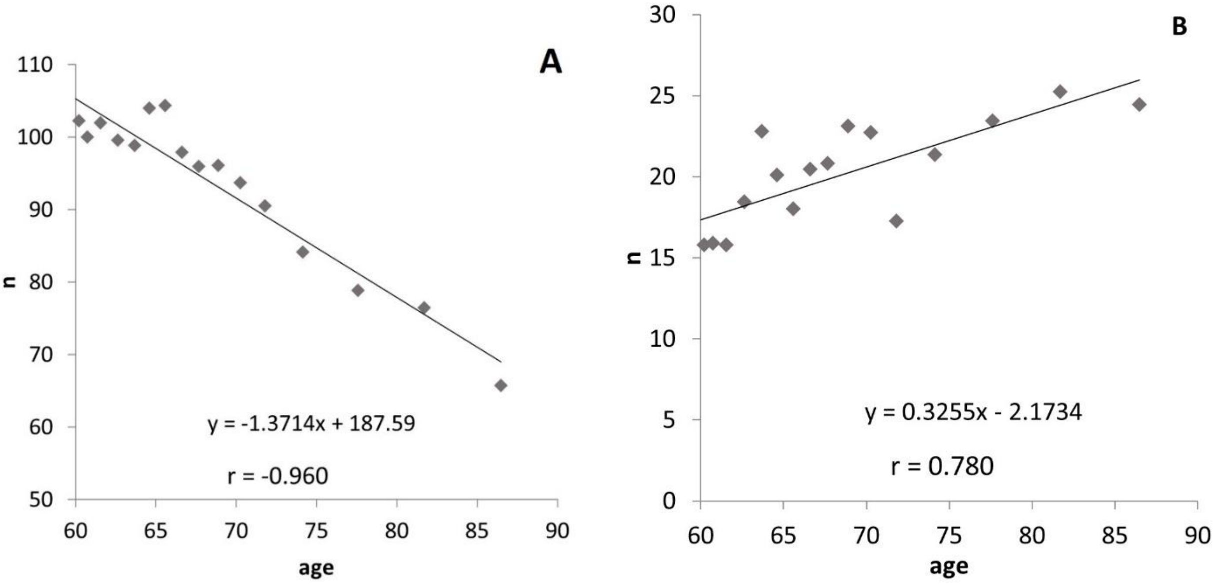

Figure 2. Example graphs of overlapping set means (M – graph A) and standard deviations (SD – graph B) from which the equations related to the 2MWT test (Table 1) were obtained

Results and discussion

The aim of the study was to construct percentile grids (reference curves) for fitness tests included in the Senior Fitness Test for Polish women over 60 years of age who move independently. The same approach was applied to adult women with Turner syndrome (Wiśniewski et al., 2001; Milde et al., 2004), or to body height vs. age (Stupnicki et al., 2001).

Percentile grids were mostly used as growth charts in children (body weight, body height, blood pressure, etc.). There are few reports presenting percentile grids for adults. In 2008, Yonei et al. published a graphical representation of changes in muscle mass in men and women aged 10 - 90+ years (Yonei et al., 2008). In 2013, Gouveia et al. published the percentile distribution of the results of individual SFT tests by age and gender. The percentile grids developed by these researchers were dedicated to the inhabitants of Madeira (Gouveia et al., 2013). In the Czech Republic, Gaba and Pridalova developed percentile curves for age-related changes in body composition (Gaba & Pridalova, 2014), whereas in 2016, percentile grids of BMI were developed for individuals aged 20-90 years (Stupnicki & Tomaszewski, 2016). An important study is a publication by a team led by Ignasiak, who presented a tabular comparison of percentile data on fitness tests based on SFT for men and women over 60 years of age in Poland. The study group consisted of nearly 5,400 individuals (Ignasiak et al., 2020).

Given the decrease in physical activity with age and the consequent decline in functional fitness, it is essential to emphasize the importance of daily moderate vigorous physical activity (MVPA). It was shown that (Liu et al., 2019; Jabłoński, 2021) moderate physical activity helped maintaining functional fitness at an appropriate level (in terms of balance, coordination, muscle strength, and physical capacity). The presented graphical percentile distributions for SFT tests enable an objective monitoring of changes in the selected aspect, taking into account individual differences related to aging. It is also important to note that percentile grids were developed for populations of local countries. For a long time, Poland experienced the process of population aging as a result of increasing life expectancy and low fertility rates. It is estimated that by 2050, the population of people aged 60+ will increase to 13.7 million and will account for over 40% of the total population of Poland (Sytuacja osób starszych w Polsce, 2015). It is important for Polish society to have national norms developed to characterize the changes in functional fitness with age in the Polish population. It is also important to develop graphical and tabular percentile distributions of changes occurring with age in various aspects of functional fitness. . This will enable an appropriate assessment of fitness tests results in relation to the entire population. It is important to detect low levels of functional fitness, as in the late adulthood they correlate positively with a poorer health status and lower self-rated quality of life. It ought to be mentioned that, in our opinion, the small number data pertaining to subjects aged 90+ did not affect the percentile grids for that age category, as the statistical relations would not be expected to break at that age.

Conclusion

Percentile grids conveniently illustrate changes in fitness levels as related to age and provide a valuable feedback for individuals. With percentile grids, individual changes relative to reference values can be monitored, e.g. the rate of decline in functional fitness.

Limitations - The present study has some limitations. E.g., living areas (urban/rural) and practiced activities were not considered and may provide interesting insights in further studies.

As to age categories – collecting more data related to subjects aged 75+ would certainly provide more accurate relationships; yet, the statistical relationships would not be expected to seriously change compared to the presented ones.

List of abbreviations - SFT – Senior Fitness Test; AC – arm curl; 30SCS - 30-second Chair Stand; BST – Back Scratch Test; CSRT - Chair Sit and Reach Test; TUG - 8-Foot Up and Go; 2MWT - 2-Minute Walk Test; n – number of repetitions; t – overtime in seconds; cm – centimeter

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Corresponding information:

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Correspondence to: Anna Leś, PhD University: The Józef Piłsudski University of Physical Education in Warsaw, Marymoncka 3400-968 Warszawa 45 Faculty: Faculty of Physical Education E-mail: anna.les@awf.edu.pl