

Effects of physical activity on Fullerton test results in the elderly

Żanna Fiodorenko-Dumas¹, Małgorzata Paprocka-Borowicz¹, Rafał Małecki²

¹ Wrocław Medical University, Department of Physiotherapy

² Wrocław Medical University, Department of Angiology, Hypertension and Diabetology

Abstract

Background. It seems that the increasingly longer average life expectancy of a human is associated with lifestyle changes. Many people care about healthy diet, the percentage of smokers has declined, and the number of people receiving regular health screening has increased. Despite the ageing society, an increasing number of senior citizens wish to be active, not only socially, but also physically. **The aim of this study** was to assess physical fitness in elderly yogis and Nordic walkers using Fullerton Fitness Test as well as to attempt to verify which of these forms of recreational activity is more beneficial in terms of good physical shape. **Material and methods.** The study included 55 individuals (27 yogis and 28 walkers). Active participation in the selected forms of activity for at least 2 years was a condition to participate in the study. Most respondents were aged between 60 and 73 years, with a mean of 63.4 ± 7.35 years. Research methods included an assessment of motor performance using Fullerton Fitness Test, complemented with 2 attempts of the Eurofit Test for adults. Socio-demographic characteristics were obtained based on author's questionnaire. Statistica 9.1 was used for statistical analysis. Parametric t-student test for independent samples and non-parametric U-Mann Whitney test for independent samples were used in order to determine the significance of differences in the mean values in the study groups. A coefficient value of $p < 0,05$ was accepted as statistically significant for all tests. **Results.** Regular physical exercise had an effect on mood improvement in 47% of yoga practitioners and 28% of Nordic walkers in the study groups. More than half of the respondents in both groups noted a significant improvement in joint mobility (59% vs. 67%) as well as reduced load of joints (35% vs. 56%). Fullerton test showed that the differences in the performed attempts between the two study groups were minor and statistically insignificant, except for the level of lower body flexibility, which was higher in Nordic walking respondents. Polish respondents achieved better results compared to the standards for the U.S. population, especially in the 8 foot up-and-go test as well as the sitting-rising test. **Conclusions.** Sports discipline determines the results of the Fullerton test. Individuals practicing yoga were able to maintain balance for longer periods compared to those practicing Nordic walking; there were no significant differences for the U.S. population. *Geriatrics 2015; 9: 211-217.*

Keywords: physical activity, old age, motor efficiency, balance

Introduction

An analysis of data from the media, newspapers as well as other news portals allows to conclude that the 20th century was a time of young people, who accounted for a large portion of population. Prognoses are, however, rather worrying. In 2050, senior citizens will account for as much as 30% of the total world population. Therefore, specialists sound a warning and describe the phenomena as a "demographic collapse". Many people's dreams of long life expectancy due to the progress of medicine have become more achievable. The

picture of an ageing world and a vision that soon more and more people will need care, whereas the number of those providing this care will decrease, entail the necessity of raising the awareness of being active among the ageing generation and provides an opportunity to achieve independence as well as the highest possible quality of life. Advances in medicine and science as well as promoting healthy lifestyle have effects on the changes in the perception of old age in those who tend to withdraw from life during this period [1].

Physical fitness and physical efficiency are factors

that determine normal development of the body as well as the smooth course of the processes of ageing. High physical fitness and efficiency levels achieved in youth and maintained in adulthood through sport and physical exercise as well as various forms of tourism and physical recreation ensure health as well as slower, physiological course of ageing throughout life. It is generally known that practicing a sport discipline that had been practiced before and whose technique is familiar ensures the greatest satisfaction. However, if this is not possible for different reasons, experts have an arsenal of choices – from athletics (run/walk, cross-country skiing) up to morning or group exercise, tourism and walks, as well as active holiday. Nordic walking, which enjoys a growing popularity, is a relatively new form of recreation chosen by the elderly. The desire to improve health through preventive measures aiming to enhance physical fitness and efficiency has become increasingly global [2].

Modern old age is a period when regressive changes become a fact. Many symptoms typical of the onset of ageing occur already in the middle age years, and these include wrinkles, weight gain, reduced muscle strength and elasticity, sight or hearing problems. It is very difficult and even impossible to match biological age to chronological age, however, some of the involuntional changes may be predicted based on the sequence of the ageing of tissues.

Decreased aerobic capacity in the skeletal muscles, constant decrease in static and dynamic endurance as well as in the overall muscle strength have effects on the willingness to take up physical exercise. Additional changes in the respiratory tract, declining vital capacity and maximum exhalation, reduced maximum individual exercise heart rate as well as symptoms associated with progressive atherosclerosis limit movement capabilities in the elderly. Musculoskeletal limitations in the form of reduced joint mobility and pain due to the gradual wear of the articular cartilage may be observed [3]. Despite these limitations, properly constructed exercise training triggers some beneficial adaptation mechanisms in the body, while exercise regularity ensures, as compared to the elderly who do not practise any sports, physical fitness shown by people several years younger. It has been suggested by The World Health Organization that such training should take into account the following guidelines: individual/group activities, varied forms of exercise, gradation of difficulty, enjoyable and relaxing exercises, regularity.

According to Szwarc et al. [4], when introducing physical exercise we should avoid static exercises, exclude apnea training and exercises that cause rapid blood flow to the head, avoid exercises that increase intrathoracic pressure, which impedes blood circulation. In modern medicine, physical exercise is regarded as absolutely essential for human health protection. The freedom of choice is only related to the selection of the recreational form and everyone - without exceptions - should exercise.

The aim of this study was to assess the physical fitness in elderly yogis and walkers as well as to attempt to verify which of these forms of recreational activity is more beneficial in terms of good physical shape, based on the level of primary motor parameters and the relationship between the assessment of senior physical fitness and the selected form of physical activity.

Material and methods

The study included 55 individuals (27 yogis and 28 walkers). Active participation in the selected forms of activity for at least 2 years was a condition to participate in the study. Most respondents were aged between 60 and 73 years, with a mean of 63.4 ± 7.35 years. All subjects were informed about the anonymity of the experiment. Measurements were performed in the post-training hours.

Research methods included an assessment of motor performance using Fullerton Fitness Test, completed with 2 attempts of the Eurofit Test for adults; socio-demographic characteristics were obtained based on author's questionnaire.

Fullerton Fitness Test, which is used to assess the functional capacity of the elderly, was developed at the California State University. The test is safe, it does not require the use of any specialist equipment and is used to assess, based on 6 items, parameters such as strength, flexibility, coordination and endurance. The sequence of items is strictly defined, and the test begins with a task of a forearm flexion, followed by rising from and sitting on a chair, "back scratch", the "chair sit and reach", the complex coordination "8 feet" trial and a 6-minute walk trial [5,6].

In order to collect all motor characteristics of physical efficiency, the study was supplemented with additional trials derived from the Eurofit Test for adults, single leg balance test and a vertical two-leg jump. Author's questionnaire was used to obtain socio-demographic characteristics [7].

Statistical analysis

Statistica 9.1 was used for statistical analysis, parametric t-student test for independent samples or non-parametric U-Mann Whitney test for independent samples were used in order to determine the significance of differences in the study groups. A coefficient value of $p < 0,05$ was accepted as statistically significant for all tests.

Results

All respondents observed that the dynamics had a significant effect on their life through enhancing their fitness and wellbeing. Mood improvement was reported by 47% of respondents practicing yoga and 28% of those practicing Nordic walking. More than half of respondents in both groups noted a significant improvement in joint mobility (59% vs. 67%) as well as reduced joint load (35% vs. 56%). The respondents noted changes in their hemodynamic parameters over the period of training. Normalized blood pressure was observed in 24% of yogis and 17% of Nordic walkers; improved blood circulation was observed by the same portion of respondents in both groups, i.e. 28%. Body weight reduction observed in 44% of walkers and decreased cholesterol levels reported by 12% of yogis were also significant (Table I).

The results for the number of forearm flexions slightly differed between the study groups; test results of $t > 0.05$ confirm that these differences were statistically insignificant.

The assessment of lower body muscle strength involved rising from and sitting on a chair during 30 seconds. The results varied, and the mean value differences were slight, i.e. 0.7; the test result $t = 1.31$

indicated statistically insignificant difference.

The assessment of upper body flexibility involved measuring the distance between the middle fingers of both hands facing the back (from the top and the bottom, a so called "safety pin"). Mean value for upper body flexibility was 1 cm in yogis and 0.9 cm in Nordic walkers, the difference was slight and statistically insignificant.

The levels of lower body flexibility differed between the study groups. The distance between the middle finger and the first toe was assessed. The distance was 3.6 cm in yoga group. These results are much poorer than those reported for Nordic walkers, where the mean distance was 6.3 cm. The difference between the groups is statistically significant, the mean test values in NWs are higher almost by half, and the t-student test indicates statistical significance with $p > 0.05$ (Table II).

There were statistically significant differences ($t=0.0003$) in the results achieved by the two study groups during the complex coordination trial, which involved an assessment of the time between rising from a chair and walking a distance. The coefficient of variation was high, indicating significant heterogeneity within the characteristic.

An evaluation of the distance covered in the six-minute walk test assessed the exercise tolerance in the elderly. The coefficient of variation in these groups indicates high divergence of results. Test results of $t = 0.00002$ indicate statistically significant differences between the groups (Table II).

Since standards for healthy elderly Polish population have not been developed so far, the results may be compared only to those obtained in the U.S population, based on a study including 7,000 U.S. citizens. Normal

Table I. The effect of physical activity on the health of subjects

The effects of physical activities on health and wellbeing	Yoga		Nordic	
	n	%	n	%
Reduced joint load	9	35	15	56
Increased joint mobility	16	59	19	67
Improved fitness and endurance	11	41	26	94
Normalized blood pressure	6	24	5	17
Improved mood	13	47	8	28
Strengthened muscles	6	24	19	67
Improved blood circulation	8	29	8	28
Reduced body weight	5	18	12	44
Reduced cholesterol levels	3	12	2	6

Table II. Fullerton test results in the study groups

	The number of forearm flexions during 30 s					
	n	mean	minimum	maximum	Standard deviation	CV
Yoga	27	17.058	13.000	20.000	2.135	12.516
NW	28	18.555	15.000	24.000	2.381	12.836
	The number of sitting-rising trails					
yoga	27	16.647	12.000	20.000	2.396	14.395
NW	28	17.333	0.000	21.000	4.485	25.876
	Upper body flexibility					
yoga	27	1.029	-6.500	9.000	3.994	387.990
NW	28	0.972	-5.000	6.500	3.345	344.077
	Lower body flexibility					
yoga	27	3.647	-3.000	14.000	5.252	144.014
NW	28	6.305	-6.500	21.000	7.744	122.817
	The "8 feet" trial					
yoga	27	4.405	3.800	4.800	0.330	7.505
NW	28	3.905	3.000	4.400	0.397	10.184
	Distance travelled in 6 minutes					
yoga	27	549.823	490.000	620.000	43.000	7.820
NW	28	640.777	590.000	720.000	43.308	6.758

Table III. Comparison of Fullerton Test results to those achieved in the U.S. population

Study group	The standard number of forearm flexions during 30 seconds			Mean value	
	Below average	Average	Above average	Yoga	Nordic Walking
females	<13	12-18	>18	17.4	19
males	<15	15-21	>21	20	16
	Standard values for rising and sitting trial				
females	<11	11-16	>16	18	17.3
males	<12	12-18	>18	19	20
	Standard values for upper body flexibility				
females	<1.5	1.5-3.5	>3.5	0.5	1.2
males	<-1.0	-1-7.5	>7.5	-5	4.5
	Standard values for lower body flexibility				
females	<-0.5	-0.5-4.5	>4.5	-2	3.5
males	<-3.0	-3.0-3.0	>3.0	-2.0	-6.5
	Standard values for "8 feet" complex coordination trial				
females	>6.4	6.4-4.8	<4.8	4.0	3.96
males	>5.7	5.7-4.3	<4.3	4.1	3.4
	Standard values for 6-minute walk trial				
females	<457	457-580	>580	522	680
males	<512	512-640	>640	490	607

range means the results achieved by 50% of subjects, whereas other results are considered as "below average" or "above average".

According to the U.S. standards, our study results for the trial assessing the number of forearm flexions indicated an average physical capacity; only NW senior

females showed higher mean results than those achieved by their U.S. counterparts.

According to our analysis, both males and females achieved far better results in "rise and sit" trial as compared to their U.S. counterparts. Regarding the type of physical activity, female yogis achieved better results

compared to female Nordic walkers, whereas in males the situation was reverse.

The assessment of upper body flexibility showed that individuals practicing yoga achieved better results compared to both, the U.S. population and NW group. Surprisingly, the assessment of lower body flexibility showed that compared to the standards for the U.S. population, female walkers achieved better results compared to both, female yogis and the average U.S. standard for the study population (Table III).

Both study groups achieved better results in the complex coordination - "8 feet" - trial, which involved rising from a chair and covering a walking distance at fastest speed possible, as compared to the U.S. population. Both individuals practicing yoga, and Nordic walkers achieved better results in this trial.

When comparing the outcomes of the 6-minute walk test to those achieved in the U.S. population, it may be concluded that better results were achieved by female Nordic walkers and male yogis (Table III).

There were no significant sports discipline-related differences between the groups in the Eurofit test involving the maintenance of the whole body balance when standing on one leg. The results of the single-leg standing balance test were similar for yoga and Nordic walking populations, therefore there was no statistical significance in this trial.

The analysis of the mean arithmetic values of the explosive power in the high jump trial indicates that yoga practitioners show higher explosive power, i.e. 17.7 cm, whereas it was lower, i.e. 16.3 cm, in the comparative group. The difference between the groups was statistically insignificant ($t > 0.05$).

According to the U.S. standards, both female and male Nordic walkers showed balance Eurofit test results indicating physical efficiency above average. These results are better than those achieved by yogis or the average results in the U.S. population.

Confrontation of our results with vertical jump standards places both groups below the average range. The achieved values were statistically insignificant when comparing the results with those achieved by Polish respondents.

Discussion

Although age-related decline in fitness and physical capacity is a natural and inevitable fact, it occurs with different pace and intensity at the individual level. Factors such as age, gender as well as living environ-

ment and education may have an effect on the level of physical fitness.

Jaracz and Woźna [8], showed in their study that the living environment becomes a determinant of a lower quality of life in terms of physical fitness. The monitored growth of the elderly population in recent years has become the foundation for a number of studies, thorough analyses and assessments of the physical condition of seniors from various social classes and backgrounds. This was to be the basis for the development of health-oriented programmes for primary and secondary prevention improving the quality of life and health in this social group.

Our studies indicate that regular physical activity not only improved the mood of respondents, irrespective of the type of physical activity they practiced. Furthermore, half of respondents in both groups noted a significant improvement in joint mobility (59% of yogis vs. 67% of Nordic walkers). Joint load reduction was reported by 35% of yogis and 56% of Nordic walkers.

Ignasiak et al. [9] showed differences in physical fitness test results between Polish and U.S. seniors (Fullerton Tests). Both men and women from the Polish population achieved poorer results in the conducted trials as well as when compared to the U.S. population.

Our results presented in this paper are much higher than the average outcomes achieved in the U.S. population. In just a few years, there has been a revival of the issue related to the support of an ageing population; the awareness of the need to exercise was raised, and a wide range of activities, which may ensure independence and strength to achieve the highest possible life quality, was popularized. Nordic walking, yoga, walking, dancing, swimming, exercises and cycling are recommended for and frequently selected by the enthusiasts of physical activity. These are natural forms of movement, which may be performed with varying intensity, are characterized by attractiveness, availability, an effect on muscle growth as well as an improvement of balance without the risk of falls.

According to Szwarc [4], most of today's diseases affecting the elderly are associated with the exposure to such risk factors as decreased physical activity or social isolation.

The presented data are supported by our results, as mentioned above, which clearly indicate that these types of physical activity are the best possible choice as when practiced regularly, they allow to effectively develop and

maintain physical fitness, cardiovascular endurance and the ability to work physically. Blood pressure normalization was achieved in 24% of yogis and 17% of Nordic walkers; improved blood circulation was observed by 28% of respondents in each group. Body weight reduction in 44% of walkers and a decline in cholesterol levels in 12% of yogis were also significant.

Szopa [10] and Kulmatycki [11] show that yoga can be used as a physical activity to develop physical capacity, reduce body weight and improve joint mobility and mood. Our study, which was conducted using Fullerton test, showed a particular impact of yoga on upper body flexibility. Also, higher results were achieved in vertical jump trial and balance maintenance as compared to Nordic walking group. Zdrodowska et al. [12], in their assessment of physical fitness in the elderly, used the Fullerton Test in order to evaluate the level of physical fitness in the students of the University of the Third Age in relation to the U.S. standards. In all conducted trials, the subjects achieved positive results after normalization to mean values and standard deviation of their U.S. counterparts. Of all tests, forearm flexion trial showed the most differences in relation to U.S. standards. Grześkowiak et al. [13] in their studies to show the differences between own results and those obtained in the USA as well as to attempt to explain the reasons for the divergence in the results achieved by the elderly, revealed that Polish females achieved poorer results compared to the control group. This occurred in the "8 feet" test or upper body flexibility test. Although similar outcomes were obtained for a trial assessing lower body flexibility, the results were similar for both groups. Our results indicated trials, whose results were higher compared to the U.S. population. This occurred in the "8 feet" test both, in females and males, as well as during the "sitting-rising" trial. The differences in the obtained results may have resulted from the type of physical activity as well as from the gender of subjects.

Szczepaniak et al. [14] assessed the physical activity of osteoporotic women over 65 years of age. In this case, Fullerton test results were also compared to those in the U.S. population, to the disadvantage of Polish respondents. This was probably due to the ongoing disease process and limited ability to perform everyday duties. According to Howley and Franks [15], physical fitness is aimed at positive physical health, which determines the low risk of diseases, while motor achievements target the ability to engage in daily tasks with adequate energy as well as satisfactory participation in

selected sports. Studies among respondents practicing yoga and Nordic walking showed that regular physical activity had beneficial effects in the Fullerton test for a six-minute walk test. Walkers achieved better results than the U.S. respondents [16].

The Fullerton Test gives the possibility of planning, leading and the control of effects of applied physical activity, it also allows to the quick and easy performance of the results of the work studied what is the very important unit of improving. The visualization of modifications and sensible co-operation, making up the justification to the farther work they let aim to achieving the better results of single Fullerton tests. Nowadays, the progressive demographic ageing of society generates the need to address the problems and the needs of the elderly. This has resulted in the establishment of Universities of the Third Age, whose aim is to include the elderly in the education system, thus enabling them to update and expand their knowledge as well as to actively participate in the processes that take place around them, to maintain and enhance their intellectual, mental and physical capacity [17].

The presented results were confirmed by Prystup et al. [18] in their studies, where healthy individuals who regularly practice physical exercise were able to achieve better Fullerton outcomes compared to physically inactive population. Although most of the activities practiced by the senior females were aerobic, strength and flexibility exercises were also included. This resulted in adequate aerobic endurance and strength in the elderly.

Unfortunately, most of the elderly in Poland are characterized by low levels of physical activity. This may result from the low health awareness related to physical activity among the elderly. This problem particularly concerns people over 70 years of age, 80% of whom do not see indications and the need of rehabilitation [19,20]. Assessment of physical fitness provides an opportunity to develop an appropriate program for physical activity, which may delay the process of ageing as well as prolong the period of independence and self-reliance of the elderly.

Regularly taken up physical activity is important in every age, particularly at older persons, because they make possible the conduct of physical efficiency. If the physical activity drops with the age, then maintenance or the improvement of efficiency will be short-term. The more exempt fall of efficiency is the long-term advantage flowing from the physical activity now in the relation by age [21].

Conclusions

1. Practiced sports discipline determines the results of the Fullerton test.
2. There were statistically significant differences between the test results and the U.S. population standards in “8 feet” and “rise and sit” trials.
3. Individuals practicing yoga were able to maintain balance for longer periods compared to Nordic walkers; there were no significant differences for the U.S. population.

Acknowledgments

The authors received no external funding for this study. The authors have no conflict of interest to declare.

Correspondence address:

✉ Żanna Fiodorenko-Dumas
Department of Physiotherapy, Wrocław Medical University
2, Grunwaldzka Str.; 50-355 Wrocław
☎ (+48 71) 784 01 86
✉ z.fiodorenko@poczta.onet.pl

References

1. Porzych K, Grzešek G, Grabowska-Gaweł A. Aktywność ruchowa u osób w wieku podeszłym. *Kwart Ortop.* 2003;4.
2. Talaga J. Sprawność fizyczna ogólna. Testy. Poznań: Zysk i S-ka; 2004. str. 120-122.
3. Saelens BE, Sallis JF, Black JB, et al. Neighborhood-based differences in physical activity: An environment scale evaluation. *Am J Public Health.* 2003;93:1552-8.
4. Szwarz H, Wasilewska R, Wolańska T. Rekreacja ruchowa osób starszych. Warszawa: AWF; 1996. str. 5-17.
5. Różańska-Kirschke A, Kocur P, Wilk M i wsp. The Fullerton Fitness Test as an index of fitness in the elderly. *Med Rehabil.* 2006;10(2):9-16.
6. Miotto MJ, Chodzko-Zajko WJ, Reich JL, et al. Reliability and Validity of the Fullerton Functional Fitness Test: An Independent Replication Study. *J Aging Physical Activity.* 1999;7:339-53.
7. Ćwirlej-Sozańska A, Wilmowska-Pietruszyńska A, Guzik A i wsp. Evaluation of the usefulness of selected scales and methods used in the assessment of balance and physical fitness in seniors – a pilot study. *Rzeszów: Przegląd Medyczny Uniwersytetu Rzeszowskiego i Narodowego Instytutu Leków w Warszawie* 2015;1:8-18.
8. Jaracz K, Woźna M. Subiektywna ocena zdrowia i jakości życia osób starszych. *Pielęg Pol.* 2001;2(12):262-9.
9. Ignasiak Z, Kaczorowska A, Katan A, Domaradzki J. Evaluation of fitness of elderly women by means of Fullerton Test. *Fizjoterapia* 2009;17(2):48-52.
10. Górna J, Szopa J. Joga, ruch – oddech – relaks. Katowice: Wydawnictwo KOS; 2005.
11. Kulmatycki L. Joga nidra, sztuka relaksacji. Warszawa: Wydawnictwo Książka i Wiedza; 2004.
12. Zdrowska A, Wiszomirska I, Niemierzycka A i wsp. Sprawność fizyczna kobiet po 60 roku życia uczestniczących w zajęciach Uniwersytetu Trzeciego Wieku. *Post Rehab.* 2012;(3):19-25.
13. Grześkowiak J, Wieliński D. Wykorzystanie testu Fullerton Functional Fitness do badania ryzyka upadków u osób w podeszłym wieku. *Antropomotoryka.* 2008;18(44):85-90.
14. Szczepaniak R, Brzuszkiewicz-Kuźmicka G, Szczepkowski M i wsp. Evaluation of the motor activity and physical fitness of women over 65 years of age diagnosed with osteoporosis. Preliminary reports. *Rzeszów: Przegląd Medyczny Uniwersytetu Rzeszowskiego i Narodowego Instytutu Leków w Warszawie;* 2014(1):62-73.
15. Howley ET, Franks BD. Health fitness instructor's handbook. Human Kinetics, Champaign; 1999.
16. Król-Zielińska M, Osiński W, Zieliński J i wsp. Sprawność fizyczna osób starszych w Polsce w porównaniu z populacją Stanów Zjednoczonych. *Studies in Physical Culture and Tourism* 2006;13:53-5.
17. Jones C, Jessie, Rikli R. Senior Fitness Test Manual. *J Aging Physical Activity.* 2002;10(1):110.
18. Prystupa T, Bolach E, Bolach B i wsp. Ocena sprawności fizycznej kobiet po 60 roku życia. *Pedagog Psychol Med-Biol Probl Phys Train Sports.* 2012;05:137-47.
19. Osiński W. Koncepcja „Health – Related Fitness” jako teoretyczna podstawa we współczesnym systemie wychowania fizycznego. W: *Wychowanie fizyczne w nowym systemie edukacyjnym.* Muszkieta R, Bronikowski M (red.). Poznań: AWF; 2000.
20. Zieliński W. Sprawność fizyczna populacji polskiej i amerykańskiej po 64 roku życia. *Ann Univ Mariae Curie-Skłodowska Med.* 2005;LX(XVI):432-5.
21. MacAuley D, Macauley D. Potential benefits of physical activity undertaken by older people. *Med Sport.* 2001;5(4): 229-36.