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## Results of Fullerton Test in older people. Group comparison due to the Nordic Walking and long walks undertaking

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**Key words:** Nordic Walking, physical activity, long walks, Fullerton test

### Abstract

**Introduction:** Standardly, high level of physical activity is prescribed to the older patients. However, it is worth to examine if every kind of physical activity give the same amount of health benefits, or is it dependent on its modality.

**Aim:** The purpose of above studies is to measure the differences in Fullerton subtests results in group who does vs in group who does not undertake regular long walks (LW) and Nordic Walking (NW).

**Material and methods:** Subtests of Fullerton tests were used to examine the physical performance of patients. Physical activity questionnaire was used to distinguish groups of patients who do vs do not engage in long walks and Nordic Walking regularly.

**Results:** There were no statistically significant differences in Fullerton scores due to NW-engagement. In contrary, group engaged in LW walked 42.41 meters more in 6-minute walk tests than group who do not undertake such activity. Moreover, Upper Right and Left Limbs Strength tests and its mean scores were better in LW-group by 4.23, 4.6 and 4.09 repetitions, respectively.

**Conclusions:** There was no statistically significant differences in results of Fullerton subtests between group of NW-engaged older people comparing to group who do not undertake NW. Group of participants engaged in long walks had better scores aerobic capacity and upper limbs strength tests.

## **Introduction**

Several studies report benefits due to undertaking the systematic physical activity in people of all ages [1, 2]. Authors define physical activity in different manners, for example Kozłowski describe physical activity as a skeletal muscle work with accompanying functional changes opposed to Caspersen et al. define as a every energy-requiring body movement [3]. In Poland, researches conducted by the Central Statistical Office of Poland in 2008 stated that only 20,7% of elderly population is involved in any form of systematic physical activity. Nordic Walking (NW) is a form of physical recreation originally created in Finland as a form training for cross-country skiing athletes. However, it could be a perfect tool to use for wide-use. Despite of the high intensity and engagement of multiple muscle groups, the poles relieve joints which makes it suitable for the older people described above [Polish Nordic Walking Association].

Additionally, it is worth to consider health in its broad sense. According to Kozdroń and Leś not only mental and social fitness but also physical fitness could be included into components of “health” [4, 5]. Laonde distinguished four of the most important determinants of health: lifestyle, environment, genetic factors and medical care organization. This has contributed to the development of awareness and promotion of health [6]. Age affects progressive destruction of motion organs and sensory functions largely responsible for balance control (proper hearing, good vision, superficial and deep feeling). This changes lead to deterioration of body stability and endurance. The aging process greatly affects the desire to engage in physical activity also is related to the decreasing lung capacity, lowering the maximum heart rate, atherosclerosis occurrence which increases the risk of heart cardiovascular events, additional to decreased joint range of movement as

a result of articular cartilage deterioration. Properly designed physical training protocol could be an effective treatment for improving decline of some of the organism functions [7, 8].

A physically capable person has specific motor characteristics: strength, agility and endurance [9]. Physical fitness in elderly people is tested with Fullerton test, which does not require any specialized equipment and provides multifaceted assessment.

Undertaking of long walks is one of the most available forms of physical activity for older people, which is associated with several health benefits. Interestingly, participation in training protocols which included 30-min walk per day 5 days per week or three 10-minutes of walks per day, 5 days per week significantly improved predicted VO<sub>2</sub>max in older participants [10]. Noteworthy, Authors claimed that three bouts of 10-minutes walks was more effective than one but of 30-minutes [10]. Long walks are associated with greater energy costs in group of healthy, older people compared to young controls [11]. Additionally, compared to walking, there is a higher level involvement of muscles in upper-body segment in NW which may play a role in higher level of energy expenditure [12,13]. Results of studies from 2011 [12] compared the effects of three interventions: NW, walking and relaxation and stretching protocol in older patients with Parkinson Disease. Walking as well as and NW significantly improved stride length, gait variability and speed, aerobic and disease-specific disability [12]. However, NW was superior to the flexibility and relaxation protocol and walking in improving postural stability, stride length, gait pattern and gait variability [12]. Furthermore, others [14] noted positive effects of NW and walking interventions on aerobic capacity and underlined that NW is a single method which improves several dimensions of physical functioning. However, as Authors [12] noted, there is a great importance of proper technique of NW execution, which should be learned in supervised conditions before taking part in training protocol [12]. Therefore, walking seems to be beneficial, noting its wide availability. Moreover, drawing conclusions from results of cross-sectional studies based on the question if participants take part in NW could be misleading: several factors, for example, economic, can influence on decision to take part in supervised protocol. Moreover, it is not possible to control of proper technique of NW by any of physical activity questionnaires used in such studied. If the NW execution technique is poor, the movement is often very similar to walking solely. Therefore, in the above studies we have decided to analyze the differences in physical performance between groups based on two categories: NW and long walks undertaking. The correct technique of Nordic walking is the key to achieving the optimal effect. The most common mistake is moving the sticks with elbows [15]. Researches results of the German Sport University in Cologne (Deutsche Sporthochschule Köln) showed that NW execution with proper technique, i.e. with shoulder joint involvement, causes an increased torso rotation and greater muscle involvement of triceps brachii, lower part of erector

spinae and lateral abdominal muscles. Inappropriate technique of NW execution is no different from walking without the sticks in terms of energy expenditure [15].

Therefore, it is worth to examine if overall physical activity level or undertaking any particular regular physical activity prevents functioning decline due to aging in longitudinal studies. In this preliminary studies, we have investigated if there is a difference in level of physical functioning between group of older people who undertake regular NW and LW vs groups who do not take part in such activity.

## **Objective**

The purpose of above studies is to measure the differences in Fullerton subtests results in group who does vs in group who does not undertake regular LW and NW.

## **Material and methods**

In this study we enrolled 128 participants who were examined in Clinic of Geriatric acquired by Physical Activity and Leisure Activity Questionnaires and assessment of functional measured by Fullerton Functional Fitness Test [16]. Patients were enrolled into studies during public health-promoting lectures, in Day Care Centers for the Elderly, and on various meeting-groups for older people. Examination was conducted at Collegium Medicum University Hospital in Bydgoszcz, in Chair and Clinic of Geriatrics.

Participants were tested by Fullerton Functional Fitness Test. Fullerton Test included a 6MWT – 6-minute walk test, UG – 8-ft up-and-go, URLS – Upper right limb strength, ULLS – Upper left limb strength, ULS–mean - Upper limb strength–mean, LLS – Lower limb strength. To examine strength we have used two tests: arm curl test and 30-s chair stand. In both tests the score is the number of repetitions done in 30 seconds. Arm curl test was performed using two types of weight - 2 kg for women and 3,5 kg for men. 30-s chair stand test was performed on the chair with a backrest. Test protocol contains standing from sitting position to a standing with full extension in knees and hips, without pushing off with the arms. Aerobic capacity was estimated by 6 Minutes Walk Tests (6MWT) [17]. The corridor distance was 50 meters, to reduce patients time spending on turning. Moreover, we decide to ask patients to walk as fast as he/or she is able to, reminding that they ought to maintain same velocity during whole test as well as we reminded two times about duration of test and ask patients to think about the walk velocity which he or she is able to maintain during whole time. Most of patients were walking alone, if not enough time interval between next patients starting test was maintained to exclude competition factor. 8-ft up-and-go measures speed, agility and balance while moving. The patients start fully seated, hands resting on the knees and feet flat on

the ground. On the command, "Go," time is started and the patient stand up and walks (no running) as quickly as possible (distance of 8 feet), returning to the chair to sit down. Timing stops as they sit down. Perform two trials.

Physical Activity and Leisure Activity Questionnaires were included three parts: Daily and social activity, traveling and physical activity. Daily and social activity included questions about frequency of reading, watching TV, listening to the radio, going to restaurant, theatre, church, visit friends, use a computer, crosswords solving etc. Traveling included questions the frequency of traveling. Physical activity included questions and frequency of different forms of physical activity as a short walks near house, long walks (more than 40 minutes), gymnastics, bike riding, jogging, swimming, nordic walking, work on the plot/garden etc. The answers of the Questionnaires were a choose a response of frequency: once a year, several times a year, 1-2 times a month, once a week, a few times a week or daily. Comparison of objective measurement done by accelometry and self-reported physical activity measures showed the highest level of correlation with, inter alia, number of long walks [10].

Shapiro-Wilk test was used to examine the distribution normality of examined variables values. Levene's test was used to examine the homogeneity of variances. Independent samples t-test with grouping variable (yes/no answers on "Do You undertake Nordic Walking" and "Do You undertake long walks" questions) was used for normally distributed values, otherwise U-Mann Whitney Test was used. All statistical analyses were performed using statistical package (StatSoft, Inc. (2014). STATISTICA (data analysis software system), version 13.1 [www.statsoft.com](http://www.statsoft.com)).

## **Results**

Whole sample group consisted of 128 individuals (Table 1). Mean age of participants was 68,8. N Value shows differences in number of observations in particular subtests of Fullerton which took place to the technical problems.

**Table 1. Descriptive statistics**

Variable	N Value	Mean	Min	Max.	Lower quartile	Higher quartile	Variation	Std. Dev.	Skewness	Kurtosis
Age	128	68.80	58.0	88.0	64	73	36.98	6.08	0.65	-0.04
6MWT	119	521.06	360	710.0	457.0	580.0	6831.55	82.65	0.24	-0.78
UG	96	5.78	3.2	17.0	4.6	6.0	4.74	2.18	2.69	9.96
URLS	110	19.66	6	36.0	15.0	23.0	39.99	6.32	0.47	0.15
ULLS	111	19.83	8	37.0	15.0	24.0	39.56	6.29	0.66	0.08
ULS	112	19.48	5	36.5	15.0	23.5	39.95	6.32	0.56	0.12
LLS	116	14.32	4	28.0	12.0	16.0	21.23	4.61	0.81	0.79

Abbreviations: 6MWT – 6-minute walk test, UG – 8-ft up-and-go, URLS – Upper right limb strength, ULLS – Upper left limb strength, ULS–mean - Upper limb strength–mean, LLS – Lower limb strength

The NW-engaged group consisted of 55 seniors aged between 58 and 88. The arithmetic mean of age was 69.07 year. The other group consisted of 72 people which were not involved in this form of physical activity. The oldest person from this group was 84 and the youngest 60 years old (Table 2). Interestingly, the mean result of the 6MWT in NW-engaged group is slightly above than 510 meters comparing to slightly above 528 meters in the not-engaged in NW group (Table 2).

In the NW group the mean result of both arms was 21.24 repetitions. Among those subjects not involved in this form of physical activity an average of 18.83 repetitions was recorded.

The mean result of the right arm force test in the group engaged in NW is 20.91 repetitions. The results ranged from 6 to 36 repetitions. The average result obtained in the control group was 18.77 repetitions. The best result was 35 and the worst 8 repetitions. It should be noted that NW-engaged subjects achieved an average 2.41 repetitions more repetitions done by upper left limb than control group, however this difference was not statistically significant. The results of the examined group in the strength of the upper left limb test ranged from 10 to 37 and 8 to 34 in the control one. In both groups subjects achieved on average better results in left upper limb force test than right upper limb force test. The mean leg force test result was 15.24 repetitions in NW and 13.62 in the control group. In the group declaring physical activity in the form of NW results ranged from 6 to 28 repetitions. Amongst subjects not engaged in this form of physical activity the worst result was 4 and the best 24.

In summary, NW-engaged subjects performed worse in 6 MWT, UG subtests included into the Fullerton test, and better in URLS, ULLS and LLS test, however differences were not statistically significant ( $p > 0.05$ ) (Table 2).

**Table 2. Between group differences due to NW-engagement**

Variable	Nordic Walking = yes				Nordic Walking = no				p Value
	N Value	Mean	Min.	Max.	N Value	Mean	Min.	Max.	
Age	55	69.07	58.00	88.00	72	68.64	60.00	84.00	n.s.
6MWT	50	510.44	360.0	685.0	69	528.75	360.0	710.0	n.s.
UG	42	5.91	3.3	17.0	54	5.69	3.2	12.4	n.s.
URLS	46	20.91	6.0	36.0	64	18.77	8.0	35.0	n.s.
ULLS	46	21.24	10.0	37.0	65	18.83	8.0	34.0	n.s.
ULS - mean	46	21.08	9.5	36.5	66	18.37	5.0	33.0	n.s.
LLS	50	15.24	6.0	28.0	66	13.62	4.0	24.0	n.s.

Abbreviations: n.s. – non-significant

The undertaking long walks group consisted of 92 seniors aged between 58 and 88. The arithmetic mean of age was 68.47 year. The other group consisted of 35 people which were not involved in this form of physical activity. The oldest person from this group was 81 and the youngest 60 years old (Table 3). Interestingly, the mean result of the LW in undertaking long walks group is slightly above than 532 meters comparing to slightly above 490 meters in the not-undertaking LW group (Table 3).

In the undertaking long walks group the mean result of both arms was 21.00 repetitions. Among those subjects not involved in this form of physical activity, an average of 15.5 repetitions has been noticed.

The mean result of the right arm force test in the group taking long walks is 20.73 repetitions. The results ranged from 6 to 36 repetitions. The average result obtained in the control group was 16.5 repetitions. The best result was 25 and the worst 10 repetitions. It should be noted that undertaking long walks subjects achieved an average 4,6 repetitions more repetitions done by upper left limb than control group, this difference was statistically significant. The results of the examined group in the strength of the upper left limb test ranged from 10 to 37 and 10 to 26 in the control one. In undertaking long walks group subjects achieved on average better results in left upper limb force test than right upper limb force test. In the control group the situation was reversed. In not-

undertaking LW group subjects achieved on average better results in right upper limb force test than left upper limb force test. However, the difference between the test results was 0.1 repetition.

The mean leg force test result was 14.8 repetitions in examined group and 12.9 in the control group. In the group declaring physical activity in the form of long walks results ranged from 4 to 28 repetitions. Amongst subjects not engaged in this form of physical activity the worst result was 6 and the best 26.

In summary, differences were statistically significant only in case of the 6MWT, URLS, ULLS and ULS - mean ( $p < 0.05$ ) (Table 3).

**Table 3. Between group differences due to undertaking long walks**

Variable	Long walks = yes				Long walks = no				p Value
	N Value	Mean	Min.	Max.	N Value	Mean	Min.	Max.	
Age	92	68.47	58.00	88.00	35	69.8	60.0	81	0.1808
6MWT	86	532.81	360.00	685.00	33	490.4	360.0	710	0.0085
UG	69	5.60	3.16	12.41	27	6.2	3.3	17	0.8905
URLS	82	20.73	6.00	36.00	28	16.5	10.0	25	0.0010
ULLS	83	21.00	8.00	37.00	28	16.4	10.0	26	0.0003
ULS - mean	84	20.49	5.00	36.50	28	16.4	10.0	25	0.0015
LLS	86	14.80	4.00	28.00	30	12.9	6.0	26	0.0538

## Discussion

The main result of above studies is that the LW-engaged group performed better in 6MWT, URLS, ULLS, and mean result of ULS subtests of Fullerton test. In contrary, no statistically significant differences were observed due to NW-engagement in the studied sample.

Zdrodowska and co-authors in 2010 [8] examined physical fitness of woman over 60 years of age participating in Third Century Initiative activities. Mean score of both upper limbs among participants involved in NW was slightly higher among subjects between 60-64 years old of age than non-NW. Moreover, mean result of 60-64 years subjects not involved in NW was comparable to result gained by participants aged between 65 and 70 years [18]. Additionally, Fiodorenko-Dumas and co-authors [8] examined the effects of physical activity (yoga and NW) on Fullerton test results of elderly (participants 60-73 years old). The results of this comparison showed no significant differences between those groups in terms of upper and lower limbs strength. In this study the means score of upper limbs strength amongst NW involved patients was similar to

patients not involved in NW. Interestingly, mean score of lower limbs strength measured within our sample was worse (15.42) than those within Fiodorenko-Dumas et al. studies [8] (yoga 16.64, NW 17.33). Moreover, the average result of 8-foot test was better for subjects examined within our studies (NW 3.90) in another sample [8]. In contrary, our NW-involved and not involved groups in our sample performed worse in the 6MTW test (510.44 and 528.82 meters, respectively) compared to results of yoga exercising subjects (549.82) or NW involved patients examined by Fiodorenko-Dumas et al. [8]. In overall, better results were observed in the NW group in another studies [8], as opposed to the results obtained within our sample. The difference is probably due to the frequency and technique of exercising. Importantly, there was no opportunity of determining whether the activity was conducted properly in our case.

Reuter et al. [13] underlined the importance of proper technique of NW execution, by adding training bouts of in the correct exercise technique. For six months, one of three sessions a week was devoted for training with the NW sticks. In our own study, it was not determined whether participants were amateurs or after NW course.

In Takeshima and co-authors [14] studies, the effects of systematic training in NW group was compared with conventional walking group. Both groups trained 3 times a week for 12 weeks in overall. In the NW group, participants were instructed in proper execution technique before intervention. Improvement in the walking group were noted in the upper and lower limb strength and overall endurance. In addition a slight decrease in the mean score of the Up and Go test (6.7%) and an improvement in the posterior and anterior reach (successive 25 and 61.3%) were observed [14]. As in Reuters and co-authors studies, better results were achieved amongst NW group than in walking group in contrast to our own research [13]. NW is a very popular form of physical activity nowadays. Compared to walks, NW seem to be more demanding and engages more the upper body parts (enabling the opportunity to burn more kilocalories). Thanks to the used sticks, upper body muscles are more activated and the length of each step is increased resulting in faster walking [13].

Many Authors in their studies, point to the benefits of physical activity at any age such as reducing the risk of cardiovascular, respiratory, nervous or motor diseases. Therefore older people should systematically train according to individually tailored training protocol that will slow down the process of involution which has a significant effect on the systems and organs. NW due to its easy accessibility and training technique became one of the most common physical activity which seems to have several benefits.

In order to verify the results of NW training on elderly people, it is advised to specify the frequency and quality of training more accurately in intervention-based studies.

## Conclusions

1. There was no statistically significant differences in results of Fullerton subtests between group of NW-engaged comparing to group who do not undertake NW.
2. Group of people who were engaged in LW had better scores in 6MWT, URLS, ULLS, ULS mean subtests of Fullerton test.

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