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ORIGINAL

Diversified health-related Nordic walking training programs and physical fitness of elderly women

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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abstract

Background Aging of societies results in the growing number of disabled individuals, although the development of medicine and increasing awareness induce such changes as the modification of eating habits and lifestyle, which help to preserved independence for a longer period of time. Due to this, proposals of effective training programs to maintain physical fitness at a level enabling the efficient functioning in everyday life are sought.

Material/Methods The study group consisted of 60 women aged 60–74 years, participating in 6-month Nordic walking training. The respondents were divided into two groups: GE1, realizing endurance training with strengthening and flexibility exercises and GE2 – stricte endurance training program. To determine the level of physical fitness, selected trials of the Eurofit for adults and the Fullerton Functional Fitness Test were used.

Results There was significant improvement in endurance in both groups (GE1 – 4.6%, GE2 – 7.1%). The benefits of exercise have also been reported in the lower limbs muscle strength (GE1 – 13.3%, GE2 – 7.7%). The increase in flexibility (7.3%) was noted only in GE1.

Conclusions The conducted experiment confirms the efficiency of both training programs in all analyzed components. GE1 group's program was more effective in improving the lower limbs muscle strength and flexibility of the spine, while the of GE2 – endurance.

Key words Health-related training, Nordic walking, women aged 60–74 years, endurance, strength, flexibility

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INTRODUCTION

Physical activity, which is an inherent element of a healthy lifestyle, is one of the key methods of improving health and counteracting diseases. According to the HRF (Health Related Fitness) concept, components of physical efficiency, which can be positively affected by regular physical training, are the basis of health [1]. Systematic lifelong physical effort is fundamental for maintaining good health condition and mood, accompanied by physical fitness and efficiency [2]. It helps to keep up functional efficiency, defined as independence in the area of bodily functions, which in turn enhances the quality of life of the elderly.

Aging of societies results in a growing number of disabled individuals, although the development of medicine and increasing awareness induce such changes as the modification of eating habits and lifestyle, which help to preserve independence for a longer period of time. However, it should be emphasized that the degree of disability is always higher among women than among men, based on the results in the compared age groups [3, 4].

Due to this, scientific societies worldwide develop directives concerning physical activity, which are to bring in return the highest health profits. The societies agree that health-related training should be dominated by endurance effort, which ought to be accompanied by strengthening exercises, weight training and flexibility workouts.

Nordic walking matches perfectly the assumptions of health-related training. This activity is based on the natural body movement and combines all crucial elements of health promotion and broadly understood health prophylactics. The universality of Nordic walking as a form of physical activity promoting health, is based on i.e. the possibility of adjusting exercises to age, motor skills level, interests, likes and dislikes of an individual or a group. Due to this, Nordic walking is an excellent activity, which enables fulfilling diverse specific goals and brings along a lot of beneficial results.

The aim of the research was to describe changes in physical fitness of elderly women participating in diversified health-related training.

MATERIAL AND METHODS

The study group consisted of 60 women aged 60–74 years, residing in Gdańsk. Only healthy individuals could participate in the program, which had to be confirmed by medical certificates. Before the program, the participants had not taken part in any organized form of physical activity. The respondents were divided into two study groups (GE1 and GE2), which were realizing health-related training programs based on Nordic walking. Data concerning the participants are presented in Table 1.

Table 1. Characteristics of the study groups at the beginning of the experiment

	COMPONENTS	GE1 (n = 30)		GE2 (n = 30)	
		$\bar{x}$	SD	$\bar{x}$	SD
Morphological components	Age (years)	68.0	4.3	68.1	4.5
	Body mass (kg)	65.2	7.6	66.2	7.5
	Height (cm)	161	5.7	161	4.5
	BMI (kg/m^2)	25.1	2.2	25.5	2.8
	FAT (%)	33.2	4.1	33.9	4.7
	FAT Mass (kg)	21.8	4.9	22.8	5.5
	FFM (kg)	43.1	3.3	43.4	2.9
	TBW (kg)	31.6	2.4	31.8	2.2

The research project was a pedagogical experiment, based on two diversified training programs. Their effectiveness was assessed on the basis of 3 samples derived from standardized tools – the Eurofit test for adults [5] and the Fullerton Functional Fitness Test [6], as well as a survey questionnaire investigating the subjective perception of changes in one's own physical fitness.

The participants' physical fitness was evaluated on the basis of physical fitness tests conducted at the beginning of the experiment. The detailed characteristics of both groups are presented in Table 2.

Table 2. The quantitative characteristics of physical fitness of women from both study groups before the experiment

STAMINA	GE1				GE2			
	$\bar{x}$	MIN	MAX	SD	$\bar{x}$	MIN	MAX	SD
Endurance index	109.5	81.4	140.7	13.6	103.0	74.6	140.4	16.8
Lower limbs muscle strength	18.1	8.0	24.0	3.3	18.2	8.0	26.0	4.0
Spine flexibility	34.0	10.5	47.0	8.2	35.3	12.0	47.0	7.5

The groups were similar in terms of age and the analyzed indicators.

The participants were following a 6-month training program based on Nordic walking. The activities were held 3 times a week and lasted 60 minutes each. During the whole training period 73 classes were conducted, preceded and summed up by tests at the physical effort laboratory at the Gdańsk University of Sport and Physical Education. The classes were led by qualified Nordic walking national coaches (PFNW/INWA).

Each training unit consisted of three main parts: introduction, main part and ending, which lasted 10, 45 and 5 minutes respectively. The training program of group GE1 was enriched with strengthening and flexibility training performed during the main part of each class. Group GE2 followed *stricte* an endurance training program.

GE1 group members did 4 kinds of strengthening exercises (in various sets) and 6 kinds of stretching exercises. The strengthening exercises, focused on the main muscle groups, were performed in 2 series, 10 repetitions each, and the stretching exercises were performed in 2 series, 10 seconds each.

The profile and length of Nordic walking outdoor trails were measured using

GPS devices.

During the whole experiment, GE1 group covered the distance of 276 km, and GE1 group – 300 km, with moderate intensity – 60% HR_{max}, estimated by Polar Team pulse meters. The average distance covered during one training unit equaled 3.8 km and 4.1 km. The difference resulted from breaks necessary to perform strengthening exercises in GE1 group.

The obtained results were analyzed statistically using STATISTICA 10 software.

RESULTS

The basic criterion determining the level of circulatory-respiratory endurance was the endurance index, calculated using an equation suggested by the Eurofit for adults [5] authors, based on the 2000-meter march test.

The endurance index diversified the participants from the two study groups the most. After the completion of the training program, statistically significant differences between the groups were observed (p = 0.0001) in terms of the analyzed indicator. The detailed analysis is presented in Table 3.

Table 3. Mean values of the endurance index variable before and after the experiment in both study groups

Study group	Test date	$\bar{x}$	Difference		Planned comparisons
			points	%	
GE1 n = 30	1	109.5	5.1	4.6	F = 4.24 p = 0.0424
	2	114.6			
GE2 n = 30	1	103.0	7.3	7.1	F = 8.73 p = 0.0040
	2	110.3			

1 – beginning of the experiment; 2 – end of the experiment. In the last column the testing function (F) and test probability (p) values are presented for comparisons of the endurance index indicator before and after each training cycle

GE1 group participants were distinguished by a higher average endurance level at the beginning of the experiment (109.5 points). In GE2 group its average initial value equaled 103 points. In both study groups the endurance index increased significantly, although the training mode performed in GE2 group brought better results (p = 0.0040) (*stricte* endurance training).

Further detailed analysis of changes in the endurance index during the experiment is presented in Table 4.

Table 4. Classification of the endurance level before and after the experiment in both study groups

Level \ Group	GE1		GE2	
	1	2	1	2
Much below average	-	-	-	-
A bit below average	3	3	8	2
Average	13	8	10	14
A bit above average	14	16	11	11
Much above average	-	3	1	3

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The level of endurance of respondents from GE1 group before the training was around average. Most women achieved average or a bit above average results. None of them scored much above average. Similarly, in GE2 group nobody scored much below average, neither before nor after the experiment. In GE2 group only one respondent scored much above average. After the end of the 6-month training cycle, 3 respondents scored much above average, like in GE1 group. In the latter group we also observed that the level of endurance increased from average to a bit above average. The efficiency of the training was also confirmed in GE2 group, where a significant number of respondents shifted towards the ‘much above average’ level. In that group only 2 women scored a bit below average.

Another important indicator in the group of individuals affected by the involution process is also the lower limbs muscle strength. Due to this, its changes under the influence of the training cycle were assessed.

The lower limbs muscle strength exhibited similar average values in both groups at the beginning of the experiment. The completion of the training cycle evoked significant changes (p = 0.0002) in this parameter. Data confirming the efficiency of both training programs are presented in Table 5.

Table 5. Mean values of the lower limbs muscle strength variable before and after the experiment in both study groups

Study group	Test date	$\bar{x}$	Difference		Planned comparisons
			Repetitions	%	
GE1 n = 30	1	18.1	2.4	13.3	F = 15.88 p = 0.0001
	2	20.5			
GE2 n = 30	1	18.2	1.4	7.7	F = 5.15 p = 0.0257
	2	19.6			

1 – beginning of the experiment; 2 – end of the experiment. In the last column the testing function (F) and test probability (p) values are presented for comparisons of the lower limbs muscle strength indicator before and after each training cycle.

The presented results indicate that the training program completed by GE1 group and enriched with strengthening exercises was nearly twice as efficient as the program performed with GE2 group; the respondents’ lower limbs muscle strength increased by 13% and 7.7% respectively.

Due to the fact that many respondents achieved results much higher than reference values presented in the literature of the subject in the form of centile charts, no such analysis was conducted so as to avoid falsification of results. The maximum number of repetitions equals 19–21 times, depending on age (60–64 years, 65–69 years, 70–74 years), yet the study results indicate that the respondents performed even up to 30 repetitions during 30 seconds. During the first tests 30% of respondents from GE1 and 26.7% from GE2 scored higher than the maximum population norms, and during the second tests after 6 months of training that ratio equaled 53.3% (GE1) and 40% (GE2), respectively. The analysis of average values scored by the respondents (the number of repetitions) is presented in Table 6.

Table 6. Mean values of lower limbs muscle strength assessed on the basis of standing up from a seated position on a chair, before and after the experiment in both study groups

Study group	Beginning of the experiment				End of the experiment			
	x̄	min	max	SD	x̄	min	max	SD
GE1	18.1	8	24	3.3	20.5	11	30	4.4
GE2	18.2	8	26	4.0	19.6	14	26	3.1

The average number of repetitions during the measurement of lower limbs muscle strength of the respondents at the beginning of the project equaled 18 in both groups. At the end of the training cycle, the number of repetitions increased to 20 in GE1 and 19 in GE2. Both groups were quite homogenous in terms of the discussed indicator, which was confirmed by the low value of standard deviation at the beginning and the end of the experiment.

What is also worth emphasizing is the minimum number of repetitions, which increased from 8 to 11 in GE1 and to 14 in GE2. The maximum number of repetitions did not change in GE2 and increased in GE1 from 24 to 30 repetitions.

The last analyzed indicator was the spine and posterior cruciate ligament flexibility. It was assessed on the basis of a test during which respondents had to lean forward while in seated position - on a box specially designed by the test authors (Eurofit for adults). This skill also improved significantly among all the respondents ($p = 0.0070$). The observed changes are presented in Table 7.

Table 7. Mean values of the spine flexibility variable before and after the experiment in both study groups

Study group	Test date	x̄	Difference		Planned comparisons
			Repetitions	%	
GE1 n = 30	1	34.0	2.5	7.3	F = 16.28 p = 0.0001
	2	36.5			
GE2 n = 30	1	35.3	(-) 0.1	(-) 0.3	F = 0.03 p = 0.8528
	2	35.2			

1 – beginning of the experiment; 2 – end of the experiment. In the last column the testing function (F) and test probability (p) values are presented for comparisons of the spine flexibility indicator before and after each training cycle.

In GE1 group spine flexibility improved significantly; in GE2 group it remained unchanged. Comparing both groups, which did not differ significantly before the experiment, we may conclude that it is worthwhile to supplement endurance training with flexibility exercises, which is confirmed by the value of the analyzed indicator at the end of the training cycle.

The analysis of physical fitness, performed on the basis of the results obtained in subsequent tests, was confronted with the subjective perception of changes in one’s own physical fitness by the respondents. The results of the survey questionnaire are presented in Table 8.

Table 8. Characteristics of the subjective assessment of physical fitness based on a survey questionnaire conducted at the end of the experiment in both study groups

	GE1		GE2	
	n	%	n	%
Did not change	3	10.0	4	13.3
Improved	27	90.0	26	86.7
Deteriorated	-	-	-	-
I don't know	-	-	-	-

The subjective assessment of the respondents' physical fitness matches the objective assessment confirmed by the results of the tests. The respondents confirmed the experiment's efficiency in terms of improving their physical fitness.

The majority of GE1 respondents observed beneficial effects of the training, amounting to 90%. The remaining 10% of individuals claimed their physical condition remained unchanged. As far as GE2 is concerned, 87% of the respondents found the training to have a positive impact on their physical fitness, and 13% observed no changes. These results prove the advantage of the GE1 program over the GE2 one, which is congruent with the objective analysis of the test results. Nobody reported a decrease in their physical fitness during the 6-month training period.

DISCUSSION

As the health promotion sector directed to the elderly has been developing poorly in Poland, a growing need for broadening the offer directed to this age group has been observed, accompanied by the grave necessity to enhance its quality [7].

It is a growing problem of the elderly to find appropriate physical activities which would be both available and attractive for them. Apart from that there is a lack of methods which would efficiently delay the progression of unsolicited changes occurring in the organism due to its ageing [8]. Therefore, seeking optimum kinds of recreational effort, aimed at preventing modern-age diseases, has become (alongside appropriate dieting habits) a priority in the lives of active people [9].

It is true that all kinds of activities improve physical fitness in many ways. However, Nordic walking is the most beneficial sport, strengthening upper body muscles, improving cardiovascular endurance and flexibility. The intensity of Nordic walking fills the gap between marching and running, which makes it an alternative for everyone, who seeks a way to provide himself with a daily dose of physical activity with optimum intensity [10]. It is hence recommended as an efficient and appropriate way to improve the overall functioning of the elderly [11, 12].

Nordic walking significantly increases oxygen consumption and energy expenditure, without an increase in the perceived effort [13]. The results of a study conducted by Halvorson [14] confirm that individuals maintain a high level of comfort during the exercises, while achieving the intensity exceeding

80% VO_{2max} – a parameter, which changes the most as far as the respiratory system is concerned (even by 70%) [15].

The increase in the circulatory and respiratory efficiency of elderly women was also confirmed by the author's own study results. The respondents from GE2 group benefited more, as they participated in the *stricte* endurance training program. The efficiency of Nordic walking in increasing endurance was also observed during a 15-week training cycle, which resulted in significant changes in the aforementioned parameter among the group of women aged 60–75 years [16].

Using poles in Nordic walking activates hand muscles much more compared to an ordinary march; nevertheless, it does not have any impact on lower limbs [17]. The results of the study conducted by Sugiyamy et al. [18] suggest that using poles decreases activity of leg muscles during supporting and pushing phases, which in turn decreases their energy consumption, but in the meantime it increases energy consumption by the upper body parts and the respiratory system. This experiment brought contradictory results, as it revealed significant changes in lower limbs muscle strength in both groups (GE1 by 13.3% and GE2 by 7.7%). The efficiency of Nordic walking in developing leg and hand strength in women aged 60-69 years was also confirmed by results of research conducted by Ossowski et al. [19]. In that study, the respondents practiced Nordic walking and improved the aforementioned skill, shifting on the scale from the 80th to the 95th centile. Both experiments proved credible due to the fact that they were conducted in the area of the Tricity Landscape Park, which is characterized by the postglacial relief.

Marching with poles has also proved beneficial in the case of individuals with chronic backaches (lumbosacral section), resulting in a limited use of painkillers after just 8 weeks of training [20]. This form of training also increased flexibility of the lumbar spine section in previously inactive individuals [21]. Ossowski et al. [16] also observed an increase in spine flexibility among elderly women. In that case their results improved by 1.37 cm within 15 weeks, and in the authors' own research the mean result improved by 2.5 cm. However, that improvement was observed only in GE1 group, who additionally practiced stretching.

Nordic walking is a safe kind of activity for the elderly, positively affecting joints and muscles and soothing excessive muscle tension [22]. This activity does not overstrain the organism, yet is sufficient to evoke positive changes in elderly women. Due to this, taking into consideration recommendations of scientific societies worldwide, training programs are developed with an aim to maintain and improve these key motor skills. The results of the analyses described above prove that the offered training program can be an efficient factor developing endurance, strength and flexibility of elderly women.

CONCLUSIONS

The health-related Nordic walking training, performed for 6 months, had a beneficial influence on physical fitness of elderly women. The applied workout enhanced training results in the case of the majority of analyzed components.

The 6-month Nordic walking training not only stopped involution changes occurring at this stage of ontogenesis but it also improved overall physical fitness.

Nordic walking training was beneficial for the physical fitness of women aged 60-74 years, improving all of the analyzed components. GE1 group's training program proved more efficient in terms of lower limbs muscle strength and spine flexibility, while *stricte* endurance training was more efficient in terms of improving the endurance index. The subjective assessment of physical fitness by the respondents also indicated that strengthening exercises are worthwhile doing during the training.

Positive results of the conducted experiment confirm the efficiency of both training programs, showcasing the usefulness of exercises which shape core muscles and are based on strengthening and stretching exercises, recommended by scientific societies worldwide as a crucial element of health-related training.

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