EFFECTS OF 8-WEEK *NORDIC WALKING* TRAINING ON SELECTED SOMATIC PARAMETERS AND CHANGES IN THE RANGE OF MOVEMENT IN THE JOINTS OF OLDER WOMEN

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SUMMARY

Aim of the study. Progressive involution processes cause negative changes in the human organism, especially in the motor and neural systems, which leads to, among other things, decreases in body balance, muscle strength, and other motor abilities. Progressive inactivity (hypokinesis) is among the most important causes of this phenomenon. Regular physical activity, adjusted to the age and abilities, should be undertaken in order to reduce deficiencies in physical fitness. The aim of this article is to analyze the relationship between increased physical effort and the range of movement in chosen joints before and after health training among women aged 55 years and older.

Material and methods. The study involved 60 inhabitants ($\bar{x}$ = 58.7 years) from the Jelenia Góra area. They participated in the *Nordic walking* health training for 8 weeks. The tests were performed twice: directly before and after the training. Basic somatic features, as well as the range of movement in chosen joints, were measured. The questionnaires elicited data concerning education, marital status, number of children, physical fitness, and subjective evaluation of health and physical activity. Statistical analysis of the outcomes was conducted using the Statistica v. 10 program.

Results. The results indicate that the majority of measured values changed significantly. Average body mass index (BMI) decreased by 1.19 kg/m^2. Abdominal obesity was a dominant feature among the respondents. After the health training, the value of waist-hip ratio (WHR) also slightly decreased. The range of chosen joints movement increased by an average of 3.5°.

Conclusions. Systematic physical activity, adjusted to the age and abilities, clearly leads to positive changes in the musculoskeletal system.

Introduction

In recent years, there has been an increase in the interest in the biological state and physical fitness of adults and elderly people. The main causes of the differences in the quality of life and health are thought to be increased stress levels and a significantly longer average life spans [1, 2, 3].

The motor system, which is an important part of the functional and anatomic whole, enables a person both to function and to have a high quality of life. Limitations in the motor system can cause problems in everyday life, thus decreasing the comfort of living. Such limitations hinder active participation in social life and in family life; they may also cause isolation and loneliness, which increase with age [4, 5, 6].

Decreased bodily movement (hypokinesis) has become an important problem that is constantly visible in society. Limitations of motoric activity leads to disorders in many systems, including the functioning of

the cardiovascular, respiratory, and nervous systems, as well as to disruptions of the lipid economy and metabolic transformations [5, 7, 8, 9, 10].

The characteristic feature of motor system disorders is the occurrence of pains and aches. Movement limitation in joints is often accompanied by recursive involution processes of muscle tissue and contractures [11]. As a result of the destructive changes in the joints, which progress with age, instability can also occur, which increases the danger of falling and endangers health [2, 5, 12, 13, 14, 15].

It is little wonder, then, that the topic of involution of the human organism is very popular in both Polish and international literature [7, 8, 16, 17, 18].

It is estimated that one in two people born in the United States and in Europe will even live for 100 years. According to a World Health Organization (WHO) report, the constant increase of the estimated life span has been noted in the countries with an optimal economic census, such as countries of Western Europe, Canada, the United States, and Japan [20]. The results presented in Poland by the Central Statistical Office in the Statistical Yearbook of 2012 show a significant increase in the average life span of citizens. In 2006, the average life span was 70.9 years for men and 79.6 years for women, while in 2012 it was 74.1 years for men and 81.9 years for women [21]. Even though some claim [19] that there are no upper limitations for the life span of humans (the human organism can regenerate itself even in old age), there is no doubt that the reshaping of the country's age structure will have many consequences, not only regarding health, but also of the economic and social nature [22]. Because of the increased average life span, there will be an increased need for greater engagement and social politics regarding the protection of elderly people's health [23].

Many research facilities are interested in the topic of elderly people's health. In recent times, health promotion and pro-health care have played an important role in keeping fit and in good health. One of the most commonly proposed ways to reduce involution is for people to implement healthy lifestyles. The following forms are especially popular: giving up addictions, physical activity suitable for the age and abilities of the participants, and becoming engaged in studying, social work, and active participation in social and family life [20, 24, 25, 26].

The most efficient form of maintaining good health is thought to be systematic physical activity, which maintains physical fitness and hinders the progress of disease [27, 28, 29]. There have already been many projects created to increase the education of elderly people, promote a healthy lifestyle, and learn the skills of assessing one's own health [30]. Publications and programs related to this issue result in an increased awareness among senior citizens of participating in physical culture. However, the achieved effects are not satisfactory. Among the effective ways of activating and motivating the increasing number of physically inactive elderly people to participate in different forms of movement activities, the control of the health-related effects of such activities is very important [18, 25, 27, 31, 32, 33]. The attractiveness of the offered forms of activity also plays an important role in this process. Undoubtedly, one such form is a kind of physical effort realized by marching with a pair of sticks, popularly called *Nordic walking*. It is also beneficial in terms of the safety of elderly people during their walks.

Aim of the study

The aim of the conducted study was to evaluate the influence of eight weeks of health training using *Nordic walking* on the level of body mass, muscle tissue distribution, and movement range of the selected joints (flexibility) of women older than 55 years, taking into consideration their socio-economic status and lifestyle.

Materials and methods

A total of 60 women from the Jelenia Góra area qualified for the study. They voluntarily took part in movement exercises labeled "Physical culture: an important element of health of people above the age of 55." The average age of the subjects was 58.7 years. The methodic and factual supervision was conducted by a team of therapists from a rehabilitation clinic. The project has gained approval from the Bioethics Committee of the University School of Physical Education in Wroclaw. Instructors from the Polish *Nordic Walking* Federation ran the classes. The program of the classes was adjusted to the age and capabilities of the trainees. One training session lasted between 60 and 90 minutes (about 80 minutes on average). The classes were held twice a week.

In compliance with the aim of the study, within two weeks time there were two testing sessions that measured: basic somatic features (body mass and height) and hip and waist circumference. Women wore sports clothing and shoes to the sessions. Body height was measured using an anthropometer in the Frankfurt

plane with an accuracy of 0.1 cm. Body mass was measured using electronic scales (with an accuracy to 0.1kg). The measurements were used to calculate the Quelet's Body Mass Index (BMI). Waist and hip circumferences were measured using the measuring tape accurate to 0.5cm. This provided a basis to calculate the waist-hip ratio (WHR) [27].

The movement of selected joints (flexibility) was measured using a Saunder's digital inclinometer as well as a traditional goniometer. The measured features included the forward and backward inflexion range of the cervical spine and inflexion range of the lumbar spine. The anteversion and retroversion of the humeral joint were also measured. The radiocarpal joint was measured in terms of dorsiflexion and palmar flexion, as well as hand abduction and adduction. Furthermore, the talocrural joint was measured in terms of dorsiflexion and plantar flexion [34, 35].

A diagnostic survey was used in order to gather data on the socio-economic status and lifestyle of the respondents. The survey used was an EuroQol survey [16, 36], which includes questions about education (higher, secondary, primary), marital status (married, single), fertility rate (childless, one or two children, or many children), financial condition (bad, average, good), and a self assessment of physical fitness (bad, average, good) and health condition (bad, average, good), as well as taking part in different forms of physical activity.

Statistical analysis included the basic features: arithmetic mean ($\bar{x}$), standard deviation (s), and variation coefficient (v). The scope of differences between the first and second testing session was measured using the Student's dependent t-test. The level considered statistically significant was $p \leq 0.05$. Survey data were included as percentage values.

Results

The results of the study enabled us to provide a general characteristic of the studied women. The data regarding social and well-being conditions can be found in Figures 1 and 2. The percentage of women with higher education was 53%; the rest of the women were below secondary education. Married women comprised 77% of the total; the rest were single. In total, 60% of the respondents had one or two children; 28% of the women had three or more children; 12% had no children. A total of 55% of the respondents lived in villages; the remaining 45% lived in towns with less than 10,000 citizens. A total of 47% of the women evaluated their financial condition as bad; 3% considered it good. Of all the respondents, 50% evaluated their socio-financial conditions as average.

The results included in the study regarding the selected elements of the studied women's lifestyles are shown in Figures 3 and 4. Smoking cigarettes and

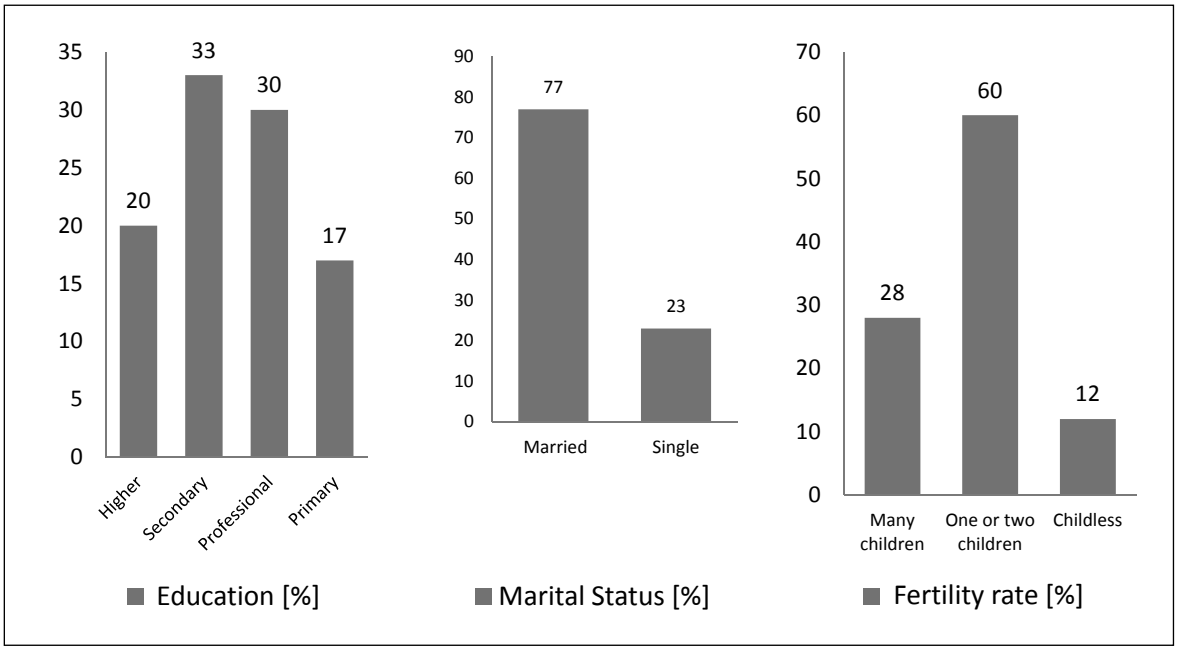

Figure 1. Percentage value of women in terms of education, marital status, and fertility rate

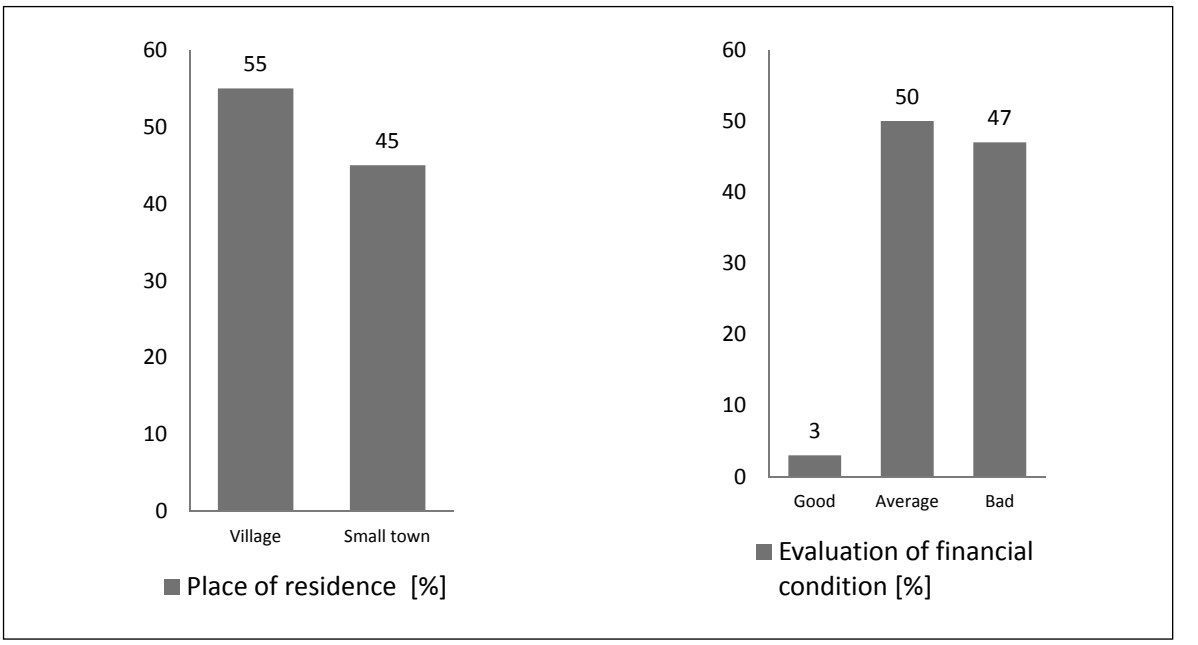

Figure 2. Percentage value of women in categories of place of residence and evaluation of financial conditions

abuse of alcohol are actions which increase susceptibility to sickness and which cause health problems. The respondents answered positively to the question about active smoking in 27% of the cases; the rest are non-smokers. In total, 89% of the respondents do not use alcohol at all; the rest do so occasionally (Figure 3).

As many as 53% of the studied group declared not to take part in any movement exercises before the beginning of the health training; the remaining 33% of the respondents do so occasionally (up to 3 times a week); 14% systematically – more than 3 times a week. Out of all the surveyed women, 13% declared themselves to be in good physical shape; 50% declared to be in average physical condition; the rest evaluated their physical fitness as bad. In total, 10% of the respondents considered their health condition to be good; 43% considered

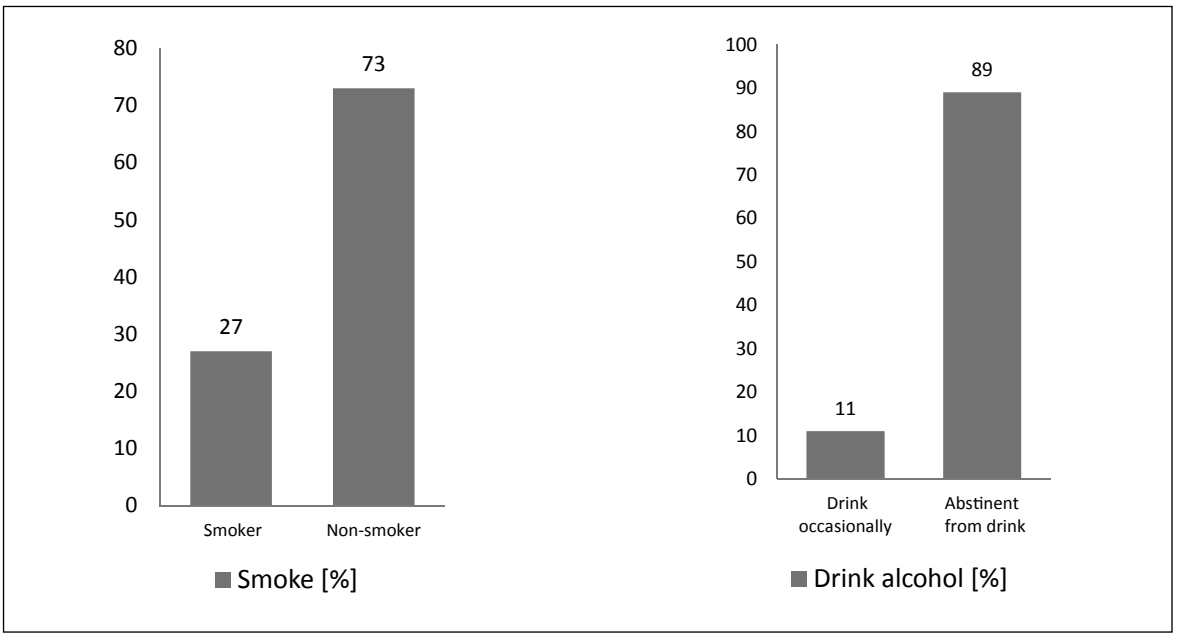

Figure 3. Percentage value of women in terms of stimulants usage

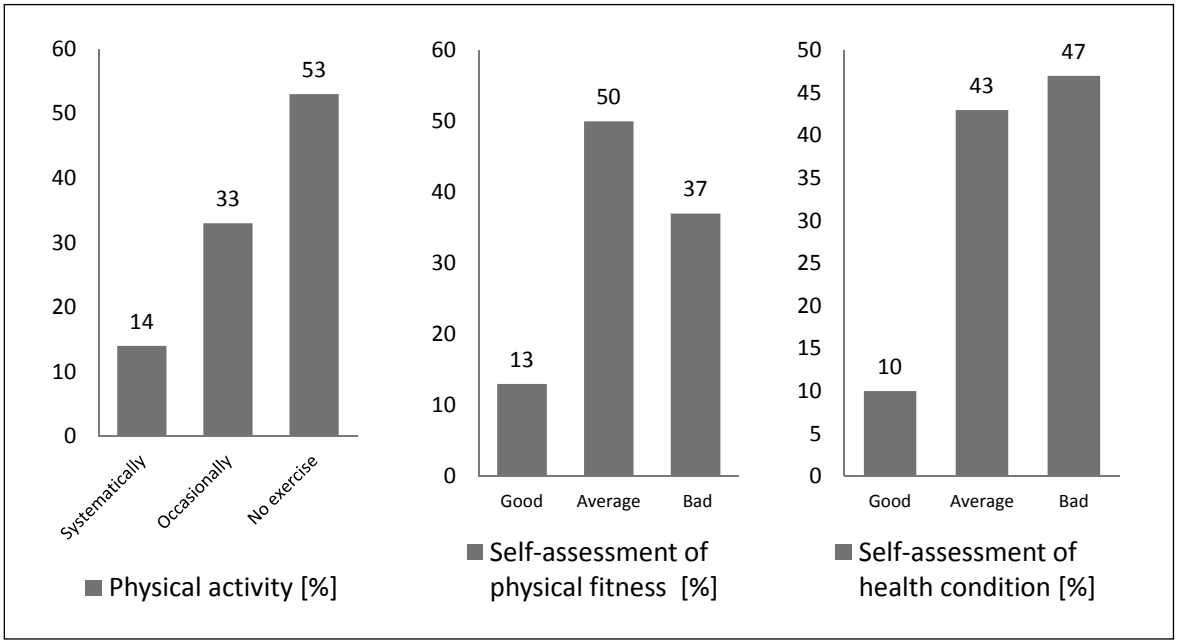

Figure 4. Percentage value of women in terms of physical activity, self-assessment of physical fitness, and health condition

Table 1. Statistical characteristics of the respondents of somatic and joint mobility range among women before and after training

Parameters	Research						t	p
	Before training			After training				
	$\bar{x}$	s	v	$\bar{x}$	s	V		
Age	65.70	4.92	7.48					
Body height [cm]	165.13	0.06	3.88					
Body mass [kg]	74.86	11.99	16.02	71.55	11.13	15.11	5.17	0.00
BMI [kg/m2] – Body mass index	27.28	3.79	13.85	26.09	3.46	12.83	3.64	0.00
WHR – Waist hip ratio	0.90	0.14	7.50	0.82	0.06	7.39	4.09	0.00
Cervical spine forward inflexion [°]	45.60	7.26	15.92	49.31	6.84	13.87	18.16	0.00
Cervical spine backward inflexion [°]	57.75	7.70	13.34	61.65	7.22	11.72	15.06	0.00
Forward lumbar inflexion [°]	23.68	3.44	14.55	25.35	3.68	14.52	5.48	0.00
Anteversion of the humeral joint [°]	167.88	4.12	2.45	168.09	3.24	3.08	0.32	0.69
Retroversion of the humeral joint [°]	40.01	6.98	17.45	44.15	5.09	11.54	5.98	0.00
Abduction of the hand [°]	13.11	2.00	15.31	18.80	2.12	11.28	31.53	0.00
Adduction of the hand [°]	32.15	2.71	8.45	38.40	2.15	5.61	27.62	0.00
Dorsiflexion [°]	49.01	5.59	11.40	51.10	5.82	11.39	6.35	0.00
Palmar flexion [°]	68.41	9.74	14.24	72.83	5.99	8.22	3.46	0.00
Dorsiflexion [°]	15.53	3.16	20.37	17.85	3.99	22.38	8.31	0.00
Plantar flexion [°]	42.45	5.39	12.70	44.75	5.29	11.84	8.00	0.00

it as average; the rest thought their health condition was bad (Figure 4).

The values of the somatic parameters were evaluated using the BMI coefficient and on the basis of any statistically significant changes occurring in the WHR coefficient (Table 1). The BMI mean value was 27.28 kg/m^2 during the first testing session and 26.09 during the second session. The coefficient value indicates overweight, even though it was significantly lower in the second session. The WHR coefficient value was 0.90 during the first testing session, which indicates the advantage of the andriodal abdominal adiposity. This is considered a high risk factor in mainly cardiovascular diseases. During the second session, the WHR coefficient value decreased significantly and was 0.82, which indicated that adiposity moved towards the thighs and hips (Table 1).

The range of movement in the evaluated joints significantly increased. The only exception was the anteversion of the humeral joint. The cervical spine was evaluated on the basis of the forward and backward inflexion. The first testing session resulted in the mean values of this movements being, respectively, 46° and 58°. In the second session it increased by 3° in the forward inflexion and 4° in the backward inflexion. The lumbar spine was measured in terms of the forward inflexion, the mean value of which reached 24° in the first testing session and increased by 1.6° in the second session. The mean value of the retroversion of the humeral joint was 40° and rose by 4° after the training cycle. In the radiocarpal joint, the mean value of the movement range was 13° regarding the abduction, which rose by 6° after the training. The adduction mean value was 32°, which rose by 6°. The dorsiflexion of the hand showed a mean value of 49°, which increased in the second testing session by 2°, while the mean value of the palmar flexion was 68° and rose by 4°. The dorsiflexion of the talocrural joint showed the value of 16°, while the plantar flexion showed the value of 42°. These values increased in the second session by, respectively, 2° and 3° (Table 1).

Discussion

Since the turn of the 21st century, there has been a noticeable increase in interest in the problems of human aging. This results from the fact that the average life span is systematically increasing. The results of numerous studies indicate that there are many problems connected with the aging process of societies. These studies are usually from the field of geriatrics and health problems of seniors, epidemiology, and socioeconomics [1, 2, 3, 9, 11, 15, 22, 23, 30]. There is no doubt that there is a need to improve the self-awareness of health and maintain an optimal quality of life. This, in turn, results in improving the psychophysical state of elderly people, increasing their activity in family and social life, and at the same time hindering involution processes.

Systematic physical activity is one of the basic factors of lifestyle in each stage of ontogenesis, but it is especially important in elderly people, as it counteracts helplessness in everyday activities and lowers the risk of the occurrence of many diseases [4, 7, 17, 37, 29, 8, 33, 38].

In recent years, *Nordic walking* has been one of the forms of physical activity targeted at adults and elderly people. The Authors agree that due to the use of poles during the walk, this kind of health training on the one hand provides a feeling of safety, while on the other hand engages joints and muscle groups in movement, thus causing an improvement in the movement range and more efficient muscle work. Such training also results in an improvement of the functioning of many organs and systems [8, 12, 22, 41].

The conducted study indicates that the range of movement in selected joints increased significantly. There was also a significant decrease in body mass and the BMI and WHR coefficients. Too much body mass is one of the main risk factors in many diseases, particularly diseases of the cardiovascular system and metabolic and psycho-motoric disturbances [1, 7, 23, 30, 39].

Women who took part in the *Nordic walking* health training organized for the study noticed the positive aspects of this form of physical activity and most of all the growth of their own physical fitness (13% before the training; 41% after 8 weeks of exercises). At the same time, the self-assessment of health condition of women rose from 10% to 50% after several weeks of health training. According to Zając-Kowalewska et al. [40], systematic *Nordic walking* health training brings benefits to the cardio-respiratory system and allows for keeping up high exercise intensity. At the same time, the subjective feeling of tiredness remains at a low level. The effort coming from an active walk with poles also positively affects the overall tolerance to effort.

The positive effects achieved by movement exercises used in *Nordic walking* indicate that it is one of the most health-efficient forms of movement and should be recommended to adults and elderly people.

Conclusions

1. Health training caused a positive impact on body mass, the effect of which was a statistically important decrease in the BMI and WHR coefficient values.
2. An eight-week *Nordic walking* training period increased, in a statistically significant way, the movement range in selected joints.
3. The results of a questionnaire indicate that only a small percentage of women (14%) systematically undertake physical activity. At the same time, two-thirds of the respondents evaluated their physical fitness as optimal. Over half of the respondents (53%) evaluated their health condition as positive.
4. The conducted experiment indicates the positive impact of physical activity in the form of *Nordic walking* on the analyzed parameters and justifies the need for its promotion among groups of older women.

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