

The influence of a ten-week Nordic walking training-rehabilitation program on the level of lipids in blood in overweight and obese postmenopausal women

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Abstract. [Purpose] The aim of this study was to evaluate the effect of a ten-week Nordic Walking (NW) rehabilitation program on chosen anthropometric parameters and the level of basic lipids in overweight and obese postmenopausal women's blood. [Subjects and Methods] The subjects were 32 women aged 50–68 (average: 59.7 ± 5.9 years). The study was carried out following a non-randomized model and entailed NW rehabilitation 5 times a week, which lasted for 10 weeks, as well as a low-calorie 1,500 kcal diet. The therapeutic results of the study were measured through changes in anthropometric and biochemical parameters. The results were subjected to a statistical analysis. [Results] After 10 weeks of NW rehabilitation it was observed that participants lost weight and their body mass index dropped. Additionally, whereas levels of total cholesterol, LDL and triglycerides dropped, and the level of HDL increased. [Conclusion] Rehabilitation carried out according to the NW model resulted in statistically significant changes in basic lipids in blood which, considerably increased the percentage of persons who achieved the recommended level of blood lipids. Obese persons were characterised by a smaller rehabilitation weight loss. More intense workouts and cooperation with a dietician are required.

Key words: Nordic walking, Obesity, Blood lipids

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INTRODUCTION

A change of lifestyle entailing increased physical activity, quitting smoking and dietary modifications is an effective and inexpensive way of improving individuals' health and lowering their cardiovascular risk¹⁻⁴⁾. Physical exercise can be prescribed as therapy in two forms: unsupervised and supervised⁵⁾. There are many models of rehabilitation, even within the scope of treating and preventing cardiovascular diseases^{1, 4, 6, 7)}. However, the most important provision is that daily physical activity should not be shorter than thirty

minutes^{3, 4)}. One of the new and increasingly popular forms of exercise is Nordic Walking which is a combination of walking and cross-country skiing, walking assisted with poles⁸⁾. The most important elements of Nordic Walking exercise comprise: thrusting the walking pole, pushing oneself off with the arm holding the pole and lifting a leg off the ground. These movements, combined in a fluent technique, influence the speed of walking and its effectiveness. Nordic Walking utilizes 90% of all muscles (including lower and upper extremity muscles), strengthens the muscles of the upper part of the body and shoulders and increases the mobility of the upper segment of the spine. Walking poles relieve stress on the joints, straighten and relieve stress on the spine and correct faulty posture by strengthening the stabilizing muscles^{9, 10)}. When performing Nordic Walking calorie consumption is 20–30 or even 67% more intense than during running. Consuming approx. 400 kcal/h (normal walking: approx. 280 kcal/h)^{11, 12)}. So far 16 randomized (1,062 participants) and 11 observational studies (831) of

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Table 1. Measured values at the beginning of the study and after the ten-week Nordic Walking program

Parameter	At the beginning of the study	After 10 weeks
Body weight (kg)	80.7 ± 14.0	76.2 ± 14.0 #
BMI (kg/m ²)	30.5 ± 4.1	28.8 ± 4.5 #
CPK (U/l)	109 ± 47.0	90 ± 37 #
Total cholesterol (mg/dl)	213.3 ± 34.5	194.1 ± 28.4 #
LDL cholesterol (mg/dl)	133.5 ± 28.8	117.2 ± 30.2 #
HDL cholesterol (mg/dl)	59.4 ± 13.0	64.9 ± 13.3 #
Triglycerides (mg/dl)	124.6 ± 46.5	97.8 ± 33.1 #
Quotient of total cholesterol and HDL	3.7 ± 0.8	3.1 ± 0.7 #
Percentage of participants with a total cholesterol concentration of < 190 mg/dl; n (%)	8 (25%)	12 (37.5%) #
Percentage of participants with LDL cholesterol concentration of < 115 mg/dl; n (%)	7 (22%)	16 (50%) *
Percentage of participants with HDL cholesterol concentration of ≥ 46 mg/dl; n (%)	28 (87.5%)	32 (100%) *
Percentage of participants with a triglyceride concentration of < 150 mg/dl; n (%)	23 (71%)	29 (91%) *
Percentage of participants with a quotient of total cholesterol concentration and HDL < 5; n (%)	30 (94%)	32 (100%)

Cut-off points for concentration of lipids were those of the European Society of Cardiology^{2, 3}. Statistically significant differences between the initial value and after the 10-week Nordic Walking program.

* p<0.05; # p<0.001

Nordic Walking have been carried out. These studies have confirmed the positive effects of Nordic Walking on resting cardiac activity, arterial blood pressure, exercise tolerance, exercise oxygen consumption and quality of life in the course of various diseases of young¹³, middle-aged¹⁴ and elderly persons^{8, 15–17}. It was confirmed that this model of rehabilitation, in particular the supervised one⁵, extends the walking distance of patients suffering from atherosclerosis in the lower extremities¹⁸, improves the fitness of patients suffering from Parkinson's disease^{19, 20}, reduces low back pain^{5, 21}, symptoms of depression²² and fibromyalgia^{23, 24}, improves the quality of sleep, reduces body weight, improves exercise tolerance and attenuates risk factors. However, these effects pertain primarily to persons with normoglycemia rather than overweight patients suffering from glucose intolerance or diabetes type 2^{16, 25–28} and a four-month Nordic Walking rehabilitation program did not improve the level of glycosylated haemoglobin (HbA1c) in patients suffering from diabetes type 2 and obesity²⁹.

Menopause is connected with numerous hormonal changes which can lead to obesity, lipid and carbohydrate metabolism disorders as well as related increases in risk of cardiovascular events and death. Increasing physical activity is one of the methods used to reduce these risks^{1, 3}. The beneficial influence of 34 cardiological rehabilitation programs on the cardiovascular risk (OR= 0.64, 95%CI= 0.46–0.88) and general mortality was recently confirmed in the meta-analysis carried out by Lawler et al⁶. The positive influence of exercise stems, among other things, from reduction in body weight and insulin resistance which, can result in improvement or even normalization of lipid and carbohydrate metabolism disorders². It was demonstrated that exercise generally lowers the concentration of triglycerides and increases the concentration of HDL cholesterol². However, as yet there is not much data on the hypolipidemic effect of Nordic Walking rehabilitation^{11, 30}. This is an issue of great importance as hyperlipidemia and obesity are the main

modifiable risk factors of atherosclerosis in Poland. A study carried out by NATPOL PLUS showed that hyperlipidemia and obesity affect 61 and 53% of persons, respectively^{31, 32}.

The aim of this study was to evaluate the effect of a ten-week Nordic Walking rehabilitation program on chosen anthropometric parameters and the level of basic lipids in overweight and obese postmenopausal women's blood.

SUBJECTS AND METHODS

The study subjects were 32 women with an average age of 59.7 ± 5.9 years (age range: 50–68). They were recruited through notices placed in outpatient clinics and published in newspapers. Their basic demographic and clinical data are presented in Table 1. None of the participants suffered from serious somatic or mental diseases. Additionally, the participants in this study did not take any medication other than metabolically neutral hypotensive drugs.

The study was carried out following a non-randomized and unsupervised medical experiment model. The primary intervention consisted of a Nordic Walking rehabilitation program carried out under a trainer's supervision. Sessions were conducted 5 times a week for 10 weeks (in total: 50 sessions, 60 minutes each) and they complied with the minimum exercise requirements recommended by the European Society of Cardiology (ESC). Prior to commencing the program in the Nordic Walking training rehabilitation technique was carried out and participants were tested on their mastery of it. All the participants mastered the exercise rules. A warm-up was organized before each training session. At the beginning the average distance covered amounted to 3.8 km. As progress in rehabilitation was made and exercise tolerance improved, the distance increased to 5.3 km. The average, estimated energy expenditure during each session was 450 kcal. During the entire period of the study each woman was on the same diet (meals consumed in catering establishments). The participants' daily diet consisted of 5

meals with a caloric value of 1,500 kcal. Energy sources were planned as follows: complex carbohydrates – 50%, fat – 30%, protein – 20%. Prior to commencement of the study no participant took statins. The participants did not change their medication as it could have that could influenced the studied parameters.

All the participants received a medical examination at the beginning and at the end of the study. During the examination anthropometric parameters (weight, height, body mass index) were evaluated and blood was collected for a biochemical investigation. The concentration of total cholesterol, LDL, HDL and triglycerides as well as creatine phosphokinase activity (CPK, a skeletal muscle damage marker) was examined before and after intervention. The measurement of biochemical parameters was performed using blood serum collected in the morning, before training, from the cubital fossa vein, with minimum tourniquet pressure, 14 hours after the last meal and after 15 minutes of rest. All biochemical assays were carried out by the same laboratory.

The effects of the rehabilitation program were measured through the changes in the values of the anthropometric and biochemical parameters described above. The absolute difference delta and relative changes in parameters (percentage change) were calculated.

This study was performed with the approval of the Bioethical Commission of the Nicolaus Copernicus University in Toruń, Ludwik Rydygier Collegium Medicum in Bydgoszcz (no. KB/602/2011) in September 2011. Each participant expressed her consent to participation in the study in writing. The study was performed in conformity with the Declaration of Helsinki.

The results are presented as the mean value and standard deviation or the median and range as well as the number (n) or percentage of participants – depending on the type of variable (quantitative, qualitative) and normality of their distribution. The significance of difference in the values of categorical variables and variation was carried out using the Wilcoxon test. The Mann-Whitney U test was used to test differences between subgroups determined by the median age value ($< i \geq 62$ years), body weight ($< i \geq 75.4$ kg), height ($< i \geq 162.5$ cm) and BMI ($< i \geq 30$ kg/m²). Additionally, the percentage of participants, who achieved the recommended levels of lipids recommended for female subject to a medium risk of cardiovascular diseases (total cholesterol < 190 mg/dl, LDL < 115 mg/dl, HDL ≥ 46 mg/dl, triglycerides < 150 mg/dl)^{2, 3)} was calculated. A comparison of the significance of differences within the scope of the size of groups was carried out using Fisher's exact test. Spearman's rank correlation was used to examine associations between outcome measures. A licensed version of STATISTICA 10.0 for Windows was used for the statistical analysis.

RESULTS

Thirty-two postmenopausal women participated in this study. Their basic anthropometric and biochemical data are presented in Table 1. After 10 weeks of exercises performed according to the Nordic Walking model statistically significant reductions in body weight (on average 4.5 kg, 5.7%) and

BMI (on average by 1.7 kg/m², 5.7%) were observed. None of the participants showed a body weight increase. Eighteen participants (56%) lost less than 5% of their body weight, 9 participants (28%) lost 5–10% of their body weight and 5 (16%) lost 10% of their body weight.

In the biochemistry results statistically significant drops in total cholesterol (median delta – 19.2 mg/dl, 8.5%), LDL (median delta – 16 mg/dl; 12%), and triglyceride concentrations (median delta – 26.8 mg/dl; 0.8%) were observed. Additionally, the concentration of HDL cholesterol increased (median delta – 5.5 mg/dl, 10%) (Table 1). After the rehabilitation program had ended, the percentage of participants with the recommended levels of total cholesterol, LDL, HDL and triglycerides had significantly increased (Table 1). The changes in lipid concentrations in blood serum observed after completion of the 10-week Nordic Walking program showed considerable individual variation and the ranges are presented in Table 2. This is the reason influence of chosen clinical and anthropometric factors on the values of studied parameters was evaluated before commencing and after complete on of the Nordic Walking program. The values of the studied biochemical parameters were compared in subgroups of women determined by on the median age ($< i \geq 62$ years), body weight ($< i \geq 75.4$ kg), height ($< i \geq 162.5$ cm) and BMI ($< i \geq 30$ kg/m²). However, statistically significant differences were found only between the group of overweight and obese women. Overweight participants (BMI ≥ 30 kg/m²) experienced a considerably lower BMI reduction (-1.3 vs. -2.1 kg/m²; -3.6 vs. -7.8% ; $p=0.045$). The initial BMI value correlated with its percentage (relative) decrease after completing the intervention ($R = -0.39$, $p = 0.026$). The absolute decrease in BMI, on the other hand, correlated with the initial height of participants. The participants, whose weight loss exceeded 5% showed bigger absolute (8.5 ± 8.1 vs. 3.1 ± 2.5 mg/dl; $p = 0.012$) and relative ($15.7 \pm 15.0\%$ vs. $5.8 \pm 4.7\%$; $p = 0.012$) increases in HDL concentration after 10 weeks of Nordic Walking rehabilitation.

DISCUSSION

Our results show that after ten weeks of Nordic Walking rehabilitation 32 overweight and obese postmenopausal women showed a statistically significant loss of body weight, as well as a drops in BMI and concentrations of atherogenic lipids in blood serum. After completing the program the percentage of participants with the recommended levels of total cholesterol, LDL, HDL and triglycerides drastically increased (Table 1). A statistically significant weight loss ($> 5\%$) was observed among 44% of the participants, also showed an increase in HDL cholesterol concentration. Moreover, the results demonstrate that participants with a higher degree of obesity experienced a smaller reduction in BMI. There was no statistical correlation between initial BMI and the hypolipidemic effect of the rehabilitation program.

Weight loss after 10–12 weeks of Nordic Walking was also observed by another group of researchers³⁰⁾. However, although our program was shorter (10 vs. 16 weeks), we observed body weight loss and BMI reduction²⁶⁾. Goodpaster et al.³³⁾ carried out a randomized single-blind trial with a

Table 2. The absolute (delta) and relative (%) changes in the outcome measures after a 10-week Nordic Walking program

Parameter	Mean value \pm standard deviation	95%CI of the mean value	Median	Scope (minimum-maximum)
D_weight (kg)	-4.5 \pm 3.4	-5.7 to -3.3	-2.95	-11.0 to -0.5
D_weight_% (%)	-6 \pm 4	-7.3 to -4.1	-3.3	-15 to -0.6
D_BMI (kg/m ²)	-1.7 \pm 1.2	-2.1 to -1.2	-1.15	-4.2 to -0.2
D_BMI_% (%)	-6 \pm 4	-7.3 to -4.1	-3.3	-15 to -0.7
D_total cholesterol (mg/dl)	-19.2 \pm 17.5	-25.5 to -12.9	-12.0	-68.0 to -2.0
D-total cholesterol_% (%)	-8.5 \pm 7	-11 to -6	-6.0	-28 to -0.09
D-LDL (mg/dl)	-16.3 \pm 17.7	-22.7 to -9.9	-11.0	-66.0 to 5.0
D_LDL_% (%)	-12 \pm 11	-16.3 to -7.8	-8.8	-50 to 2.9
D_HDL (mg/dl)	5.5 \pm 6.2	3.2 to 7.7	5.0	-2.0 to 30.0
HDL_% (%)	10 \pm 11.5	6.0 to 14.3	9.3	-3.7 to 55.6
D-triglycerides (mg/dl)	-26.8 \pm 25.4	-36.0 to -17.7	-16.5	-86.0 to 0.00
D_triglycerides_% (%)	-19.2 \pm 15	-24.5 to -14.0	-15.6	-55 to 0.00
D_TC/HDL(U/I)	0.61 \pm 0.41	-0.76 to -0.46	0.52	-2.0 to -0.03
D_TC/HDL_% (%)	-16 \pm 9	-19.5 to -12.8	-13.6	-42 to -0.6

Delta (D) = difference at the end of the study presented at the absolute value (D_parameter) and the relative value (parameter_%), the percentage change with respect to the initial value; TC/HDL quotient of total cholesterol and HDL concentration (the atherogenic lipids in blood serum index); 95% CI confidence interval 95%.

one-year observation period, during which they investigated whether moderately strenuous exercise, of an intensity similar to a quick march, performed 5 times a week for 60 minutes by morbidly obese subjects could increase weight loss compared to diet alone. After 6 months of controlled exercise and dietary intervention, 80% of the participants showed a 5% weight loss to 60% of the participants who were only advised to change their diet. In our study only 44% of women experienced weight loss exceeding 5% after 10 weeks of exercise. This suggests that it is necessary to implement a dietary intervention in order to increase the effectiveness of weight loss. It might be worth involving more specialists (for example a bariatrist, a bariatric surgery specialist, a psychologist, a psychiatrist, etc.) who would cooperate just like a cardiological heart team. Our study also showed that a greater weight loss was observed among taller participants which confirms the negative correlation between energy expenditure when doing Nordic Walking and the length of the poles previously reported in the literature¹²). Therefore, it would be beneficial to further analyse the usefulness of complex programs (dietary intervention, exercises, behavioural therapy) in treating obesity with respect to the reduction in cardiovascular risk, even when weight loss is small (5–10%)³³.

As mentioned above, the 10-week Nordic Walking rehabilitation program had a positive effect on the level of basic blood lipids in overweight and obese postmenopausal women (Table 1). The Nordic Walking program reduced the total cholesterol, LDL and triglyceride concentrations and increased the concentration of the anti-atherogenic fraction of HDL (Table 2). After completion of the rehabilitation program, concentrations of total cholesterol and LDL were lower on average by 19 (\pm 9%) and 16 (\pm 12%), respectively. Similar results were reported by other research groups^{30, 34}.

Our study was not planned to evaluate the occurrence of main hard end points. However, previous epidemiological observations^{3, 35, 36}) and the results of multicentre randomized intervention studies justify the hypothesis that the observed effects of lipid rehabilitation in the Nordic Walking model have noticeable health-related benefits. It is generally accepted that as far as the treatment of the obesity is concerned, health-related advantages are achieved even when weight loss is small 5–10%³³). Moreover, it is known that an increase in total cholesterol of 1% leads to an increase in the cardiovascular event risk of 2%^{35, 36}). A drop in LDL concentration of 1 mmol/l (approx. 40 mg/dl) during statin therapy, on the other hand, correlates with a 10% reduction in the total mortality and a 22% reduction in the risk of death and cardiovascular morbidity rate²). In addition, whereas the probability of a serious coronary event reduces by 23%, the risk of cerebral stroke reduces by 17%. A further potential benefit of rehabilitation through Nordic Walking arises from the increase in HDL cholesterol concentration. An increase in HDL of 1 mg/dl is reported to reduce the cardiovascular risk by 2–3%³⁷). In the present study, the increase in HDL cholesterol concentration amounted on average to 5.5 mg/dl (10%) which would correspond to an average reduction in cardiovascular death of 10–15%. A higher average increase in HDL was achieved by participants whose weight loss exceeded 5%. These results are consistent with the data presented in the literature showing that weight loss of 1 kg is associated with an increase in the HDL cholesterol concentration of 0.4 mg/dl²). An increase in HDL cholesterol can also be achieved through regular physical activity and quitting smoking²). It is worth mentioning that the most popular hypolipidemic medicine, statins, increase the level of HDL in a similar way, i.e. by 5–10%².

The potential benefits of reducing the concentration

of triglycerides are controversial³). Some authors are of the opinion that the level of triglycerides after a meal is a better determinant of cardiovascular risk³⁸). In the present study triglycerides were determined on an empty stomach, and their level after 10 weeks of practising Nordic Walking was 27 mg/dl (10% on average). According to the literature, reduction in body weight through physical activity should lower the level of triglycerides by 20–30%²). The fact that our results were poorer than this can be explained the lack of a dietary intervention. Nevertheless, the overall clinical results of the proposed Nordic Walking rehabilitation program were associated with its hypolipidemic effect, and can be expressed as the potential reduction in cardiovascular risk, estimated to be in the range of least 20–25% (10% dependent on LDL reduction and 10–15% dependent on HDL increase), before considering the advantages of the workout and weight loss. The described effect is achieved with the help of an average dose of statin²). Yet, during the study the response to the suggested rehabilitation program varied significantly among individuals (Table 2). Consequently, future studies of the clinical effectiveness of Nordic Walking are warranted in order to identify subjects who apart from physical activity, require an additional intervention to reduce their cardiovascular risk.

The relatively small group of participants was a limitation of this study. Nevertheless, other studies were based on a similar number of subjects. In addition, the present study was non-randomized and unsupervised. There is also no certainty that the meals consumed by participants were the only food they consumed. Additionally, we did not use the RISK SCORE table to evaluate the initial and final cardiovascular risk.

In conclusion, a summary of our findings are presented below.

- A ten-week Nordic Walking workout program resulted in a relatively small, yet statistically significant, weight loss, significant reductions in atherogenic serum lipids levels, and an increase in anti-atherogenic HDL cholesterol levels as well as a drop in the skeletal muscle damage index (CPK). The percentage of participants with the recommended level of lipid fractions had increased at the end of the intervention.

- Obese participants showed relatively lower weight loss at the end of the intervention than overweight subjects, and those who lost more than 5% of their body weight showed a bigger HDL cholesterol concentration increase and the end of the Nordic Walking program.

- Overweight and shorter participants probably require a more intense workout and cooperation with a dietician to achieve a statistically significant weight loss.

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