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The impact of Nordic walking on the body in diseases acquired in the context of deteriorating environmental situation in the world

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Abstract. The article presents an analysis and interpretation of the health benefits of Nordic walking in general. The possibility of using this practice in diseases acquired in conditions of environmental degradation. Comparison of Nordic walking with brisk walking and jogging in terms of their effect on heart rate, maximum oxygen uptake, quality of life, and other health-related criteria. According to the study, Nordic walking was found to be a form of physical activity with compelling overall health benefits and had better short-term and long-term effects on the cardiorespiratory system compared to brisk walking. Short-term effects show higher heart rate, VO2, respiratory exchange rate, lactate thresholds, and calorie expenditure.

1 Introduction

Walking is the safest form of physical activity and can be easily adapted for people with pathological conditions associated with environmental degradation around the world. However, walking provides significant health benefits. Over the past 20 years, Nordic Walking (NW), i.e. walking with the dynamic use of special poles, has become an increasingly popular form of exercise. Proper NW technique engages the muscles of the upper extremities, maintains a long stride at a constant gait speed, and requires high loads with low impact force. In NW, arm movement increases heart rate (HR), oxygen uptake, and energy expenditure while maintaining perceived exertion levels lower than walking at the same speed.

With Nordic walking or Nordic walking, you can travel a greater distance and at a higher speed than with walking without poles.

The purpose of this paper is to systematically summarize information from the literature, analyze and interpret the health benefits of Nordic walking in general and compare it with brisk walking and jogging in terms of their impact on heart rate, maximum oxygen consumption, quality of life and other criteria, health related.

Aerobic physical training is effective in the treatment of patients with cardiovascular diseases. Indeed, this type of training allows patients to develop physical abilities, mainly in

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the cardiovascular system and respiratory system. As an endurance exercise, walking is widely recommended for physical recovery. Nordic walking improves physical endurance in healthy people, and a positive effect has also been noted for patients with coronary and arterial diseases. Kocur et al. [18] reported a significant effect on cardiovascular adaptation to exercise, mainly by reducing heart rate at a given intensity and the risk of a heart attack equivalent to that of walking without poles.

Compared to walking without poles, despite the greater muscle involvement, Nordic walking does not place a significantly greater strain on the heart. Research studies have sought to determine whether Nordic walking in a training program differs from walking without poles in increasing walking distance for patients with acute coronary syndrome (ACS) and peripheral arterial occlusive disease (PAOD).

2 Materials and methods

The study included 34 participants with cardiovascular diseases (men; mean age 57.2 ± 11 years). The participants were randomly divided into 2 groups: the Nordic Walking group and the Nordic Walking group. The two groups did not differ in pathology, did not differ in baseline age or anthropometric parameters (height, weight and BMI); baseline maximum heart rate, distance traveled, or power output in a treadmill stress test; or original walking distance. The sample size was estimated by defining effect size bounds as small (ES: 0.2), medium (ES: 0.5), and large (ES: 0.8, "very noticeable and therefore large"). We calculated that we need a minimum of 17 patients per cohort to isolate an effect size of 1 with a two-tailed type Iα error of 0.05 and a statistical power of 80%. Quantitative data are expressed as mean ± standard deviation or median (quarter-to-quarter range) as appropriate. The normality assumption was tested by the Shapiro-Wilk test. Quantitative data were compared using Student's t-test or Mann-Whitney test, as appropriate. The assumption of homoscedasticity was verified by the Fischer-Snedekor test. Categorical data were compared using Pearson's or Fisher's exact chi-square test. Relationships between quantitative variables were determined using the Pearson or Spearman correlation. Paired comparisons included a paired t-test or Wilcoxon test. A two-tailed $P<0.05$ was considered statistically significant. The normality assumption was tested by the Shapiro-Wilk test. Quantitative data were compared using Student's t-test or Mann-Whitney test, as appropriate. The assumption of homoscedasticity was verified by the Fischer-Snedekor test. Categorical data were compared using Pearson's or Fisher's exact chi-square test. Relationships between quantitative variables were determined using the Pearson or Spearman correlation. Paired comparisons included a paired t-test or Wilcoxon test. A two-tailed $P<0.05$ was considered statistically significant. The normality assumption was tested by the Shapiro-Wilk test. Quantitative data were compared using Student's t-test or Mann-Whitney test, as appropriate. The assumption of homoscedasticity was verified by the Fischer-Snedekor test. Categorical data were compared using Pearson's or Fisher's exact chi-square test. Relationships between quantitative variables were determined using the Pearson or Spearman correlation. Paired comparisons included a paired t-test or Wilcoxon test. A two-tailed $P<0.05$ was considered statistically significant. Categorical data were compared using Pearson's or Fisher's exact chi-square test. Relationships between quantitative variables were determined using the Pearson or Spearman correlation. Paired comparisons included a paired t-test or Wilcoxon test. A two-tailed $P<0.05$ was considered statistically significant. Categorical data were compared using Pearson's or Fisher's exact chi-square test. Relationships between quantitative variables were determined using the Pearson or Spearman correlation. Paired comparisons included a paired t-test or Wilcoxon test. A two-tailed $P<0.05$ was considered statistically significant.

Each group completed a training program of 5 sessions per week, with an effective duration of 45 minutes. The Nordic Walking Group (NWG) used Nordic walking for training, and the control group (WG) used walking without poles.

In addition to these workouts, each participant completed the same recovery program, including 5 sessions on an erg bike, 5 sessions in the gym, and 5 sessions of adapted physical activity per week (Monday to Friday, with an effective duration of 45 minutes, each for a total difficulty for 4 weeks).

Walking sessions included a 900m outdoor walking trail.

Nordic walking sessions included the use of special poles consisting of a handle and an adjustable glove with height adjustment markers. The pole was made from carbon fiber for a combination of flexibility and strength, as well as a weight limit of 150g to 200g depending on the size of the pole. The light weight of the pole also limited the risk of injury to the shoulder girdle. A good pole length was determined by the distance between the arm with the elbow at 90 degrees and the ground when the person was standing.

For each participant in both groups (NWG and WG), training intensity was recorded in relation to heart rate as determined by the maximum heart rate recorded during the exercise test performed in the first training session using the Karvonen formula [19]. Karvonen's formula aims to determine work intensity based on the percentage of heart rate reserve represented by the difference between maximum heart rate and resting heart rate. To maintain maximum aerobic exposure, this percentage was set at 50%, which corresponds to the first threshold or ventilation threshold 1 [19]. A limit of ±10% is allowed given that it is difficult to maintain a heart rate close to 50%.

Prior to the Nordic walking lessons, all NWG participants underwent individual training in the Nordic walking technique for 30 minutes.

Walking sessions for both groups began after a 10-minute warm-up to stimulate and effectively prepare the cardiorespiratory and muscular systems for exercise. Each participant then completed a 45-minute walking session at a pace determined by their heart rate during the workout. All participants were equipped with a heart rate monitor. Before each workout, resting heart rate and blood pressure were measured. Any heart rate or blood pressure that was considered excessively high before exercise (>90 beats per minute for heart rate and 150 beats per minute). None of the participants in the experiment who took part in this study showed values exceeding the pre-activity thresholds. Thus, they could all perform the same number of sessions. During these sessions, the trainee regularly and instantly monitored their heart rate to make sure it matched the heart rate during the workout. After the main part of the training, low-intensity exercises were performed for 5 minutes.

After the recovery period, the participants in the experiment of both groups were asked to perform trials and tests of morphofunctional readiness to assess the functional state of the cardiovascular and respiratory systems (Table 1).

Table 1. Assessment of the functional state of the cardiovascular and respiratory systems.

Type of trials	Estimate			
	Excellent	Good	Satisfactory	Unsatisfactory
Rufier Index	Less than 5	6-10	11-15	More than 16
Stange's test	60 and more	50-59	35-49	35 and less
Genchi test	50 and more	40-49	30-39	29 and less

The Romberg test allows you to determine the coordination functions of the nervous system.

An orthostatic test allows you to assess the state of the heart, state of training, fitness for working (Table 2).

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Table 2. Evaluation of the coordination functions of the nervous system and the degree of fitness for working.

Type of trials	Estimate			
	Excellent	Good	Satisfactory	Unsatisfactory
Romberg test	Strong stability for more than 15 seconds in the absence of tremor of the fingers and eyelids.		Swinging, slight tremor of the eyelids and fingers when held for 15 seconds.	The pose is held for less than 15 seconds.
Orthostatic test	6-8	8-10	10-16	20 and more

Based on the processed data, the average indicators were derived, the deviation from the norm of these indicators in the control groups.

3 Results

The main criterion was walking distance (m). Secondary criteria were maximum heart rate during exercise (bpm) and power output (W). All of these criteria were measured before and after the training period. Before the protocol (W0), the trainees underwent two 6-minute walking tests with a 24-hour interval to avoid training effects [20]. The best walking distance from both tests was saved. After four weeks of exercise training (W4), patients completed a third test with a 6-minute walk. The tests were carried out indoors at a distance of 30 m. Participants were asked to walk as far as possible within 6 minutes.

Recorded the maximum heart rate achieved during the tests. Walking distance was also measured using treadmill stress tests before and after four weeks of training. Prior to the protocol (W0), patients underwent a triangular stress test based on a modified Bruce test [22]. This stress test was consistent with the conditions described by Broustet and Monpère [23] and validated in patients with arterial disease. The test was stopped when the participant reported too much pain or fatigue to continue.

For the treadmill stress test, power output was measured in watts with the metabolic equivalent of a task (MET) endpoint achieved at the end of the test [22]. The calculated power output was based on the ratio of two formulas for determining MET. The first formula determines the MET value depending on the speed and slope achieved at the final level of the stress test [25]. The second formula determines the value of the MET depending on the power and weight of the participant [24]. The trainees passed the second stress test at the same time.

4 Discussions

The results of this systematic review clearly define Nordic walking as a healthy and accepted form of physical activity. Nordic walking could potentially be included in the daily lives of people with conditions associated with environmental degradation around the world and thus help increase their daily physical activity. In addition, because it has a beneficial effect on several important parameters such as heart rate, blood pressure, exercise, maximum oxygen consumption and quality of life in a wide range of diseases, it is well suited for primary and secondary prevention.

Nordic walking is gaining more and more popularity among the population. Multiple observational studies have shown that the short-term benefits of Nordic walking compared to brisk walking without poles include an 11–23% increase in VO2, a peak heart rate of 4%–18%, a respiratory exchange rate of 5%, a lactate concentration of 12%, and an expenditure of 18 calories. –22% [17].

Nordic walking results in a higher cardiorespiratory capacity in the long term compared to walking without poles due to the greater amount of muscle mass utilized through additional upper body locomotor activity. This leads to an increase in the cardiovascular and respiratory response when walking at the same speed, which leads to an increase in energy expenditure [18]. At speeds up to 8.5 km/h (i.e. 2.4 m/sec), it even results in the same or higher VO2 and heart rate values than jogging.

In summary, Nordic walking is an appropriate form of aerobic exercise for most apparently healthy men and women aged 40–60 who can benefit from training at an appropriate aerobic exercise intensity of 4 to 8 METs, an intensity range that is too high to obtain with regular walking. and too low to reach while running. In these parameters, Nordic walking is suitable for narrowing the intensity gap between walking and jogging and thus represents an alternative for anyone looking for a sport that meets the needs of daily physical activity at optimal intensity, resulting in health benefits. 12 weeks of Nordic walking showed a reduction in BMI, total fat mass, low-density lipoprotein,

The preventative arguments for Nordic walking are clear. As is the case with physical activity in general. Nordic walking may have a similar positive effect on chronic conditions such as diabetes or obesity. In cardiac rehabilitation programs, Nordic walking has the same short-term and long-term cardiorespiratory effects as normal walking for people with coronary heart disease [21].

In chronic obstructive pulmonary disease (COPD), Nordic walking is associated with increased daily physical activity, functional exercise capacity, and quality of life. In addition, it reduced exercise-induced dyspnea, anxiety, and depression, and is a simple and effective method of physical fitness for COPD patients.

In patients with chronic pain, strength training combined with endurance training has a positive effect on some types of non-specific pain in the neck, shoulders and lower back.

Nordic walking further improves shoulder mobility and reduces sensitivity to pain in the upper body without worsening lymphedema. In addition, Nordic walking benefits patients with progressive neurodegenerative movement disorders such as Parkinson's disease. Results from small trials have shown that patients benefit from improved motor skills, impaired functional mobility, walking speed, and distance, possibly resulting in reduced incidence of falls and improved quality of life [29].

Regular moderate endurance training is also used therapeutically for moderate to severe depressive disorders and has been shown to improve patients' mood.

In terms of depression scores as well as quality of life, Nordic walking showed trends of improvement.

Since Nordic walking is associated with a relatively low injury rate, it is suitable not only for the experienced, but also for a wide range of beginners.

Overall, Nordic walking has proven to be a form of physical activity with compelling overall health benefits and has better short-term and long-term effects on the cardiorespiratory system compared to brisk walking. Short-term effects show higher heart rate, VO2, respiratory exchange ratio, lactate thresholds and calorie expenditure, as well as an excellent lipid profile.

The current literature unanimously defines Nordic walking as a safe, feasible and easily accessible form of endurance training that has many positive effects on a wide range of people with various diseases and healthy people. Therefore, Nordic walking can be recommended for those who want to increase their daily physical activity through effective cardiorespiratory training as part of primary or secondary prevention.

5 Conclusions

The study compared the effect of short-term intensive training with Nordic walking and walking without poles. For study participants, after a 4-week training program, both Nordic walking and pole-free walking significantly increased walking distance and power output. However, the distance traveled during the 6-minute walk test was greater with Nordic walking than with walking without poles at the end of the training program.

We found significant improvement in walking distance after 4 weeks of training in both the 6-minute walk test and the treadmill stress test. These results are similar to those obtained by Keast et al. [27], who reported a significant increase in walking distance on a 6-minute walk test in patients with moderate to severe heart failure after a 12-week exercise program. In patients awaiting lung transplantation, after a 12-week Nordic walking training program, walking distance increased by 20% on a 6-minute walk test [28]. Scimi et al. [29] reported a 44% improvement in walking without poles in elderly patients after a program similar to that used in our study. In addition, increasing walking distance with the 6-minute walk test, which we found exceeds the minimum significant difference reported by Täger et al. [26] for the same type of population.

The effectiveness of exercise in Nordic walking and walking without poles is also supported by the results of Kocur et al. [18] and Kukkonen et al. [16], who reported a significant increase in distance in the 6-minute walk test with both types of training over periods of 3 to 13 weeks, respectively.

The significant increase in power output during the treadmill stress test for the 2 groups after the 4-week training period was directly related to the increase in walking distance. Thus, the rate achieved by patients at the end of the trial was greater than previously achieved. Since the MET value is directly dependent on speed and is directly related to output power, increasing speed is likely to increase the calculated output power. This relationship may explain the increase in power output at the end of 4 weeks of training.

Although both groups showed significant improvement in both tests after 4 weeks of the protocol, they did show some differences. Indeed, the Nordic walking group showed a significantly increased MET compared to the no-pole group. This difference can be explained by the greater muscle mass gained by Nordic walking than by walking without poles.

However, training results showed a greater improvement in knee extensor strength with Nordic walking than with walking without poles. The explanation lies in the significant increase in walking distance in Nordic walking. Pole walking has been found to significantly increase the distance that patients with arteritis can walk compared to the distance that can be walked without poles. Walking distance increased significantly during Nordic walking training compared to walking without poles, suggesting greater muscle loading. Moreover, there was a significant increase in walking speed after Nordic walking training compared to walking without poles. Combining these improvements with Nordic walking training versus stickless walking explains the significant difference in increased walking distance between the two groups.

However, this difference in walking difference was only significant for the 6-minute walk test. For a meaningful assessment, the stress test should be as specific as possible, especially considering the characteristics and practice of the trainee. Thus, compared to a treadmill stress test, a 6-minute walk test may give different results. This difference is again explained by the specificity of the test. For most people, walking on a treadmill feels intimidating and unnatural, which limits the intensity of their maximum effort, mainly because they are afraid of falling, but also because of the change in phase of the movement. The differences between the two tests we used helped explain the results. The 6-minute walk test was actually much more specific than Bruce's modified treadmill test.

The heterogeneity of our participants may be considered a limitation of this study. However, the groups had the same number of participants with each pathology and could therefore be compared.

After 4 weeks of a conventional rehabilitation program, Nordic walking was more effective than walking without poles in increasing distance on the 6-minute walk test. Nordic walking compared to walking without poles had a greater effect on functional performance, mainly by increasing walking speed and gaining muscle mass. According to the trainees, Nordic walking was associated with an important motivation: they walked faster and longer with sticks than without sticks, which increased their motivation to exercise. In addition, this activity is inexpensive and can be done almost anywhere, which can help you continue practicing on your own. Nordic walking can be recommended in any rehabilitation training, provided there are no contraindications.

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