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Nordic Walking May Safely Increase the Intensity of Exercise Training in Healthy Subjects and in Patients with Chronic Heart Failure

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation;
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Abstract

Background. Physical activity in patients with chronic heart failure (HF) improves the exercise capacity and quality of life, and may also reduce mortality and hospitalizations. The greatest benefits are achieved through high-intensity aerobic exercises resulting in a stronger cardiorespiratory response. Nordic walking (NW), a walking technique using two poles and mimicking the movements performed while cross-country skiing, is associated with the involvement of more muscle groups than in the case of classic walking, and should therefore make it possible to increase exercise intensity, resulting in more effective training for patients with HF.

Objectives. The aim of the study was to assess the feasibility and safety of the NW technique, and to compare the effort intensity while walking with and without the NW technique in both healthy subjects and in patients with chronic HF.

Material and Methods. The study involved 12 healthy individuals (aged 30 ± 10 years, 5 men) and 12 men with stable chronic systolic HF (aged 63 ± 11 years, all categorized in New York Heart Association class II, median LVEF 30%, median peak VO_2 18.25 mL/kg/min). All the participants completed two randomly assigned submaximal walking tests (one with NW poles and one without) conducted on a level treadmill for 6 min at a constant speed of 5 km/h.

Results. Walking with the NW technique was feasible, safe and well tolerated in all subjects. In both the control group and the chronic HF group, walking with the NW technique increased peak VO_2 , RER, VE, PET CO_2 , HR and SBP over walking without the poles; and the fatigue grade according to the abridged Borg scale was higher. Dyspnea did not increase significantly with the NW technique.

Conclusions. The NW technique can increase the intensity of aerobic training in a safe and well-tolerated way in both healthy individuals and in patients with chronic HF (*Adv Clin Exp Med* 2016, 25, 1, 145–149).

Key words: Nordic walking, heart failure, new training concepts, total body workload, high intensity training.

In patients with chronic heart failure (HF), regular physical training improves the exercise capacity and the quality of life, and can reduce mortality and hospitalizations [1–2]. Regular physical effort is therefore a highly recommended standard management in this group of patients.

In accordance with recommendations of scientific associations, all clinically stable patients with heart failure should participate in cardiac rehabilitation programs involving regular physical exercise [1, 3–5]. So far, it has not been determined how to manage physical activities in an optimal

way, how to select the types and forms of physical activity, and how to schedule loads; however, there have been reports indicating that the greatest benefits are achieved with high-intensity aerobic exercises resulting in a more intense cardiorespiratory response [6–8].

In HF patients, regular walking sessions are usually prescribed as an inexpensive, safe and well-tolerated form of exercise. Recently, a new form of aerobic training has been gaining greater popularity – namely Nordic walking (NW), energetic walking supported by two appropriately sized poles [9]. The NW technique mimics the movements performed while cross-country skiing and involves more muscle groups than regular walking performed in a similar way. In NW, in addition to the muscles of the lower extremities and trunk, the muscles of the chest, shoulders and abdomen also take part [10]. The use of the NW technique therefore results in increased effort intensity, and it consequently might be a more effective training method for HF patients than regular walking.

The aim of this study was to assess the feasibility and safety of the NW technique under controlled laboratory conditions and to compare the effort intensity, measured by cardiopulmonary exercise testing, in comparison with standard walking in fit healthy volunteers and in patients with chronic heart failure.

Material and Methods

The study involved 12 healthy volunteers with high physical performance levels (a mean age of 30 ± 10 years, 5 males) and 12 males with stable systolic chronic heart failure who were being treated at the Outpatient Heart Failure Clinic at the 4th Military Hospital in Wrocław, Poland. Table 1 presents the clinical characteristics of the two study groups. All the HF patients were categorized in New York Heart Association (NYHA) class II; their median of peak oxygen consumption (peak VO_2) was 18.25 mL/kg/min. The HF patients in the study were treated in accordance with the recommendations of the European Society of Cardiology [1]. After being enrolled in the study, all the participants were given practical training to familiarize them with the Nordic walking technique.

The Bioethics Committee for Research Studies at the University School of Physical Education in Wrocław approved the study.

All the participants completed two walking tests (one using the NW technique and one involving regular walking) conducted on a mobile treadmill (General Electric, Fairfield, CT, USA) according to a protocol prepared for the purpose

Table 1. Clinical characteristics of the healthy controls and the patients with HF

Clinical variable	Healthy controls (n = 12)	HF patients (n = 12)
Age [years]	30 ± 10	63 ± 11
BMI [kg/m ²]	22.3 ± 1.9	27.1 ± 4.2
NYHA class II [%]	–	100
Peak VO_2 (mL/kg/min)	–	18.25
ICD, n	0	11
Ischemic etiology NS, n [%]	–	66
Median LVEF [%]	65	30
Beta-blockers, n [%]	0	100
ACE-I, n [%]	0	95
Statins, n [%]	0	95
ASA, n [%]	0	60
Loop diuretics, n [%]	0	85
Digoxin, n [%]	0	35

Table 2. Protocol for treadmill exercise tests

Stages	Protocol for treadmill exercise tests		
	duration (min)	treadmill speed [km/h]	treadmill slope [°]
Rest	5	0	0
Exercise	6	5	0
Recovery	60	0	0

of this study (Table 2). During each walking test a distance of 500 meters was reached. The protocol resembled a 6-min corridor walk test, which is a standard diagnostic tool used in patients with HF, and is usually a well-tolerated form of exercise. During two consecutive cardiopulmonary exercise tests on the mobile treadmill, the following parameters were assessed: ECG (ECG module, General Electric, USA), oxygen consumption (VO_2), carbon dioxide production, respiratory exchange ratio (RER), minute ventilation (VE), partial end-tidal CO_2 (PET CO_2) (Ultima, Graphics, Medical Graphics Corporation, St Paul, MN, USA) systolic blood arterial pressure (manual sphygmomanometer, Riester, Jungingen, Germany) and heart rate (HR) (Polar heart monitor, Kempele, Finland). The participants' subjective feelings of fatigue and dyspnea related to the task performed were also

assessed, using a simplified 10-point Borg Rating of Perceived Exertion scale. The parameters measured while walking with and without NW poles were compared using the Wilcoxon signed-rank test. A p -value < 0.05 was considered significant.

Results

All the subjects completed the walking tests with and without NW poles without complications. During and after the tests there were no symptoms of myocardial ischemia, increased effort dyspnea or significant arrhythmia. In the group of patients with HF, walking with the NW technique increased VO_2 , RER, VE, PET CO_2 , HR and systolic arterial pressure, in comparison to regular walking, and the fatigue grade according to the abridged Borg scale was higher than after regular walking (Table 3). Similarly, increases in VO_2 , RER, VE, PET CO_2 , HR, systolic arterial pressure,

and fatigue level while walking with the NW technique were observed in the healthy subjects. At the same time, dyspnea did not increase significantly in either group.

Discussion

The results of this study indicate that walking with the NW technique is feasible, safe and well-tolerated both in healthy volunteers and in HF patients. None of study participants exhibited symptoms of increased dyspnea, symptoms of myocardial ischemia, signs of heart failure or significant arrhythmia while walking with the NW poles. Additionally, none of participants complained about discomfort or asked for an earlier end to the test. This is of special importance because aerobic training is effective only if regularly performed for an extended period of time, and with the prescribed effort intensity [11]. Consequently, if any form of physical activity is too burdensome for a patient or is associated with signs or symptoms of significant discomfort, patients will have a negative attitude toward the exercises and will not comply with the recommended training schedule over the long term, which will undoubtedly result in a failure to achieve the expected effects.

Secondly, the results of this study indicate that the NW technique, compared to traditional walking, significantly increases the intensity of effort performed, as expressed by the more intense response of the participants' circulatory and respiratory systems. Although the current European Society of Cardiology recommendations do not establish an optimal form of physical activity that should be implemented as part of cardiac rehabilitation, and many studies in this field recommend continuous training of medium intensity, it seems that training sessions of higher intensity may provide significantly greater benefits [1, 12–14]. There have been reports of significantly better effects on the performance of the circulatory system in the case of high-intensity training than with low- or medium-intensity training, both in healthy volunteers and in patients with ischemic heart disease and HF [7, 8, 15, 16]. Wisloff et al. demonstrated a significant correlation between the type and intensity of aerobic training and achieved therapeutic effects in HF patients [6]. A randomized study with 27 patients with stable systolic HF compared the effects of intense interval training and continuous training of moderate intensity, and demonstrated a greater increase in exercise capacity and greater improvement of vascular endothelial functions and the quality of life in a subgroup of patients subjected to intense training. Beneficial reverse

Table 3. Patients with heart failure (#: $p < 0.05$)

Median change in parameter from baseline to peak during exercise	Walking without poles	Nordic walking
VO_2 [mL/kg/min]	9.2	11.2 [#]
RER	0.04	0.15 [#]
VE [L/min]	22.7	38.5 [#]
PET CO_2	3.6	3.8 [#]
HR [bpm]	41	47 [#]
Systolic BP [mm Hg]	13	23 [#]
Fatigue [Borg scale]	3	5 [#]
Dyspnea [Borg scale]	3	4

Table 4. Healthy controls (#: $p < 0.05$)

Median change in parameter from baseline to peak during exercise	Walking without poles	Nordic walking
VO_2 [mL/kg/min]	9	14.5 [#]
RER	0.03	0.12 [#]
VE [L/min]	14.1	22.4 [#]
PET CO_2 [mm Hg]	2	5 [#]
HR [bpm]	20	49 [#]
Systolic BP [mm Hg]	10	25 [#]
Fatigue [Borg scale]	1	3 [#]
Dyspnea [Borg scale]	1	1

remodeling of the left ventricle was observed only in the group that underwent intense training [6]. This indicates that increasing the intensity of exercises performed as part of a cardiac rehabilitation program may be a good strategy that can increase the beneficial therapeutic effects. The use of the NW technique as part of a cardiac rehabilitation program appears to have specific advantages, as it does not cause any additional load to the muscles of the lower extremities that are usually active while walking, but it involves additional groups of muscles, resulting in more even load distribution on individual muscles, which may translate into good tolerance and safety. This type of physical activity, featuring so-called total body workload and based on the participation of a large number of different muscle groups, can be an optimal way to

achieve higher effort intensity, especially in HF patients who might not tolerate increases in the speed of regular walking, for example.

The Nordic walking technique increased the intensity of aerobic training in a safe and well-tolerated way in both healthy individuals and in patients with chronic heart failure. However the number of patients in the current study was relatively small, and HF subjects were all male, and all in NYHA functional class II. The results of the study should therefore be regarded as preliminary, and need to be confirmed in larger studies comprising more heterogeneous HF populations. Nevertheless, the authors believe that the data presented may contribute important information to current knowledge about cardiac rehabilitation in HF patients.

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