Health Benefits of Nordic Walking
A Systematic Review

Marcus Tschentscher, MSc, David Niederseer, MD, PhD, BSc, Josef Niebauer, MD, PhD, MBA

Context: Modern lifestyle, with its lack of everyday physical activity and exercise training, predisposes people to chronic diseases such as diabetes mellitus, obesity, hypertension, and coronary artery diseases. Brisk walking as a simple and safe form of exercise is undisputedly an effective measure to counteract sedentary lifestyle risks even in the most unfit and could lead to a reduction of the prevalence of chronic diseases in all populations. The purpose of this review is to systematically summarize, analyze, and interpret the health benefits of Nordic walking (walking with poles), and to compare it to brisk walking and jogging.

Evidence acquisition: A systematic and comprehensive literature search was performed between November 2010 and May 2012. Data were analyzed between April 2011 and May 2012.

Evidence synthesis: Sixteen RCTs with a total of 1062 patients and 11 observational studies with 831 patients were identified. The current analysis revealed that with regard to short- and long-term effects on heart rate, oxygen consumption, quality of life, and other measures, Nordic walking is superior to brisk walking without poles and in some endpoints to jogging.

Conclusions: Nordic walking exerts beneficial effects on resting heart rate, blood pressure, exercise capacity, maximal oxygen consumption, and quality of life in patients with various diseases and can thus be recommended to a wide range of people as primary and secondary prevention.
(Am J Prev Med 2013;44(1):76–84)

Context

Modern lifestyle, with its lack of everyday physical activity and exercise training, predisposes people to chronic diseases including diabetes mellitus, obesity, hypertension, and coronary artery diseases.[1] Despite the fact that the benefits of regular physical activity are widely known, the choice of a sedentary lifestyle is increasing in prevalence.[2,3] Therefore, identifying forms of physical activity that are easily accessible is warranted and can be performed by a large number and wide range of people for a sufficient amount of time and with an appropriate intensity to induce fitness and health effects.

Brisk walking as a simple and safe form of exercise is undisputedly an effective measure to counteract sedentary lifestyle risks even in the most unfit and could lead to a reduced prevalence of chronic diseases in all populations.[4] However, it is not considered very fashionable and has not been adopted by a meaningful proportion of the population. Nordic walking (walking with poles) was developed in Scandinavia and introduced in central Europe nearly 20 years ago. People of all ages quickly were attracted by it.[5] Nordic walking proved to be a simple and feasible form of physical activity that can be done by nearly everybody, everywhere, and at almost any time. It is the same as brisk walking except for the additional use of specially designed poles that provide the advantage of actively involving the upper body and arms (Figure 1).

The purpose of this review is to systematically summarize, analyze, and interpret the health benefits of Nordic walking in general, and to compare it to brisk walking and jogging with regard to its effects on heart rate, maximal oxygen consumption, quality of life, and other health-related measures.

From the University Institute of Sports Medicine, Prevention and Rehabilitation, Paracelsus Medical University of Salzburg; Institute of Sports Medicine of the State of Salzburg; Sports Medicine of the Olympic Center Salzburg-Rif, Salzburg, Austria

Address correspondence to: Josef Niebauer, MD, PhD, MBA, University Institute of Sports Medicine, Prevention and Rehabilitation, Paracelsus Medical University of Salzburg, Lindhofstrasse 20, Salzburg, Austria 5020. E-mail: j.niebauer@salk.at.

0749-3797/$36.00
http://dx.doi.org/10.1016/j.amepre.2012.09.043

Evidence Acquisition

Literature Search: Inclusion and Exclusion Criteria

To cover the wide range of possible Nordic walking articles, the following databases were searched: ISI Web of Knowledge, PubMed, CENTRAL, CINAHL, and PEDro. The main search items included "Nordic walking," "pole walking," "pole striding,"

Figure 1. Nordic walking, an outdoor sport

and "exerstriders." In a second step, all items were amended by each of the cited diseases. If an article included more than one search item, it was counted only once during further analysis. The search was limited to articles written in English and German and a time range of 1950 to the present. Data collection took place between November 2010 and May 2012, and data analysis was performed between April 2011 and May 2012. References of all included articles were checked for further relevant publications.

Only RCTs and observational studies were included, matching the search criteria referring to health topics. If studies did not apply a proper Nordic walking technique or did not use specially designed Nordic walking poles, they were not considered. Because "exerstriding" was one of the first commercial forms of Nordic walking with an identical technique, articles on that topic were included and assessed along with all other papers specifically on Nordic walking.

Selection Process and Data Extraction

A total of 211 articles included the search terms used. Of these, 141 had to be excluded on the basis of title and abstract, because they dealt with Nordic walking in a context other than health. Next, search results obtained from the five databases were compared for coinciding matches. The remaining 27 articles were accepted for final analysis, including 16 RCTs and 11 observational trials (Figure 2). Two independent reviewers read all abstracts, and disagreements on eligibility were later solved by consensus. Articles were then checked for relevant data, which were extracted twice and compared for accuracy. Two reviewers performed statistical analyses and citation handling.

Evidence Synthesis

Overall, 16 RCTs were identified with a total of 1062 patients (Nordic walking group, $n=559$; control group, $n=503$), representing the long-term health effects of Nordic walking. Mean study duration was 3–24 (13.1 ± 7.3) weeks (Table 1). Additionally, the data of 11 observational trials with 831 patients were included in the analyses, to demonstrate the short-term health effects of the sport (Table 2). In all reviewed articles, maximum heart rate and/or maximal oxygen uptake were typically measured by a maximum incremental test.

Healthy Subjects

In 1995, the first observational study to demonstrate superior short-term effects of Nordic walking as compared to brisk walking without poles was carried out in ten female subjects. It found that 30 minutes of Nordic walking at a submaximal intensity (6.7 km/hour [i.e., 1.9 m/second]) led to an 11% greater mean oxygen consumption (VO_2); 8% higher peak heart rate; a raised respiratory exchange ratio of 5%; and an 18% higher energy expenditure as brisk walking at same pace (all $p<0.05$).[6] Similar increases (VO_2: 23%; peak heart rate: 18%; energy expenditure: 22%; all $p<0.05$) were found 2 years later in another observational study by Porcari et al.[7] in 16 women and 16 men on two separate 20-minute walking protocols at submaximal pace. Jordan et al.[8] ($n=10$) as well as Church et al.[9] ($n=22$) were able to confirm these findings on VO_2, heart rate, and energy expenditure in separate observational studies (Table 2). In a further observational study, Aigner et al.[10] observed in ten women and ten men that Nordic walking resulted in higher arterial blood lactate (12%) and higher peak heart rate (4%; all $p<0.01$) than brisk walking on a treadmill.

Schiffer et al.[11] assessed cardiorespiratory parameters in 15 healthy women during Nordic walking, walking, and

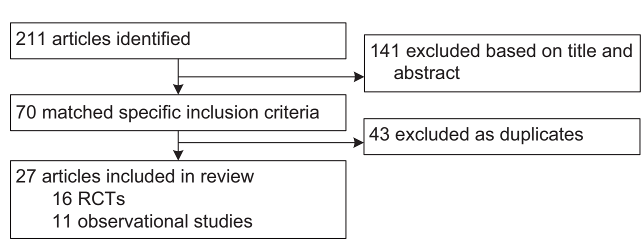

Figure 2. Selection of articles

Table 1. Overview of RCTs on the effects of Nordic walking on chronic diseases

Study	State of health	N	Intervention	Intensity	Results
Breyer (2010)[22]	COPD	60	Int: n=30; 60 minutes, three times per week NW, 12 weeks Con: n=30; sedentary	NW: 75% HR_{max}	↑ walking time ($p<0.01$) ↑ 6MWT ($p<0.01$) ↓ sedentary behavior ($p<0.01$)
Collins (2005)[21]	Peripheral arterial disease	49	Int: n=25; 3 times per week NW, 24 weeks Con: n=24; sedentary	N/A	↑ HR_{max} (p=0.04) ↑ VO_{2peak} (p=0.016) ↑ perceived pain (p=0.02) ↓ BP ($p<0.001$)
van Eijkeren (2008)[28]	Parkinson's disease	19	Int: n=10; 60 minutes, two times per week NW, 6 weeks Con: n=9; sedentary	NW: individual speed	↑ 6MWT ($p<0.01$) ↑ QoL ($p<0.01$)
Figard-Fabre (2010[15]	Obesity	11	Int: n=6; three times per week NW, 4 weeks Con: n=5; 3 times per week walking, 4 weeks	NW and walking: 4 km/h (1.1 m/s)	↑ HR_{max} ($p<0.001$) ↑ VO_{2peak} ($p<0.001$) ↑ energy consumption (p=0.022) ↓ RPE (p=0.031)
Figard-Fabre (2011)[16]	Obesity	23	Int: n=12; 45 minutes, three times per week NW, 12 weeks Con: n=11; 45 minutes, three times per week walking, 12 weeks	NW and walking: individual speed	↑ VO_{2peak} (p=0.005) ↑ adherence (p=0.011) ↓ body fat (p=0.011) ↓ BP ($p<0.001$)
Gram (2010)[14]	Diabetes mellitus type 2	68	Int1: n=22; 45 minutes, two times per week NW, 8 weeks Int2: n=24; exercise group Con: n=22; sedentary	NW and exercise: >40% VO_{2peak}	↓ Fat tissue mass (p=0.021) (↓) HbA1c (n.s.)
Hagner (2009)[13]	Healthy	168	Int: n=168; 12 weeks NW (65 pre-, 53 peri-, 53 postmenopausal) Con: none	NW: individual, moderate speed	↑ HDL ($p<0.01$) ↓ LDL ($p<0.01$) ↓ triglycerides ($p<0.01$) ↓ BMI ($p<0.01$)
Hartvigsen (2010)[5]	Low back and/or leg pain	136	Int1: n=45; 45 minutes, two times per week NW, 8 weeks Int2: n=45; self-controlled NW; Con: n=46; physical activity counseling	N/A	n.s.
Henkel (2008)[24]	Neck pain	85	Int1: n=28; two times per week NW, 12 weeks Int2: n=30; one time per week walking with MBT® shoes Con: n=27; two times per week spine training	N/A	↑ QoL (p=0.043) ↓ Neck pain ($p<0.001$) ↓ functional spine impairment (p=0.011)
Kocur (2009)[18]	Post acute coronary syndrome	80	Int1: n=40; 30 minutes, four times per week NW, 3 weeks Int2: n=20; 30 minutes, four times per week walking Con: n=20; standard rehabilitation	NW and walking: individual walking speed	↑ exercise capacity (p=0.025)

(continued on next page)

Table 1. *(continued)*

Study	State of health	N	Intervention	Intensity	Results
Kukkonen-Harjula (2007)[12]	Sedentary	121	Int: n=60; 40 minutes, four times per week NW, 13 weeks Con: n=61; 40 minutes, four times per week walking, 13 weeks	NW and walking: 50% HR_{max}	↑ HR_{max} (95% CI=–2.3, 1.7) ↑ RER (95% CI=–0.1, 0.03) ↑ VO_{2peak} (95% CI=–1.1, 0.9) ↑ lactate (95% CI=–0.5, 0.5)
Langbein (2002)[20]	Peripheral arterial disease	52	Int: n=27; 30–45 minutes, four times per week NW, 24 weeks Con: n=25; sedentary	NW: 70%–80% HR_{max}	↑ exercise tolerance ($p<0.001$) ↓ claudication pain ($p<0.001$)
Mannerkorpi (2010)[23]	Fibromyalgia	67	Int: n=34; 20 minutes, two times per week NW, 15 weeks Con: 33; 20 minutes, two times per week walking, 15 weeks	NW: RPE <12 walking: RPE 10–11	↑ 6MWT (p=0.009)
Reuter (2011)[29]	Parkinson's disease	90	Int: n=30; 70 minutes, three times per week NW, 24 weeks Con I: n=30, walking; Con II: n=30, flexibility exercise	N/A	↑ walking speed ($p<0.001$) ↑ walking distance ($p<0.02$) ↓ BP (p=0.004)
Sprod (2005)[26]	Breast cancer rehabilitation	12	Int: n=6; 20 minutes, two times per week NW, 8 weeks Con: n=6; 20 minutes, two times per week walking, 8 weeks	NW and W: 40%–50% HRR	↑ upper extremity strength (p=0.046)
Suija (2009)[30]	Depressed	21	Int: n=16; depressed, 30 minutes, three times per week NW, 24 weeks Con: n=5; healthy, 30 minutes, three times per week NW, 24 weeks	N/A	n.s.
Total		1062			

Note: 95% CIs are between groups.
BP, blood pressure; Con, control group; COPD, chronic obstructive pulmonary disease; HR_{max}, maximum heart rate; HRR, heart rate reserve; Int, intervention group; N/A, not available; n.s., not significant; NW, Nordic walking; PDQ-39, Parkinson Disease Questionnaire; QoL, quality of life; RER, respiratory exchange ratio; RPE, rate of perceived exertion; sig., significant; 6MWT, 6-minute walking test; VO_{2peak}, peak oxygen consumption; ↑, increase; ↓, decrease

jogging in an observational field test on separate days. Their data indicate higher VO_2 for Nordic walking than for walking and jogging at 6.5–7.2 km/hour (1.8–2 m/second; $p<0.05$). At a comparable speed (up to 8.5 km/hour [i.e., 2.4 m/second; $p<0.05$), VO_2 and heart rate during Nordic walking compared well with that during jogging.

In an RCT, Kukkonen-Harjula et al.[12] investigated the long-term effects of Nordic walking (n=60) and walking (n=61) during self-guided training intervention for 12 weeks (40 minutes, four times per week), similar for both groups, in previously sedentary women at 50% of the individual maximum heart rate. Maximum heart rate, respiratory exchange ratio, peak oxygen consumption, and lactate threshold improved over the training period but there was no difference found between the groups (Table 1 shows group-difference CIs).

Hagner et al.[13] divided 168 women into three age groups according to their menopausal stage for an RCT. After 12 weeks of Nordic walking, results showed decreases (all $p<0.01$) in BMI, total fat mass, low-density lipoproteins, triglycerides, and waist circumference and an increase in high-density lipoproteins in pre-, peri- and post-menopausal women. No group differences were reported, and there was no control group.

In summary, these observational studies and RCTs demonstrate that the short-term as well as long-term

Table 2. Overview of observational studies on the short-term effects of Nordic walking on health

Study	State of health	N	Testing and intervention	Intensity	Results: NW compared to walking
Aigner (2004)[10]	Healthy	20	Incremental treadmill test	NW and walking: until exhaustion	↑ HR_{peak} ($p<0.01$) ↑ arterial blood lactate ($p<0.01$)
Baatile (2000)[27]	Parkinson's disease	8	8 weeks NW	NW: individual speed	↑ exercise capacity ($p=0.025$)
Church (2002)[9]	Healthy	22	1600-m walking test	NW and walking: individual speed	↑ HR_{peak} ($p<0.01$) ↑ VO_2 ($p<0.001$) ↑ energy expenditure ($p<0.001$)
Jordan (2001)[8]	Healthy	10	1600-m walking test	NW and walking: 75% HR_{max}	↑ HR_{peak} ($p<0.05$) ↑ VO_2 ($p<0.05$) ↑ energy expenditure ($p<0.05$)
Knobloch (2006)[31]	Healthy	137	Total 29,160 hours NW	NW: individual speed	Documentation of injury rates
Leibbrand (2010)[25]	Breast cancer	563	3 weeks NW	N/A	↑ shoulder mobility (p=N/A) ↑ QoL (p=N/A) ↓ sensitivity to pain (p=N/A)
Oakley (2008)[19]	Peripheral arterial disease	20	Treadmill test	NW and walking: 3.2 km/h at 4% gradient	↑ HR_{peak} ($p<0.001$) ↑ walking distance ($p<0.001$) ↓ perceived leg pain ($p=0.002$)
Porcari (1997)[7]	Healthy	32	20-minute, two times walking test	NW and walking: submaximal	↑ HR_{peak} ($p<0.05$) ↑ VO_2 ($p<0.05$) ↑ energy expenditure ($p<0.05$)
Rodgers (1995)[6]	Healthy	10	30-minute walking test	NW and walking: submaximal (6.7 km/h, i.e., 1.9 m/s)	↑ HR_{peak} ($p<0.05$) ↑ VO_2 ($p<0.05$) ↑ RER ($p<0.05$) ↑ energy expenditure ($p<0.05$)
Schiffer (2006)[11]	Healthy	15	Incremental field test	NW and walking: 1.2 m/s until exhaustion Jogging: 1.8 m/s until exhaustion	↑ HbA1c (n.s.) ↓ fatty tissue mass ($p=0.021$)
Walter (1996)[17]	Coronary artery disease	14	8-minute walking test	NW and walking: 1.6 m/s	↑ VO_2 ($p<0.05$) ↑ HR_{peak} ($p<0.05$)
Total		831			

HR_{peak}, peak heart rate during walking test; N/A, not available; n.s., not significant; NW, Nordic walking; QoL, quality of life; RER, respiratory exchange ratio; VO_2, oxygen consumption; ↑, increase; ↓, decrease

effects of Nordic walking are equal or superior to brisk walking and (in one study) to jogging, in healthy subjects.

Subjects with Selected Diseases

Diabetes mellitus type 2. Only one RCT[14] examined the effects of Nordic walking in patients with diabetes mellitus type 2. The Nordic walking group ($n=22$) trained for 2 months (45 minutes, twice per week), followed by for an additional 2 months (45 minutes, once per week; $n=22$). Results were compared to a sedentary control group ($n=22$) and a second exercise group ($n=24$) performing 30 minutes per week of unsupervised endurance training for 4 months. There was no difference between groups with regard to HbA1c and energy expenditure, but fat tissue mass decreased ($p=0.021$).

Obesity. In an RCT, Figard-Fabre et al.[15] examined in 11 obese women (mean BMI 33.1) the effect of 4 weeks (12 sessions) of 5-minute walking exercises (four times per week) with and without poles at 4 km/hour (1.1 m/second) and various inclinations. The use of poles led to an increase in heart rate; VO_2 (both $p<0.001$); energy expenditure ($p=0.022$); and decreased ratings of perceived exertion ($p=0.031$) compared to walking without poles. In a later RCT, Figard-Fabre et al.[16] could further demonstrate in 23 obese women (mean BMI 33.3) that Nordic walking for 12 weeks (30 minutes, three times per week) also led to a decrease in body mass ($p=0.011$) and blood pressure ($p=0.001$) compared to a walking group with similar exercise duration.

Coronary artery disease. In a 1996 observational study, Walter et al.[17] observed 14 patients in Phase-III and Phase-IV cardiac rehabilitation in two separate 8-minute walking trials, with and without poles, and they confirmed Rodgers's[6] findings that walking with poles led to an increased VO_2 (21%; $p<0.05$); peak heart rate (13%; $p<0.05$); and slightly higher blood pressure during exercise testing. In an RCT, Kocur et al.[18] investigated the effects of 3 weeks of Nordic walking in addition to a standardized cardiac rehabilitation program. Eighty men, 2–3 weeks after an acute coronary syndrome, were randomized among three groups: (1) cardiac rehabilitation plus Nordic walking ($n=40$; 2.5 km, 4 times per week); (2) brisk walking in addition to cardiac rehabilitation ($n=20$; 2.5 km, four times per week); and (3) standard cardiac rehabilitation only ($n=20$). Energy expenditure was higher in both the Nordic walking and the walking group compared to the control group (10.8 ± 1.8; 10.0 ± 1.9; 9.2 ± 2.2 METs, respectively; $p=0.025$). In addition, the Nordic walking group showed an increase in lower body endurance and dynamic balance ($p<0.05$).

Peripheral arterial disease. In an observational study on 20 patients with intermittent claudication, Oakley et al.[19] confirmed a longer walking distance ($p<0.001$) and less perceived pain (using a Borg CR 10 scale; $p=0.002$) despite a higher workload. They also recorded an increase in cardiopulmonary work capacity, as indicated by an increase in VO_2 ($p<0.001$). In 2002, Langbein et al.[20] ran an RCT on 52 peripheral arterial disease patients with intermittent claudication. After 24 weeks of Nordic walking (30–45 minutes, three times per week; $n=27$) at an intensity of 70%–80% maximum heart rate, they found that training improved peak oxygen consumption as well as walking duration and decreased perceived level of claudication pain (Walking Impairment Questionnaire; all $p<0.001$) compared to a non-exercising control group ($n=25$).

Collins et al.[21] included 49 patients with intermittent claudication into an RCT with an identical study protocol. After 24 weeks of training, they were able to demonstrate that total treadmill time (10.3 ± 4.1 vs 15.1 ± 4.5 minutes; $p<0.001$); peak oxygen consumption ($p=0.016$); level of perceived claudication ($p=0.02$) during exertion; and quality of life (by SF-36 [short-form health survey with 36 questions] and Walk Impairment Questionnaire; $p=0.031$) improved.

Chronic obstructive pulmonary disease. Breyer et al.[22] enrolled 60 chronic obstructive pulmonary disease (COPD) patients into a 12-week Nordic walking RCT. The Nordic walking group ($n=30$) trained for 60 minutes three times per week at an intensity of 75% of maximum heart rate, compared to a sedentary control group ($n=30$). Nordic walking increased daily physical activity and the distance covered in a 6-minute walk test (both $p<0.01$). Further, Nordic walking decreased exercise-induced dyspnea (Borg dyspnea score) and anxiety and depression (Hospital Anxiety and Depression Scale) and improved quality of life (SF-36 Physical Component Summary and Mental Component Summary; all $p<0.01$). No changes in lung function parameters or medication were reported.

Fibromyalgia syndrome. Mannerkorpi et al.[23] in an RCT examined the effect of Nordic walking ($n=34$; rate of perceived exertion [RPE] <12) compared to brisk walking ($n=33$; RPE: 10–11) on pain in fibromyalgia in 67 women, 20 minutes, twice per week for 15 weeks. Nordic walking was found to improve the functional capacity in a 6-minute walk test ($p=0.009$) and to decrease the perceived level of activity limitation (Fibromyalgia Impact Questionnaire Physical Scale; $p=0.027$). Nevertheless, individual severity of pain did not change during the intervention period.

Pain in general. In an RCT, Henkel et al.[24] studied the effects of twice-per-week Nordic walking for 12 weeks in 27 patients with chronic neck pain and observed a reduction in unspecific, chronic neck pain ($p<0.001$) and increased quality of life (SF-36 questionnaire; $p=0.043$). In another RCT[5] on patients with lower back pain and/or leg pain ($n=136$), 8 weeks of Nordic walking twice a week for 45 minutes showed a tendency toward reduced lower back pain, which resulted in a reduction of oral pain medication (for both, see Table 1 for controls).

Breast cancer. In a questionnaire observation on female breast cancer patients, Leibbrand et al.[25] found an improved shoulder mobility and quality of life while sensitivity to pain in the upper body was reduced within the group. No worsening of existing preconditions to lymphedema was described.

Sprod et al.[26] showed in a small RCT on 12 female breast cancer patients that 8 weeks of Nordic walking for 20 minutes twice a week led to an increase in muscular endurance of the upper body (p=0.046) compared to walking.

Parkinson's disease. Baatile et al.[27] performed a Nordic walking observational study for 8 weeks (40 minutes of walking, three times per week) in six male subjects with Parkinson's disease and demonstrated increased functional independence and quality of life by disease-specific questionnaires (Unified Parkinson's Disease Rating Scale; p=0.026); Parkinson Disease Questionnaire–39 (p=0.028)). An RCT by van Eijkeren et al.[28] trained 19 Parkinson's patients (14 women, 5 men) for 6 weeks (60 minutes twice per week). They found an increase in physical activity and quality of life (both $p<0.01$) compared to a sedentary control group. In another RCT, Reuter et al.[29] were able to show in 90 Parkinson's patients that an exercise program of Nordic walking for 24 weeks (70 minutes three times per week) brought superior effects on walking speed ($p<0.02$) and distance ($p<0.001$) as well as on blood pressure (p=0.004; Table 1 shows controls).

Depression. In 16 depressed subjects, Suita et al.[30] investigated in an RCT the impact of Nordic walking (30 minutes three times per week) over a period of 24 weeks. Nordic walking led to a nonsignificant increase in patients' physical activity and mood.

Complications and injuries. Knobloch and Vogt[31] assessed the safety of Nordic walking in 137 healthy, skilled Nordic walkers (101 women, 36 men; aged 53.5 years; average BMI 25.6) and documented the incidence of related injuries through a questionnaire. After a total of 29,160 hours of Nordic walking, the rate of injury was reported with 0.926 injuries per 1000 hours of training. This is very low compared to other popular sports such as basketball or squash (each 14 injuries per 1000 hours). Rates of upper body injuries were slightly higher as compared to the lower body (0.549 vs 0.344 per 1000 hours). Most common injuries were strains of the ulnar collateral ligament; thumb (equivalent to skier's thumb); and upper ankle. No data are available on the injury rates of Nordic walking in patients with specific medical disorders.

Discussion

Results of this systematic review clearly identify Nordic walking as a healthy and well-accepted mode of physical activity. Nordic walking potentially can be incorporated into patients' daily lives and thus help increase their daily physical activity. Further, because it exerts beneficial effects on several relevant parameters such as resting heart rate, blood pressure, exercise capacity, maximal oxygen consumption, and quality of life in a wide range of diseases, it is well suited for primary and secondary prevention.

Nordic walking has gained increasing popularity in the general population of several northern and central European countries. Numerous observational studies have shown that the short-term benefits of Nordic walking in comparison to brisk walking without poles include an increased VO_2 of 11%–23%[6–9,11]; peak heart rate of 4%–18%[6–11]; respiratory exchange ratio of 5%[6]; lactate concentration of 12%[10]; and caloric expenditure of 18%–22%.[6–8,10] Nordic walking generates up to 6.3–7.7 MET[7] at brisk paces whereas walking reaches 3.3–5.0 MET.[32] Nordic walking over the long-term leads to superior cardiorespiratory fitness as compared to walking without poles because of the higher amount of muscle mass used through additional motor activity of the upper body. This results in an increased cardiovascular and respiratory response when walking at the same pace, causing increased energy expenditure.[12] Up to a pace of 8.5 km/hour (i.e., 2.4 m/second), it even leads to similar or higher values of VO_2 and heart rate than jogging.[11]

Therefore, Nordic walking is a suitable form of aerobic exercise for most of apparently healthy male and female subjects aged 40–60 years who would benefit from training at a proper aerobic exercise intensity between 4 and 8 METs, an intensity range that is too high to obtain by regular walking and too low to achieve while running. In these subjects, Nordic walking is suitable to close the intensity gap between walking and jogging and thus presents an alternative for everybody seeking a sport that fulfills the needs of daily physical activity at an optimal intensity that results in gaining health benefits while exceeding personal exertion limits. Previous studies[13,16] have shown that 12 weeks of Nordic walking demonstrated a decrease in BMI, total fat mass, low-density lipoproteins, triglycerides and waist circumference and an increase in high-density lipoproteins in otherwise healthy postmenopausal women.

The preventive arguments for Nordic walking are obvious. As with physical activity in general,[3,32] Nordic walking may have similar positive effects on chronic diseases such as diabetes or obesity.[14,15] As part of cardiac rehabilitation programs, Nordic walking has the same short-term and long-term cardiorespiratory effect as regular walking for people suffering from coronary artery disease.[17,18] For patients with peripheral arterial disease, walking on a regular basis is recommended.[33] Nordic walking is a useful exercise strategy for improving walking distance, cardiovascular fitness, and quality of life as well as decreasing the level of perceived claudication pain.[19–21]

In COPD, Nordic walking is associated with increased daily physical activity, functional exercise capacity, and quality of life. Further, it decreased exercise-induced dyspnea, anxiety, and depression and is a simple and effective physical training modality for patients with COPD.[22,34]

Even though little research on Nordic walking in fibromyalgia has been published, combined training sets of aerobic endurance, strength, and flexibility training have been shown to bring ease to fibromyalgia pain; increase physical functioning, muscular endurance, and strength; and improve psychological parameters such as self-esteem and quality of life.[23,35]

In patients with chronic pain, strength-training combined with endurance-training has a positive effect on several kinds of nonspecific neck, shoulder, and low-back pain.[36] Nordic walking, in combination with strength and mobility training, has been shown to significantly reduce unspecific, chronic neck and lower back pain, concomitantly increasing quality of life.[24]

Regular physical activity positively affects exercise tolerance and quality of life in breast cancer patients.[37,38] Nordic walking additionally improves shoulder mobility and reduces sensitivity to pain in the upper body, without worsening lymphedema and can be recommended for breast cancer patients to increase their activity index.[25,26]

Also, patients with progressive neurodegenerative movement disorders such as Parkinson's disease have been shown to benefit from Nordic walking. Results of small trials revealed that patients benefit by improved motor skills, impaired functional mobility, walking speed, and distance, possibly leading to a reduced rate of falls and an improved quality of life.[27–29] Regular, moderate endurance exercise training is used also therapeutically for moderate to severe depressive disorders, and has been shown to improve patients' mood.[39–40] With regard to depression scores as well as quality of life, Nordic walking showed trends toward improvement.[30] Because Nordic walking is associated with a comparably low rate of injuries, it is suitable not only for the experienced but also for a wide range of newcomers.[31]

Taken together, the presented findings on the health benefits of Nordic walking partly derive from small studies that are sometimes inconsistent or not in keeping with the findings of RCTs. Nevertheless, their results can be viewed as hypothesis generating and are of general interest. However, conclusions have to be drawn and generalizations have to be made with caution.

Overall, Nordic walking has been shown to be a form of physical activity with convincing benefits for health in general and has superior short-term and long-term effects on the cardiorespiratory system as compared to brisk walking. Short-term effects show higher values of heart rate, VO_2, respiratory exchange ratio, lactate thresholds and caloric expenditure,[6–11] as well as a superior lipid profile.[13]

Current literature unanimously identifies Nordic walking as a safe, feasible, and readily available form of endurance exercise training, which exerts a panoply of beneficial effects in a wide range of people with various diseases and the healthy. Nordic walking can therefore be recommended to those who wish to increase their daily physical activity with an effective cardiorespiratory training routine as part of primary or secondary prevention.

T. Rathgeber and M. Niederseer helped with the literature search.

No financial disclosures were reported by the authors of this paper.

References

1. Chakravarthy MV, Booth FW. Eating, exercise, and "thrifty" genotypes: connecting the dots toward an evolutionary understanding of modern chronic diseases. J Appl Physiol 2004;96(1):3–10.
2. Bassett DR Jr, Tremblay MS, Esliger DW, Copeland JL, Barnes JD, Huntington GE. Physical activity and body mass index of children in an old order Amish community. Med Sci Sports Exerc 2007;39(3):410–5.
3. WHO. Global recommendations on physical activity for health. Switzerland: WHO Library Cataloguing-in-Publication Data, 2010.
4. Lee IM, Buchner DM. The importance of walking to public health. Med Sci Sports Exerc 2008;40(7S):S512–S518.
5. Hartvigsen J, Morso L, Bendix T, Manniche C. Supervised and non-supervised Nordic walking in the treatment of chronic low back pain: a single blind randomized clinical trial. BMC Musculoskelet Disord 2010;11:30.
6. Rodgers CD, VanHeest JL, Schachter CL. Energy expenditure during submaximal walking with Exerstriders. Med Sci Sports Exerc 1995;27(4):607–11.
7. Porcari JP, Hendrickson TL, Walter PR, Terry L, Walsko G. The physiological responses to walking with and without Power Poles on treadmill exercise. Res Q Exerc Sport 1997;68(2):161–6.
8. Jordan AN, Olson TP, Earnest CP, Morss GM, Church TS. Metabolic cost of high intensity poling while Nordic walking versus normal walking. Med Sci Sports Exerc 2001;33(5S1):S86.
9. Church TS, Earnest CP, Morss GM. Field testing of physiological responses associated with Nordic walking. Res Q Exerc Sport 2002;73(3):296–300.
10. Aigner A, Ledl-Kurkowski E, Hörl S, Salzmann K. Effects of Nordic walking and accordingly normal walking on heart rate and arterial lactate concentration. Austrian J Sports Med 2004;(3):32–6.
11. Schiffer T, Knicker A, Hoffman U, Harwig B, Hollmann W, Struder HK. Physiological responses to Nordic walking, walking and jogging. Eur J Appl Physiol 2006;98(1):56–61.
12. Kukkonen-Harjula K, Hiilloskorpi H, Manttari A, et al. Self-guided brisk walking training with or without poles: a randomized-controlled trial in middle-aged women. Scand J Med Sci Sports 2007;17(4):316–23.

13. Hagner W, Hagner-Derengowska M, Wiacek M, Zubrzycki IZ. Changes in level of VO2max, blood lipids, and waist circumference in the response to moderate endurance training as a function of ovarian aging. Menopause 2009;16(5):1009–13.
14. Gram B, Christensen R, Christiansen C, Gram J. Effects of Nordic walking and exercise in type 2 diabetes mellitus: a randomized controlled trial. Clin J Sport Med 2010;20(5):355–61.
15. Figard-Fabre H, Fabre N, Leonardi A, Schena F. Physiological and perceptual responses to Nordic walking in obese middle-aged women in comparison with the normal walk. Eur J Appl Physiol 2010;108(6): 1141–51.
16. Figard-Fabre H, Fabre N, Leonardi A, Schena F. Efficacy of Nordic walking in obesity management. Int J Sports Med 2011;32(6):407–14.
17. Walter PR, Porcari JP, Brice G, Terry L. Acute responses to using walking poles in patients with coronary artery disease. J Cardiopulm Rehabil 1996;16(4):245–50.
18. Kocur P, Deskur-Smielecka E, Wilk M, Dylewicz P. Effects of Nordic walking training on exercise capacity and fitness in men participating in early, short-term inpatient cardiac rehabilitation after an acute coronary syndrome—a controlled trial. Clin Rehabil 2009;23(11): 995–1004.
19. Oakley C, Zwierska I, Tew G, Beard JD, Saxton JM. Nordic poles immediately improve walking distance in patients with intermittent claudication. Eur J Vasc Endovasc Surg 2008;36(6):689–94; discussion 95–6.
20. Langbein WE, Collins EG, Orebaugh C, et al. Increasing exercise tolerance of persons limited by claudication pain using polestriding. J Vasc Surg 2002;35(5):887–93.
21. Collins EG, Langbein WE, Orebaugh C, et al. Cardiovascular training effect associated with polestriding exercise in patients with peripheral arterial disease. J Cardiovasc Nurs 2005;20(3):177–85.
22. Breyer MK, Breyer-Kohansal R, Funk GC, et al. Nordic walking improves daily physical activities in COPD: a randomised controlled trial. Respir Res 2010;11:112.
23. Mannerkorpi K, Nordeman L, Cider A, Jonsson G. Does moderate-to-high intensity Nordic walking improve functional capacity and pain in fibromyalgia? A prospective randomized controlled trial. Arthritis Res Ther 2010;12(5):R189.
24. Henkel J, Bak P, Otto R, Smolenski UC. Effect of selected prevention concepts on functional health of persons with nonspecific chronic recurrent neck pain. Manual Med 2008;47(1):57–66.
25. Leibbrand B, Kähnert H, Exner AK, et al. Nordic walking—trend or ideal performance training in breast cancer? Onkologie 2010;33(S6): 182–3.
26. Sprod LK, Drum SN, Bentz AT, Carter SD, Schneider CM. The effects of walking poles on shoulder function in breast cancer survivors. Integr Cancer Ther 2005;4(4):287–93.
27. Baatile J, Langbein WE, Weaver F, Maloney C, Jost MB. Effect of exercise on perceived quality of life of individuals with Parkinson's disease. J Rehabil Res Dev 2000;37(5):529–34.
28. van Eijkeren FJ, Reijmers RS, Kleinveld MJ, Minten A, Bruggen JP, Bloem BR. Nordic walking improves mobility in Parkinson's disease. Mov Disord 2008;23(15):2239–43.
29. Reuter I, Mehnert S, Leone P, Kaps M, Oechsner M, Engelhardt M. Effects of a flexibility and relaxation programme, walking, and Nordic walking on Parkinson's disease. J Aging Res 2011;2011:232473.
30. Suija K, Pechter U, Kalda R, Tahepold H, Maaroos J, Maaroos HI. Physical activity of depressed patients and their motivation to exercise: Nordic walking in family practice. Int J Rehabil Res 2009;32(2):132–8.
31. Knobloch K, Vogt PM. [Nordic pole walking injuries—Nordic walking thumb as novel injury entity]. Sportverletz Sportschaden 2006;20(3): 137–42.
32. Ainsworth BE, Haskell WL, Whitt MC, et al. Compendium of physical activities: an update of activity codes and MET intensities. Med Sci Sports Exerc 2000;32(9S):S498–S504.
33. Mosti MP, Wang E, Wiggen ON, Helgerud J, Hoff J. Concurrent strength and endurance training improves physical capacity in patients with peripheral arterial disease. Scand J Med Sci Sports 2011;21(6): e308–e314.
34. Kortianou EA, Nasis IG, Spetsioti ST, Daskalakis AM, Vogiatzis I. Effectiveness of interval exercise training in patients with COPD. Cardiopulm Phys Ther J 2010;21(3):12–9.
35. Garcia-Martinez AM, De Paz JA, Marquez S. Effects of an exercise programme on self-esteem, self-concept and quality of life in women with fibromyalgia: a randomized controlled trial. Rheumatol Int 2012;32(7):1869–76.
36. Kadi F, Ahlgren C, Waling K, Sundelin G, Thornell LE. The effects of different training programs on the trapezius muscle of women with work-related neck and shoulder myalgia. Acta Neuropathol 2000; 100(3):253–8.
37. Bicego D, Brown K, Ruddick M, Storey D, Wong C, Harris SR. Effects of exercise on quality of life in women living with breast cancer: a systematic review. Breast J 2009;15(1):45–51.
38. Irwin ML, McTiernan A, Manson JE, et al. Physical activity and survival in postmenopausal women with breast cancer: results from the Women's Health Initiative. Cancer Prev Res (Phila) 2011;4(4):522–9.
39. Sturm J, Plöderl M, Fartacek C, Kralovec K, Neunhäuserer D, Niederseer D. Physical exercise through mountain hiking in high-risk suicide patients. A randomized crossover trial. Acta Psychiatr Scand 2012:In press.
40. Knubben K, Reischies FM, Adli M, Schlattmann P, Bauer M, Dimeo F. A randomised, controlled study on the effects of a short-term endurance training programme in patients with major depression. Br J Sports Med 2007;41(1):29–33.