Scientific Evidence on Nordic Walking – a Summary

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This paper reviews 52 scientific articles published on Nordic Walking in years 1992-2006.. Studies are classified according to the target group into four categories:

- Nordic Walking studies related to health or health related fitness (done on sedentary, on elderly individuals or in patients)
- Nordic Walking studies related to fitness (done on physically active individuals)
- Nordic Walking studies related to sports type of performance (done on athletes)
- Other (done on various groups, reviews, fitness assessment, safety and popularity of NW)
- Summary

References of all studies are listed in alphabetical order.

Studies Related to Health

First research results on responses to pole walking training were published in 1992 by Stoughton, Larkin and Karavan from the University of Oregon. They studied psychological profiles (mood states) as well as muscular and aerobic fitness responses before and after 12 weeks of Exerstriding or walking training in sedentary women. Exerstriding is a modified form of walking that incorporates the use of specially designed walking stick (Exertriders®) in a standard walking workout. This study group consisted of 86 20-50 year old women whose fitness was at moderate level. Maximal aerobic power (VO_{2max}) varied between 34-37 ml/kg/min. A study group was divided into three sub-groups. Control group did remain all their exercise habits. Walking and Exerstrider groups did walk 30-45 minutes four times a week at the intensity corresponding to the 70-85 % maximum heart rate for twelve weeks. In Exerstrider group both the walking speed and the distance walked were slightly less than in the walking group.

In both groups the maximal aerobic power and maximal treadmill time increased significantly. These increases were 8 and 19 % on an average. A slight increase in maximal ventilation occurred in the Exerstrider group, but not in the walking group. Muscular endurance did improve in the Exerstrider group by 37 % and in the walking group 14 %. Muscular strength assessed using triceps pushdown and a modified lateral pull-down did not improve in either group. Exerstrider walkers showed significant improvements in depression, anger, vigor, fatigue, total mood disturbances and total body-cathexis scores. The walking group showed significant improvements only in vigor and total body-cathexis. It was speculated that the Exerstrider group may have felt more unique and special because of their opportunity to do a new and more enjoyable method of walking.

Exerstriders were also compared to the weighted vests, angle weights, hand and wrist weights, weighted gloves and Powerbelts™ by Porcari (1999) with similar results as above.

The effort involved during Nordic Walking has also been investigated in coronary heart patients (Walter et al. 1996). In this study fourteen men aged 61 years walked two eight minute repetitions: the first consisted of normal walking while during the second the subjects used half kilogram poles. The subjects walked at the maximum pace allowed in the light of their symptoms. All subjects had had either heart bypass or angioplasty operations or had suffered cardiac infarctions. During pole walking average energy consumption increased 21%, heart rate by 14 beats/minute and highest systolic/diastolic blood pressure figures by 16 and 4 mmHg respectively when compared with figures during normal walking. Oxygen pulse figures (i.e. oxygen consumption multiplied by heart rate) are indicative of changes in oxygen consumption and are not connected with undesirable rises in blood pressure. The research group concluded that pole walking is a safe form of rehabilitation for heart patients.

A Finnish study (Anttila et al. 1999) did compare Exel pole walking with the regular walking training for 12-weeks on 55 female office workers. The EMG-measurement showed that electrical activities of the muscles in the upper body neck-shoulder-upper back) where significantly higher when walking with poles. Pole walking training diminished neck and shoulder symptoms and subjective feeling of pain. Mobility of the upper body increased as well. The similar results were obtained also in the study by Karvonen et al. (2000). They did study neck-shoulder area pain on 31 44-50 year old person who had no previous experience on Nordic Walking. Exercise group did train twice a week for ten weeks and for 60 min per session. Nordic walking did decrease neck and shoulder pain in general and at work. In addition, the disturbance of neck and shoulder stiffness and pain in the movement of head were significantly decreased. A third study (Koskinen et al. 2003) did examine the effectiveness of NW on ageing employees on their postural control as well as to the muscular strength of lower extremities and the middle trunk. Subjects (n=24) were 45 to 61 year old , majority of women. They did NW three times weekly and partly instructed. The group did improve in health-related fitness parameters evaluated by the Fitness Test battery developed by UKK Institute.

In a study by Baatile et al. (2000) 16 72-year old veteran males with Parkinson's disease did Nordic Walk 8-weeks in an interval training program three times weekly for 60 min per session with the perceived rating of intensity (Borg 13). Researchers concluded that regular NW exercise program increased perceived functional independence and quality of life in individuals with Parkinson Disease

The aim in Parkatti et al. study (2002) was to examine the benefits of NW on functions important to everyday life among older sedentary individuals in Virginia, USA. Altogether 18 73-year old (62-87 yrs) person participated. They did exercise was 60 min twice a week for 12 weeks (10 min warm-up, stretching in the middle and cool-down at the end) by Nordic Walking. Functional capacity battery of tests included: chair stand, arm curl, chair sit and reach, scratch test, 2 min step in place and "up and go" test was used before/after intervention. Also a health questionnaire was used. The results of all functional tests were statistically significantly better after training. The study showed that NW is suitable for elderly and effective to affect on functional capacity.

In 2003 Collins et al. did publish a study where they studied 52 (65-70 yrs) patients with peripheral vascular diseases (PVD). The program consisted of three weekly session of pole walking for 30-45 min. Also Vitamin E (dose 400 IU daily) was studied. Pre- and post peak oxygen uptake, Quality of Life -interview and biweekly ankle blood pressure measurements were conducted. Pole group improved exercise tolerance significantly, they had also less claudication pain after exercise. Additionally, distance and walking speed improvement in pole groups. Researchers concluded that pole walking effectively improved both the exercise tolerance and perceived quality of life of patients with PVD. E-vitamin caused little additional benefit.

Purpose of a research by Kukkonen-Harjula et al (2004) was to study training responses of brisk walking with or without poles on cardiorespiratory fitness (both in submaximal and maximal exercise) and on some other indicators of health-related fitness in healthy middle-aged women. Training prescription was aimed at moderate intensity (50-85 % of HR reserve, HRR). Two-hundred-and-twelve women volunteered. Their age was 50-60 years, no major health problems, BMI 20-30 kg x m^{-2} and leisure exercise training no more often than twice weekly. After screening examinations 121 women were accepted and randomized into a NW or a walking (W) group. Walking and NW techniques instructed in small groups. Training was 4x weekly for 40 mins, intensity 53% HRR, Borg 13.7. The increase in peak VO_2 (about 8 % in both groups) during 13 weeks training was modest. Study also showed that the mode of maximal exercise testing (with or without poles) had no influence on peak VO_2 and its change during training in women with initially little familiarity with NW technique.

In a study by Aigner et al. (2004) 20 untrained healthy individuals (average age 47 years) were studied while walking with or without poles on separate days. The speeds of walks were 7.9 km/h on an average and mean heart rates 165 and 158 bpm with and without poles. The corresponding blood lactate levels were 5.7 and 5.0 mmol/l. In all speeds between 3 to 7 km/h heart rates and lactates were significantly higher in Nordic Walking compared to regular walking.

Heikkilä et al (unpublished 2004) did study NW in 13 33-54-year old overweight (BMI 32 kg/m²) individual. Subjects did exercise NW 4 months regularly HR controlled with progressive load. The results did show that subjects did lose weight (- 5kg on an average), and body fat (waist- 6.6cm), improved in aerobic fitness (+29%), and in blood lipids. The key factors, according researchers, to these very positive results were that intensity of training was moderate-high and that is was progressive in nature.

Wilk et al. (2005) did study NW in 16 acute coronary disease patients in Poland. Based on this exercise intervention they concluded that NW is a purposeful activity for cardiac rehabilitation.

Studies Related to Fitness

The physiological responses to walking with and without Power Poles™ were studied by Hendrickson (1993) and by Porcari et al. (1997). Power Poles are specially constructed, rubber-tipped ski poles designed for use during walking. Hendrickson's study group consisted of sixteen fit women (VO_{2max} 50 ml/kg/min) and men (59). They did walk with and without poles on a treadmill with the speeds of 6-7,5 km/h. There were no differences in the responses between males and females. It was found that the use of poles significantly increased oxygen uptake, heart rate and energy expenditure by approximately 20% compared to the walking without poles in fit subjects. In Porcari's study on 32 healthy men and women walking with poles resulted in an average of 23% higher oxygen uptake, 22% higher caloric expenditure and 16% higher heart rate responses compared to walking without poles an a treadmill. RPE values averaged 1,5 units higher with the use of poles and the pattern of responses was similar for men and women.

A dual-motion treadmill Cross Walk has been studied by Knox (1993), Foley (1994) and by Butts et al. (1995) . The Cross Walk Dual Motion Cross Trainer as a motorized treadmill designed to increase the energy cost of walking by incorporating arm activity during walking, thus increasing the muscle mass used during exercise. The activity is not the same as field walking with poles, but can be used as reference to NW. Knox did study thirty-seven 17-35 year old women and they all performed six 5-min steady-state exercises with and without arm activity. Walking with arm activity increased significantly heart rate, ventilation, oxygen uptake and energy expenditure compared to the walking without arm activity. E.g. heart rate increased 17-31 beats per minute. Rating of perceived exertion as well as energy expenditure increased with an average of 14 percent. In Butt's study both the 24-year old women and men were studied with a similar design. In this study arm work increased energy expenditure by 55 % on an average compared to the regular walking, but did increase rating of perceived exertion only little. This was consistent with the results from the Foley, who did study Cross Walk in 24-year-old men.

Rogers at al. (1995) did compare energy expenditure during submaximal walking with Exerstriders® in ten 24 year old fit women. Mean maximal aerobic power (21 vs. 18 ml/kg/min) and heart rate (133 vs. 122 bpm) were significantly greater during the walking with poles compared to walking without. Also the total caloric expenditure in a 30 minute session was significantly greater during pole walking (174 vs. 141 kcal). In contrast, the rating of perceived exertion did not differ significantly between the two conditions.

Laukkanen (1998, unpublished) did compare heart rate during normal and fast walking speeds with and without Exel Walker poles. Ten middle-aged men and women were studied on an indoor hall track. The heart rate increase, measured with telemetric Polar HR monitor, was between 5-12 bpm and 5-17 bpm in women and men.

Gullstrand & Svedenhag (2001) from Sweden did study acute physiological effects on walking on a treadmill with or without poles. This study on 13 55-year old subjects did show that VO_{2max}, VE, blood lactate and HR did increase, but RPE (rating of perceived exertion) remained unchanged in NW compared to regular walking

The effects of Exel's Nordic Walker pole training on heart rate responses was studied in ten men and women. Their heart rates were 5-12 and 5-17 beats x min^{-1} higher for moderate and vigorous Nordic Walking in an indoor sports hall in comparison with walking without poles (Laukkanen 1998).

In the study published by the Cooper Institute group from Texas, USA the metabolic cost of NW was compared to normal walking in 22 31-year-old men and women (Morss et al. 2001, Church et al. 2002). Participants of this study did walk on an outdoor 200-m track with Cosmed K4b for oxygen consumption and Polar Vantage heart rate monitor for HR measurements. Study indicated significant increases of oxygen consumption (20% on average), caloric expenditure and HR in NW compared to normal walking. The range of increase was large, i.e. in oxygen consumption 5-63% indicating differences in poling intensity and technique. Perceived exertion did not differ between the walks. Same group did also compare separately metabolic cost of high intensity poling (Jordan et al. 2001). In high intensity poling NW increased HR 35 bpm on an average compared to regular walking.

In a study by Willson et al. (2001) the purpose was to determine whether walking with poles reduces loading to the lower extremity during level over ground walking. Three-dimensional gait analysis was conducted on 13 healthy adults who completed 10 walking trials using three different poling conditions (selected poles, poles back, and poles front) and without the use of poles (no poles). Results did show that there were differences in kinetic variables between walking with and without poles. The use of walking poles enabled subjects to walk at a faster speed with reduced vertical ground reaction forces, vertical knee joint reaction forces, and reduction in the knee extensor angular impulse and support moment, depending on the poling condition used.

A study done in Germany by Ripatti (2002) 24 individuals (48±8 yrs) did NW for 6 weeks 2 times weekly for 60 min (65-85 %HRmax). This improved their endurance capacity even walking at lower speed.

Mänttäri et al (2004) did conduct a pilot study for Kukkonen-Harjula et al. intervention study (2004). In this pilot they compared the cardiorespiratory and musculoskeletal responses of NW and W in field conditions in middle-aged women, with three self-guided exercise intensities. After screening examinations 20 middle-aged women performed a maximal exercise test on a treadmill with poles. All the subjects were familiar with Nordic walking or cross-country skiing. These results showed that Nordic walking increased the mean HR compared to regular walking only from 2.6% to 4.9% and the mean V_{O2} from 2.5% to 10.8%, during the three different self-guided walking intensities. This increase seems to be due to the increased muscle activity in the upper body muscle groups. Compared to previous studies the statistically significant mean differences between NW and W were modest.

Studies Related to Sport

In a Norwegian study by Haugan and Sollesnes (2003) 16 sports students (22 yrs) were measured in a laboratory walking at the speeds of 5.5, 6.0 and 6.5 km/h with or without poles on an elevated treadmill (17%). Half of the subjects were cross-country skiers. Oxygen uptake increased significantly at all speeds when using poles in walking in others, but not in c-c skiers.

Other

Nordic Walking has also been under study in The Netherlands. Lande et al. did publish in 2003 a systematic review of the physiological effects of pole walking.

Parkkari et al. (2004) did evaluate injury risk in various commuting and lifestyle activities in a cohort of 3657 15-74-year old Finns. The individual injury risk per exposure time was overall relatively low, ranging from 0.19 to 1.5 per 1000 hours of participation. Highest risk in all recreational and competitive sports was in squash (18.3) , judo (16.3) and orienteering (13.6). In Nordic Walking (pole walking) the risk was 1.7. In the cohort 11 % participated actively this sport.

In a questionnaire study by Schmidt et al. (2004) 226 German adults (66% women) who practiced NW regularly were interviewed during winter 2003-2004. The average age was 52 yrs and BMI 25 kg/m^2. The main motivation for NW was health, 12% wanted to test something new, 6% did it as an option for c-c skiing in summer. 71% worked out for arm and trunk muscles, 23% in order to reduce joint load. 54% would prefer to have a similar net of trails like those for hiking.

Nordic Walking has also been studied from the consumer perspective (Shove and Pantzar 2004). Authors conclude that popularity of the NW has arisen through the active and ongoing interaction of images, artifacts and forms of competence; a process in which both consumers and producers are both involved.

Summary

To summarize the acute physiological effects of Nordic walking, it increases the energy consumption of the body compared to regular walking with the same speed without poles both in women and men and in fit and less fit individuals. The increase is due to larger working muscle mass in the upper body. The increase varies individually according to walking speed and technique. If the speed is very fast, there is less time for efficient pushing off with poles and thus decreased upper body muscular involvement. Similarly to energy consumption the increase in heart rate is variable. Because perceived exertion in pole walking is often less than true physiological strain, controlling heart rate may beneficial for those tending to overreach. The resulting increases in energy consumption and heart rate in Nordic walking mean that the cardiovascular strain induced by Nordic walking is greater compared to walking without poles at the same speed. This is desirable for those people who have difficulty reaching their training heart rate by walking - instead of having to start running they can start using walking poles and continue walking. Walking involves less harmful impacts to the lower extremities compared to running, and therefore may prevent from injuries.

To summarize, the training effects of Nordic walking on cardiorespiratory fitness and endurance have been shown to be similar to walking training in middle-aged and elderly women. In fit individuals and in men intervention studies are missing. In the studies, the improvement in Nordic walking was reached by lower speed and thus by shorter distance walked, because the cardiovascular strain was greater in Nordic walking than in ordinary walking without poles if the same speed was used. Walking with poles improves mainly aerobic fitness, muscular endurance, decrease neck-shoulder area disabilities and pain and can have positive effects on mood state. In order to improve muscle power, uphill walking is required. Pole walking affecting on body coordination and motor fitness has been published little. Nordic Walking is safe activity and individuals are motivated to Nordic Walk mainly due health reasons.

Even there is rather strong scientific evidence on both acute and long-term effects of Nordic Walking some research challenges still remain. Randomized controlled trials on dose-responses of health and fitness improvements in men and in women, in healthy, in fit and in individuals with minor health problems (body weight, insulin-resistance, blood pressure, osteoporosis) are still lacking. Also, motivation and adherence in NW as well as overall global participation (walkers, their demographics and their social and other status) in Nordic Walking activity is missing.

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