

Acute effects of walking with Nordic poles in persons with mild to moderate low-back pain

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ABSTRACT

International Journal of Exercise Science 9(4): 507-513, 2016. Regular walking with or without Nordic poles is effective over time at reducing discomfort in individuals with chronic low back pain (LBP). Nordic pole use increases balance and stability, distributes weight through the arms and torso, and decreases loading of the spine and lower limbs. The purpose of this study was to determine if Nordic poles would reduce perceived acute discomfort while self-paced walking in individuals with LBP. We also examined whether walking with or without poles increased heart rate (HR) and ratings of perceived exertion (RPE) or speed of movement. Subjects included 20 adults (12 males, 8 females; mean age of 45.1±16.3) who were experiencing LBP of at least six months' duration (Oswestry Disability Index (ODI): mean 17 ± 8%, range 6-36% indicating minimal to moderate disability) with no current active flare-up. Participants walked a predetermined dirt-path course (805 m or 0.5 mi) with and without poles in randomized order. Data were analyzed using a 2 X 2 repeated measures ANOVA (Condition X Time), where Condition was poles vs no poles and Time was pre- and post-walk. HR and RPE increased significantly from walking the course, whereas pain did not change. There were also no differences between walking with or without poles for pain (ODI Sec #1: 0.2 points, p=0.324), HR (4 bpm, p=0.522) and RPE (0 points, p=0.759). The mean course time (sec) was slower with poles: 617±87 vs 566±65 (p<0.001). Unexpectedly, there was a noticeable drop in pain following the warm up which was done using poles (0.9 points, p<0.001). Nordic pole use is well tolerated in those with current back pain and can be encouraged, however it cannot be recommended as a superior method of addressing acute symptoms when walking.

KEY WORDS: Nordic walking, hiking poles, Oswestry Low Back Pain Disability Index, exercise therapy

INTRODUCTION

One of the most significant orthopedic conditions affecting individuals in western society is chronic, nonspecific low back pain (LBP) which is estimated to affect 80% of

adults at some point in their lifespan (1). Health care costs for managing these musculoskeletal disorders is high, and more clinically effective and cost-effective methods of treatment are needed. Walking is a simple and practical form of physical

activity that can be done by almost anyone, almost anywhere, and at almost any time while incurring little expense. It has been shown to reduce the negative risks of a sedentary lifestyle and the prevalence of chronic diseases in all populations studied (15). Incidence and symptoms of LBP have been reduced with implementation of walking and other non-specific aerobic exercise programs (17). For instance, Torstensen et al. (23) recorded a 9% reduction in pain ratings in participants with LBP after a 3-month walking program.

Despite the apparent health benefits that walking/aerobic exercise can present to those with LBP (17) many patients are hesitant to exercise, which may reflect fear-avoidance behavior (26). Vlaeyen and Linton (2) suggest that fear-avoidance, the reduction or elimination of movements or activities based on fear of pain or re-injury, may be a central mechanism in the development of long-term back pain problems. Therefore, incorporating tools and techniques that reduce pain may help encourage patients to pursue regular exercise such as walking.

Nordic poles may be a means of reducing pain ratings during walking and therefore may provide a tool to help encourage a person with LBP to exercise regularly. Nordic walking is similar to brisk walking except for the additional use of specially designed poles that provide the advantage of actively involving the upper body and arms in a manner similar to cross-country skiing using the diagonal technique (24). Thus, Nordic walking is generally safe, easy to learn, fun and may even increase adherence to exercise programs (6, 11, 20, 24). Compared to regular walking, Nordic

walking may result in increased heart rate (HR), oxygen use and caloric expenditure (4, 6, 16, 18), without necessarily increasing perceived exertion (RPE) (4). It also increases balance and stability and spreads weight distribution through the arms and torso, sparing loading of the spine and lower limbs (2, 12). In fact, several studies have demonstrated reduced pain ratings in persons with LBP over six-week and eight-week periods of Nordic walking (e.g., 8, 19). Despite evidence for the long-term effectiveness of Nordic walking in reducing LBP, there is no evidence of the acute impact of Nordic walking in this group. Similarly, while several researchers have examined the physiologic cost of Nordic walking in healthy participants via oxygen uptake, HR, RPE at given or self-selected speeds (4, 6, 16, 18), no similar reference data exists for persons with LBP. Thus, the purpose of this study was to determine if Nordic walking would impact acute measures of pain, HR, RPE, and walking speed in individuals with LBP.

METHODS

Participants

Participants included 20 adults (12 males, 8 females) with a mean age of 45.1 ± 16.3 years, who were experiencing chronic LBP for at least six months prior to the study. Participants were verbally screened upon arrival by car to the walking course in a rural park to ensure that they were stable and not in an active flare-up at the time of testing. Extent of LBP was assessed using the Oswestry Low Back Pain Disability Questionnaire (ODI) (5) score taken in the parking lot immediately before exercise began. The questionnaire is designed to gather information as to how one's back or

leg pain is affecting one's ability to manage in everyday life. Inclusion in the study required that participants were confident they were able to walk at least one mile despite LBP and did not have any other orthopedic injuries/problems or other acute or chronic health conditions that would increase risk. These were assessed using the Physical Activity Readiness Questionnaire (PAR-Q) (22). None of the participants had previous experience with Nordic walking. Prior to administering these questionnaires all participants were informed of the possible benefits and risks and signed an informed consent form. The Central Michigan University institutional review board approved this study.

Protocol

This study was performed entirely in the field in a rustic setting without any laboratory measurements taken. Following prescreening with the ODI and PAR-Q, participants were instructed in Nordic walking technique according to Leki Nordic Walking Instructions (25). Subjects were then given about five minutes to experience and familiarize themselves with the poles and warm up by walking 340 m (0.2 mile) from the parking lot to the starting line of the walking course. After several minutes' rest they were then asked to walk a designated 805 m (0.5 mile) straight-line up-and-back course. The walking course was located on a flat dirt path at a local park. Participants were randomly assigned to walk the course at their self-preferred pace either with or without Nordic poles. Then, after a 10-minute rest period they repeated the walking course with the opposite condition.

The participants' rating of perceived acute LBP was assessed using ODI Section #1 (i.e.,

Pain Intensity) (5) prior to the warm-up period, and before and after each traverse of the walking course. In brief, this is a six-point verbal descriptor pain scale with corresponding numbers that goes from a score of 0 which indicates *I have no pain at the moment* to a score of 5 which indicates *the pain is the worst imaginable at the moment*. This scale was used to maintain continuity for the participants who were already familiar with it from administration of the ODI upon intake to the study. Participants' RPE and HR were also recorded before and after each walk and the time it took to complete the course was recorded. RPE was indicated using the Borg Scale (3), whereby participants rated their perceived exertion on a scale of 6 to 20. A score of 6 indicates *no exertion at all*, ie. "at rest" and a score of 20 indicates *maximal exertion*. HR was assessed using a Polar heart rate monitor with chest strap (Model FT4, Polar Electro Inc., NY: USA).

Statistical Analysis

All analyses were performed using SigmaPlot 13.0 (Systat Software Inc, USA). Repeated measures analyses of variance (ANOVA) were used to assess the within-subject effects of condition (poles or no poles) and time (pre-walk, or post-walk) HR and RPE. For each significant ($p < 0.05$) interaction found, post-hoc analyses were performed using the Tukey method. Pain rating data failed to demonstrate a normal distribution (i.e., failing Shapiro-Wilk test), and was converted to ranks, then a two-way repeated measures ANOVA was performed on these ranked data. A Student's paired t-test was used to assess changes in pain ratings from warm-up to pre-walk as well as total walking time with and without poles. Paired t-tests were also used to compare

each outcome (i.e., pain, HR, RPE and time to course completion) on the first walk compared to the second walk, regardless of walking pole condition.

RESULTS

Mean ODI score for participants was $17 \pm 8\%$ largely indicating minimal disability, with a range of 6 - 36% (“minimal” to “moderate disability”) on the day of testing. Pain ratings decreased significantly following the warm-up with walking poles (Table 1).

Table 1. Pain responses to a warm-up with walking poles (mean \pm SD)

	Pre-warm-up	Post-warm-up	p-value
Pain (0-5)	2.5 ± 0.6	1.6 ± 0.5	<0.001

Mean data for walking trials with and without poles, pre- and post-walk are presented in Table 2. There was a significant Condition x Time main effect for HR ($p = 0.007$), such that HR was significantly higher post-walking (at 805 m) for both the pole and no pole conditions (mean change 31 bpm, $p < 0.001$ and 27 bpm, $p < 0.001$, respectively) (Table 2). There was no significant Condition x Time effect for RPE; there were significant Time main effects ($p < 0.001$), however. Mean RPE increased (mean 3 points on 6-20 scale) across pole conditions. Mean time to completion for the course was significantly longer during the walking pole condition (mean 617 ± 87 seconds vs 566 ± 65 seconds) ($p < 0.001$). Median pain ratings among time and pole conditions were not significantly different ($p = 0.324$). Mean change in pain ratings during the walk were 0.2 points on a 0-5 point scale whether patients walked with or without Nordic poles. There was no difference between

using Nordic poles in the first or second trial as there was no significant order effect on pain, HR, RPE or time.

DISCUSSION

Use of Nordic poles has been shown to increase balance and stability while redistributing loading from the lower back and lower limbs during walking (2, 12). Compression load and shear forces on the lumbar spine and lower limbs have been shown to be reduced as part of the body weight is distributed to the Nordic poles and absorbed by the upper body (12). Thus, we hypothesized that pain associated with walking would be reduced in people living with LBP when they engaged in Nordic walking compared to walking without walking poles. In this study we found a significant reduction in pain from the 5-minute warm-up using poles to walk to the start of the course. We found no further reductions in pain during the walking trials, neither with nor without walking poles. This study did however demonstrate that walking with poles required more time.

Previous work has indicated that walking with Nordic poles results in increased physiological costs (measured as heart rate, oxygen uptake and caloric expenditure) (4, 6, 16, 18). In addition to the normal demands of walking, walking with Nordic poles recruits upper body musculature which may account for the increased caloric expenditure compared to walking alone. Although Nordic walking results in an increased heart rate and oxygen uptake it does not necessarily increase RPE (4, 6) compared to normal walking. In addition, walking with Nordic poles has been demonstrated to be a useful long-term

Table 2. Responses to walking with and without walking poles (mean ± SD).

Measure (units)	Poles		No Poles		Condition	Time	Condition x Time
	Pre	Post	Pre	Post	p - values	p - values	p - values
HR (bpm)	84±11	115±16	85±10	111±15	0.522	<0.001	0.007
RPE (6-20)	6±1	9±2	6±1	9±2	0.759	<0.001	0.225
Time (s)*	617±87		566±65		<0.001		

*Student's t-test; HR = heart rate; RPE = rating of perceived exertion; and, pre- and post- refer to before and after walking the course.

exercise strategy for reducing resting heart rate and blood pressure, improving walking distance, cardiovascular fitness, upper body strength and quality of life (20, 24). Our results suggest that walking at a self-selected pace with or without poles resulted in increased physiological cost, indicated by a significant increase in HR and RPE after walking in either condition. In our study the increases in HR and RPE above baseline resting levels were similar to those reported by others. (4, 6). Several studies have noted greater HR (4, 6, 16, 18) and RPE (16, 18) with Nordic walking compared to normal walking; however, this is likely due to the use of the same walking pace with and without poles. Our participants self-selected their pace for both conditions and they tended to walk slower with poles. The reduced pace for our subjects walking with poles likely kept their HR and RPE similar between conditions.

A slower pace is likely to have an additional interaction with the occurrence of pain during walking. Several studies have demonstrated that compared to healthy participants, persons with LBP tend to walk more slowly (9, 10, 13, 21). This slower speed tends to be achieved via shorter stride lengths, and asymmetrical gait patterns (9). In this study average self-selected walking

speed (calculated as: 805 m (0.5 miles)/ total walking time (Table 2)) were 1.3 m/s and 1.42 m/s, for walking with and without poles, respectively. These speeds are similar to self-selected walking speed in persons with LBP reported by Lee et al (14). Given that pain levels were not significantly higher when walking with poles, it is unlikely this slower walking pace was related to LBP itself; thus, it is likely a side effect of the poles themselves and our novice users. In fact, the additional use of walking poles has been linked to slower walking speeds in elderly participants (7) and lower physiological costs in those not accustomed to their use (6); however, to date no other direct comparisons of walking speeds with or without Nordic poles has been published to our knowledge.

Hartvigsen et al. (8) demonstrated that the use of Nordic poles as a regular exercise program can reduce pain levels in persons with LBP. That study tracked patient pain and disability in response to supervised and unsupervised Nordic walking over an 8-week period. In our study we aimed to determine if walking with Nordic poles could have an acute effect on pain in persons with mild to moderate disability (mean ODI: 17%). While pain levels did not decrease significantly during the course of walking,

they did decrease during the warm-up/familiarization period. On initial intake, prior to warm-up, patients rated their pain intensity a mean of 2.5 on the ODI Pain scale, with 9 participants rating their pain as “*very mild at the moment*,” 10 participants rating pain as “*moderate at the moment*” and 1 subject rating pain as “*fairly severe at the moment*.” After completing the 5-minute warm-up/familiarization pain ratings reduced to an average of 1.6 and remained low through the end of the course (mean = 1.7/5). Thus, it appears that walking with poles did achieve a significant reduction in pain after only a few minutes of walking and continuing to walk the course did not increase pain significantly. With many participants rating pain near the lowest point on the scale at the start of the walking course ratings may have been susceptible to a floor effect with little room for further reductions of their pain. Future studies should more closely examine the effects of warm up alone with or without Nordic poles on separate days following a separate day of familiarization and technique development.

Future work might target participants with a higher level of pain to provide a greater potential in determining the relative value of Nordic walking. Similarly, the addition of a tool addressing other potential benefits of the Nordic poles might yield more substantive results (i.e., Fear Avoidance Beliefs Questionnaire, Fear of Movement, etc). Overall, Nordic walking did seem to offer some acute benefits in terms of pain reduction post-warm-up, as well as providing a mild cardiovascular stimulus (e.g., increased HR and RPE). Thus, Nordic walking could be beneficial to both pain and overall health and fitness if routinely continued as part of an exercise plan. Future

studies should be conducted on participants with a higher level of pain and possibly include controlling for walking speed to better understand the effects of walking with Nordic poles on the modulation of pain in persons with LBP.

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REFERENCES

1. Andersson G. Epidemiological features of chronic low-back pain. *Lancet* 354(9178): 581-585, 1999.
2. Bohne M, Abendroth-Smith J. Effects of hiking downhill using trekking poles while carrying external loads. *Med Sci Sports Exerc* 39(1): 177-83, 2007.
3. Borg G. Psychophysical bases of perceived exertion. *Med Sci Sports Exerc* 14(5): 377-81, 1982.
4. Church T, Earnest C, Morss G. Field testing of physiological responses associated with Nordic Walking. *Res Q Exerc Sport* 73(3): 296-300, 2002.
5. Fairbank J, Pynsent P. The Oswestry Disability Index. *Spine* 25(22): 2940-52, 2000.
6. Figard-Fabre H, Fabre A, 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* 108(6): 1141-51, 2010.
7. Gonnerman J, Guerin E, Koza K, Tofte C. The effect of walking poles on gait characteristics and fear of falling in community dwelling, four-wheel walker dependent and non-assistive device dependent older

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- adults. Doctor of Physical Therapy Research Papers, St. Catherine University, 2011.
8. 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 Musculoskeletal Disord*,11:30, 2010.
9. Keefe F, Hill R. An objective approach to quantifying pain behavior and gait patterns in low back pain patients. *Pain*, 21(2): 153-161, 1985.
10. Khodadadeh S, Eisenstein S, Summers B, Patrick J. Gait asymmetry in patients with chronic low back pain. *Neuro-orthopedics* 6(1): 24-27, 1988.
11. Knobloch K, Vogt P. Nordic pole walking injuries-Nordic walking thumb as novel injury entity. *Sportverletz Sportschaden* 20(3): 137-42, 2006.
12. Koizumi T, Tsujiuchi N, Takeda M, Fujikura R, Kojima T. Load dynamics of joints in Nordic walking. *Procedia Engineering* 13: 544-551, 2011.
13. Lamoth C, Meijer O, Wuisman P, van Dieen, J, Levin, M, Beek, P. Pelvis-thorax coordination in the transverse plane during walking in persons with nonspecific low back pain. *Spine* 27(4): E92-E99, 2002.
14. Lee C, Simmonds M, Etnyre B, Morris G. Influence of pain distribution on gait characteristics in patients with low back pain: Part 1: Vertical ground reaction force. *Spine* 32(12): 1329-1336, 2007.
15. Lee I, Buchner D. The importance of walking to public health. *Med Sci Sports Exerc* 40(7 Suppl): S512-8, 2008.
16. Porcari J, Hendrickson T, Walter P., Terry L, Walsko G. The physiological responses to walking with and without Power Poles on treadmill exercise. *Res Q Exerc Sport* 68(2): 161-6, 1997.
17. Rainville J, Hartigan C, Martinez E, Limke J, Jouve C, Finno M. Exercise as a treatment for chronic low back pain. *Spine J* 4(1): 106-15, 2004.
18. Rodgers C, VanHeest J, Schachter C. Energy expenditure during submaximal walking with Exerstriders. *Med Sci Sports Exerc* 27(4): 607-11, 1995.
19. Shim J, Kwon H, Kim H, Kim B, Jung J. Comparison of the effects of walking with and without Nordic Pole on upper extremity and lower extremity muscle activation. *J Phys Ther Sci* 25(12): 1553-6, 2013.
20. Song M, Yoo Y, Choi C, Kim N. Effects of Nordic Walking on body composition, muscle strength, and lipid profile in elderly women. *Asian Nurs Res* 7(1): 1-7, 2013.
21. Spenkelink C, Hutten M, Hermens H, Greitemann B. Assessment of activities of daily living with an ambulatory monitoring system: A comparative study in patients with chronic low back pain and nonsymptomatic controls. *Clinical Rehabilitation* 16(1): 16-26, 2002.
22. Thomas S, Reading J, Shephard R. Revision of the Physical Activity Readiness Questionnaire (PAR-Q). *Canadian Journal of Sport Sciences* 1992.
23. Torstensen T, Ljunggren A, Meen H, Odlund E, Mowinckel P, Geijerstam S. Efficiency and costs of medical exercise therapy, conventional physiotherapy, and self-exercise in patients with chronic low back pain: A pragmatic, randomized, single-blinded, controlled trial with 1-year follow-up. *Spine* 23(23): 2616-2624, 1998.
24. Tschentscher M, Niederseer D, Niebauer J. Health benefits of Nordic walking: A systematic review. *Am J Prev Med* 44(1): 76-84, 2013.
25. Nordic Walking 101. Retrieved from http://usa.leki.com/970--nordic_walking_101.html, 2015.
26. Vlaeyen J, Linton S. Fear-avoidance and its consequences in chronic musculoskeletal pain: A state of the art. *Pain* 85(3): 317-332, 2000.