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THE EFFECT OF HIKING POLES ON OXYGEN UPTAKE, PERCEIVED EXERTION AND MOOD STATE DURING A ONE HOUR UPHILL WALK

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ABSTRACT

Duncan MJ, Lyons M. The effect of hiking poles on oxygen uptake, perceived exertion and mood state during a one hour uphill walk. ***JEP****online* 2008;11(3):20-25. This study assessed changes in oxygen uptake, perceived exertion and mood state during a one hour uphill walk with and without hiking poles. Six males and one female with hill walking experience (Mean age ± SD = 24.2 ± 4.7 years) completed two, one hour walking trials in a counterbalanced order (one with hiking poles, one without) and separated by 48-72 hours, on a treadmill inclined at 5%. Treadmill velocity was established a priori such that the subject's heart rate was between 55-65% of their maximum, using the Karvonen formula. Ratings of perceived exertion (RPE) were collected at 10-minute intervals. Oxygen uptake ($ml\cdot kg^{-1}\cdot min^{-1}$) was assessed continuously and averaged over 10-minute periods and mood state was assessed pre and post each condition. Results indicated that oxygen uptake was significantly greater ($P = 0.001$) during the poles condition compared to the no poles condition. RPE was not significantly different across conditions ($P = 0.07$). In addition, there was a significantly greater change in mood state (pre to post) in the no poles condition compared to the poles condition ($P = 0.03$). These results indicate that the use of hiking poles may have a psychological benefit to hill walkers despite increased physiological load associated with their use.

Key Words: Hill Walking, Fatigue, Activity, Fitness.

INTRODUCTION

Hill walking is a popular leisure time physical activity that engages both males and females, typically tends to be prolonged and moderate in intensity and can provide both physical and psychological health benefits (1). However, hill walking can be strenuous and moderate physical activity of this nature can lead to fatigue induced injury particularly when the walking is prolonged (1). One potential aid to combat the stress of prolonged uphill walking is hiking poles. According to proponents, hiking poles alleviate discomfort and improve balance (2). Despite their potential benefit, there is inadequate experimental documentation of the physiological response to hill walking in general and the psychological response to walking with hiking poles has received even less research attention (3). Recent studies have documented a significant reduction in mood state over a 1 day prolonged hill walking without poles (3). However, the impact of hiking poles use on mood state during walking has yet to be investigated. This may be an interesting area for future study. If hiking pole use can offset the decline in mood states experienced during walking they may be a beneficial aid for walkers in terms of alleviating discomfort and providing a less demanding psychological or perceptual experience. This may be particularly so for those new to the activity or those who undertake hill walking for enjoyment or recreational purposes.

Some research has however, focused on the usefulness of hiking poles as a walking aid. Research by Knight and Caldwell (2) reported that RPE was significantly lower in the poles condition but there was no significant difference in VO_2 between walking with and without poles following 60 minutes uphill walking at 55-65% maximum heart rate. Work by Jacobsen et al. (4) also reported no significant differences in oxygen uptake following 15 minutes walking at various gradients with and without hiking poles.

Further research by Porcari et al (5) reported that oxygen uptake was 23% higher and RPE was 1.5 pts higher when walking with poles compared to walking without poles. However, Porcari et al (4) cited participants self selecting walking pace a confounding variable. They then suggested that as the ACSM recommends exercise at 50% heart rate reserve for improved cardiovascular endurance, this should be investigated in future studies examining the physiological impact of walking with hiking poles. Thus, although the findings of this study do suggest that oxygen uptake and the perceptual response is greater when walking with poles, the experimental procedure used in this study ensures that any changes in the dependant variables cannot be guaranteed as a result of the use of hiking poles. Rather, these findings may be a result of walking at different intensities across walking trials. It would therefore be useful for future studies to standardize walking intensities across trials. It appears the few studies have examined the physiological response to hill walking with hiking poles and no study appears to have combined this issue with the psychological response to hill walking. This is potentially an important topic of study and may be useful in developing assistive strategies for hill walkers. Therefore, the aim of this study was to examine the impact of 1 hour simulated uphill walking with and without hiking poles on oxygen uptake, perceived exertion and mood state.

METHODS

Subjects

Following ethical approval and informed consent, 6 males and 1 female (Mean age ± SD = 24.2 ± 4.7) volunteered to participate in this study. Volunteers were not permitted to participate if they answered yes to any question on the Physical Activity Readiness Questionnaire. No participants reported taking any medication prior to or in between walking trials.

Procedures

Each participant performed two, 1-hour walking trials (separated by 48-72 hours), on a Woodway PPS Med treadmill inclined at 5%. Pilot testing employing short-term walking trials (10-15 minutes) with 4 active males who were not participating in the actual study reported here was used to ensure that the treadmill width was sufficient to allow the simulation of normal walking mechanics with poles. A 5% gradient was chosen based on a previously reported study that examined the influence of hiking poles on muscular and metabolic costs of walking (2). This gradient provided an uphill simulation that was sustainable for >1 hour, therefore replicating the prolonged nature of hill walking. Participants performed the 1-hour walking trial with and without hiking poles in random order using a counterbalanced design, according to recommended protocols (2). Treadmill velocity was established a priori, without the use of poles, such that the subject's heart rate was between 55-65% of their maximum heart rate determined via the Karvonen formula (6). Maximum heart rate was predicted using the Tanaka, Monahan and Seals (7) equation. Treadmill velocity was established during a baseline visit to the laboratory which involved participants walking at various velocities until steady state heart rate within 55-65% of their maximum heart rate was obtained. This velocity was then used during all walking trials. Heart rate was monitored throughout walking trials to ensure that subjects maintained an intensity between 55-65% of their maximum heart rate. To reduce the effects of thermal overload associated with prolonged exercise, participants ingested approx 250 ml H_20 15 minutes before and again at 30 minutes into the testing. Dietary data were not collected from subjects throughout the walking trials. However, all participants were asked to replicate the food stuffs consumed the night before and morning of each trial. Participants were also asked to refrain from caffeine and strenuous exercise for the 24 hours preceding each walking trial. All participants reported adherence to these requirements. Ratings of perceived exertion (RPE) were collected using the Borg 6-20 (8) scale at 10-minute intervals. Oxygen uptake ($ml \cdot kg^{-1} \cdot min^{-1}$) was assessed continuously and averaged over 10-minute periods using the Cortex Metalyser 3B (Cortex Biophysic, Leipzig, Germany). Calibration procedures were carried out according to the manufacturer's instructions. This included calibration of volume using a 3 liter Hans Rudolph syringe, air pressure calibration and gas calibration using two span gases of known values. This metabolic cart has previously been reported to be valid and reliable by adhering to this process (9).

Mood state was assessed using the fatigue subscale of the Brunel Mood State Inventory (BRUMS) (10) pre- and post-testing. The BRUMS is a 24-item self-report questionnaire designed to assess mood state in British Populations. It consists of six subscales relating to the mood states of anger, confusion, depression, fatigue, tension and vigor. A number of studies have evidenced acceptable psychometric characteristics for BRUMS in support of its concurrent, factorial and predictive validity (10, 11). In the case of the current study the fatigue subscale was of primary interest and demonstrated good internal consistency (Cronbach's a = .88).

Statistical Analyses

A 2 (condition) X 6 (time) way, repeated measures ANOVA was used to examine differences in oxygen uptake and RPE over time and across conditions. Where any significant differences were detected Bonferroni adjustments were completed to determine where any differences lay. A paired samples t-test was used to examine any differences in change in mood state between the two conditions. SPSS Version 13 (SPSS inc, Chicago) was used for all analysis.

RESULTS

Table 1. Mean ± SD of Oxygen Uptake, RPE and changes in the BRUMS Fatigue subscale with and without hiking poles

	Oxygen Uptake ($ml{\cdot}kg^{-1}{\cdot}min^{-1}$)	RPE	BRUMS Fatigue Subscale
Poles	**28.2±2.9**	**11.5±1.4**	**2.0±1.7**
	25.1±2.1	**12.2±1.1**	**4.1±1.7**

Oxygen uptake was significantly greater ($F_{1,6}$ = 36.015, P = 0.001) during the poles condition compared to the no poles condition. Mean ± SD of O_2 Uptake was 28.2 ± 2.9 $ml{\cdot}kg^{-1}{\cdot}min^{-1}$ for the poles condition and 25.1 ± 2.1 for the no poles condition $ml{\cdot}kg^{-1}{\cdot}min^{-1}$. Oxygen uptake did not differ over time within each condition (P = 0.105) (See Figure 1). RPE was not significantly different across conditions ($F_{1,6}$ = 4.583, P = 0.07). In addition, there was a significantly greater change in mood state (pre to post) in the no poles condition compared to the poles condition (t_6 = -2.78, P = 0.03). Mean ± SD of oxygen uptake, RPE and changes in the BRUMS Fatigue subscale are presented in Table 1.

DISCUSSION

Results of this study indicated that oxygen uptake was significantly greater when walking with hiking poles. This supports research by Porcari et al. (5) but refutes claims made by Knight and Caldwell (2) that there is no difference in oxygen uptake when walking with and without poles. The difference between the findings of the current study and that of Knight and Caldwell (2) is puzzling as both studies used the same exercise protocol. However, the study by Knight and Caldwell also involved load carriage which may, in part, explain the discrepancy between these studies. The research study completed by Jacobsen et al. (4) also involved load carriage but required participants to walk for differing periods of time at differing inclinations of the treadmill. Unlike the present study they found no significant differences in oxygen uptake when walking with and without hiking poles. However, Jacobsen et al. (4) did report a trend towards greater oxygen uptake in the poles condition in their study.

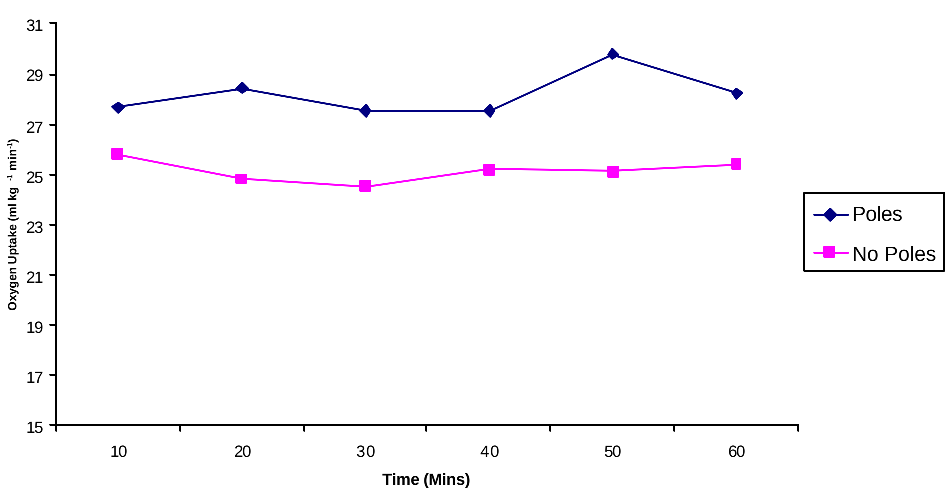

Figure 1. Mean Oxygen Uptake ($ml{\cdot}kg^{-1}{\cdot}min^{-1}$) over time and across poles and no poles conditions

Although RPE was not significantly different across conditions, the trend for RPE in the current study supports claims made by Knight and Caldwell (2) that RPE is lower when walking with hiking poles compared to when walking unaided. In regard to mood states, the current study examined the change in the BRUMS fatigue subscale pre to post across conditions. The results indicate a greater change in the fatigue subscale across the no poles condition compared to the poles condition. This novel finding may have important applications to other areas such as individuals wishing to lose weight of those on general exercise programs. Participants in this study were physiologically working harder during the poles condition yet their perception of exertion did not change across conditions. In addition, their mood state, specific to the concept of fatigue, was more positively influenced when walking with poles compared to walking without poles. This change in mood reported in the pole condition is similar to changes in mood profiles with general exercise (11). In the context of the present study these results would suggest that the use of hiking poles provides a psychological benefit when undertaking uphill walking. No prior research appears to have addressed this issue although one study has documented changes in mood states over prolonged walking without poles (3). In this study by Ainslie et al. (3), mood state was monitored pre and post a 12 km hill walk. Ainslie et al. (3) reported increases in the fatigue subscale of the profile mood state following a 12 km walk. Despite this, it is difficult for this study to draw comparisons to other work although future research using all the subscales of the BRUMS would be desirable to fully capture the mood profiles associated with walking with and without hiking poles.

Further research is needed in a number of areas in order to fully evaluate the efficacy of hiking poles during hill walking. The current study used a simulated hill walking, treadmill protocol. Future research is desirable that examines physiological, psychological and perceptual responses to walking with/without hiking poles during a prolonged hill walk outdoors rather than in a laboratory setting. Likewise, load carriage was not examined in this study. Future research that examines walking with/without poles and with/without load would be advantageous.

Despite this, these findings offer broad support for a beneficial impact of hiking poles when undertaking uphill walking of at least 60mins in duration. Walking with poles results in greater oxygen consumption, appears to result in more favorable responses to the fatigue subscale of the BRUMS and is similar in terms of effort perception compared to simulated uphill walking without hiking poles.

CONCLUSIONS

The findings of the current study suggest that although walking uphill with hiking poles is associated with increased oxygen uptake compared to walking without poles, there are no differences in perceived exertion and perception of fatigue is lower when walking with hiking poles. Therefore, hiking poles may offer psychological benefit when undertaking uphill walking despite increased physiological cost. Furthermore, the role of hiking poles in promoting exercise adherence may be a valuable topic to consider further.

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