Research on Balance Walking

Executive Summary - 2010
Kennesaw State University - Health, Physical Education, and Sport Science

Balance Walking Increases the Physiological Responses to Walking

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Background

The US Department of Health and Human Services and the American College of Sports Medicine has recommended that most adults accumulate between 150 and 300 minutes of moderate physical activity every week, though current statistics complied by the U.S. Centers for Disease Control and Prevention (CDC) indicate that fewer than 50 percent of US adults are reaching that threshold, and further, over 24% perform no leisure-time physical activity. It may be that the lack of physical activity explains part of the explosive growth in rates of overweight and obesity.

Walking is often cited as a safe and effective form of exercise. However, the energy expenditure associated with walking is generally modest, and the musculature involved in the activity is also limited primarily to the lower extremities. Recently developed and popularized forms of exercise have been touted as invoking a greater energy expenditure than walking while also increasing amount of muscle mass involved and remaining achievable for most adults. One such exercise form is Balance Walking. This form of exercise modifies standard walking by incorporating two key components: 1) wearing of a medical-grade shoe characterized especially by an angled sole with between 15 degrees and 20 degrees of heel lift, and 2) the use of walking poles with hand straps.

The purpose of this investigation was to compare the physiological and subjective responses to normal walking and Balance Walking, and further, to determine the effects of the individual components of Balance Walking (i.e., angle-soled shoes and walking poles) on physiological and subjective responses to walking.

Methods

Subjects were recruited from among the student body of Kennesaw State University. The protocol was approved by the Kennesaw State University Institutional Review Board, and after informed consent was attained, subjects completed a form confirming their eligibility.

Subjects were apparently healthy, free of cardiovascular and metabolic disease, and had never trained with walking poles or worn angle-soled shoes. Upon enrollment, body composition was determined with a Bod Pod (LMI, Concord, CA) with the residual volume estimated. Subjects were then provided approximately 30 min of training in the use of walking poles while wearing the Chung Shi angle-soled shoes to enhance familiarity with the shoes and poles before being' asked to wear them on a treadmill. Each training session involved the following four steps:

1) Walking for several minutes with a normal gait and arm swing pattern while dragging the walking poles behind.

2) Walking for several minutes as in Step 1, but with a slightly exaggerated arm swing.

3) Subjects were positioned with their backs facing a wall, approximately one foot away from the wall, and the walking poles were positioned on the floor where it met the wall while subjects were asked to apply a near-maximal force against the walking poles. This was done to demonstrate the amount of upper-body musculature involved with the addition of the walking poles, and subjects were asked to attend to the feeling the effort produced in the muscles of the upper back and shoulders, triceps, and abdomen. Subjects were then asked to again apply a near-maximal force against the hiking poles, and were then asked to reduce the magnitude of their effort to approximately 25% of maximal, and to attend to how that felt. The effort applied to the walking poles during each session in which they were used was to be approximately 25% of maximal.

4) With the experience of what approximately 25% of maximal force production felt like, subjects completed the training with approximately 10-15 min of practice walking with the walking poles while applying that effort against the walking poles. The practice continued until subjects consistently demonstrated proper technique with a normal arm-leg relationship.

Adjustable-length walking poles with wrist straps (Balance Walking, Marietta, GA) were used in this study, and pole length was adjusted in the training and exercise sessions (described below) so that the elbow joint formed a 100 degree angle while the upper arm was vertical and positioned against the torso, and the walking pole was oriented vertically.

After the training session subjects participated in four exercise testing sessions in a random sequence within two weeks. The exercise sessions were:

Condition 1) flat-soled shoes, without poles

Condition 2) angle-soled shoes without poles

Condition 3) flat-soled shoes with poles

Condition 4) Balance Walking, or the combination of angle-soled shoes with poles.

The angle-soled shoes examined in this study were the Chung Shi Comfort Step, and the flat soled control shoes used in this study were Aetrex walking shoes (Teaneck, NJ). All sessions were initiated within one hour of the same time of day, this to minimize variability in the effects of diurnal hormones and pretesting activity. Each exercise session began with subjects putting on the correct shoes, applying a Polar heart rate monitor chest strap transmitter, and, if appropriate, having walking poles strapped to their wrists. Subjects then stepped onto the treadmill (Woodway, Waukesha, WI), and the headgear, valve, and nose clip were applied and metabolic cart (Parvo Medics, Sandy, UT) tubing was attached. After one minute of standing quietly on the treadmill, the exercise began. Exercise in each condition was continuous and consisted of up to five, 3-minute stages, beginning at 53.6 m .min-I and increasing at *1304* m. min-I increments, terminating at a maximum velocity of 107.2 m .min-I. Alternatively, exercise was terminated after the 93.8 m .min-I stage if (a) subject was unable to sustain a walking gait pattern at 107.2 m .min-I, or (b) heart rate reached above 85% of age-predicted maximal (220 - age). Heart rate and V02 were measured continuously during each exercise session and recorded every 15 sec. In addition, rating of perceived exertion (RPE - Borg scale) was recorded during the final 15 sec of each stage.

All data are reported as mean ± standard deviation. Several mean comparison statistics were determined. First, univariate 2 x 2 repeated-measures ANOVAs were performed to test for shoe and pole main effects (shoes: flat soles vs. angle-soled shoes; poles: walking poles vs. no poles) and interactions. Alpha level for these tests was 0.05. All statistics were determined using SPSS Version 16.

Results

Descriptive data are recorded in table 1. A total of 25 subjects completed all study appointments, and 22 of them completed all of the exercise velocities (i.e., 53.6, 67.0, *8004,* 93.8, and 107.2 m .min-I). The other three participants terminated the exercise sessions after completion of the 93.8m .min-I stage - two terminated early because the 107.2 m .min-I stage elicited a running gait pattern, and one subject terminated after the 93.8 m . min-I stage because heart rate had reached 85% of age-predicted maximal heart rate. Table 2 contains the heart rate and oxygen uptake data during the final minute of each stage, and the RPE data acquired during the final 15 sec of each stage.

A main-effect was seen for pole condition and shoe condition at all walking velocities for V02and heart rate (HR) (see figure 1 and figure 2). There was also a pole main effect for RPE at all walking velocities, and a shoe main effect for RPE at all walking velocities except for the slowest (53.6 m . min-I: p = 0.357; see figure 3). There was no pole x shoe interaction at any velocity for any variable measured.

The mass of the flat-soled control shoes tended to be slightly less than the angle-soled shoes, though the difference was not significant. The right shoes of each pair were weighed. In the women's shoes (n = 20), the mass of the flat-soled shoes was 372.6 ± 27.5 g, while the angle soled shoes was 389.0 ± 32.9 g (p = 0.10). Similarly, in the men's shoes (n = 5) the mass of the flat-soled shoes was 457.7 ± 62.7 g, and the mass of the angle-shoed shoes was 517.1 ± 38.1 g (p = 0.11). The mean mass of all of the shoes (N = 25) was 389.6 ± 49.6 g for the flat-soled shoes, and 414.6 ± 62.0 g for the angle-soled shoes (p = 0.12).

Conclusion

Balance Walking resulted in significantly greater oxygen uptake, a higher heart rate, and a greater RPE than regular walking at all walking velocities. In addition, wearing the Chung Shi angle-soled shoes resulted in an increase in oxygen uptake and heart rate at all walking velocities; likewise, utilization of walking poles at an estimated 25% of maximal effort resulted in an increase in oxygen uptake and heart rate at all walking velocities. Finally, the utilization of walking poles resulted in higher RPE at all walking velocities, and the wearing of the Chung Shi angle-soled shoe also resulted in a higher RPE at all walking velocities except 53.5 m .min-I.

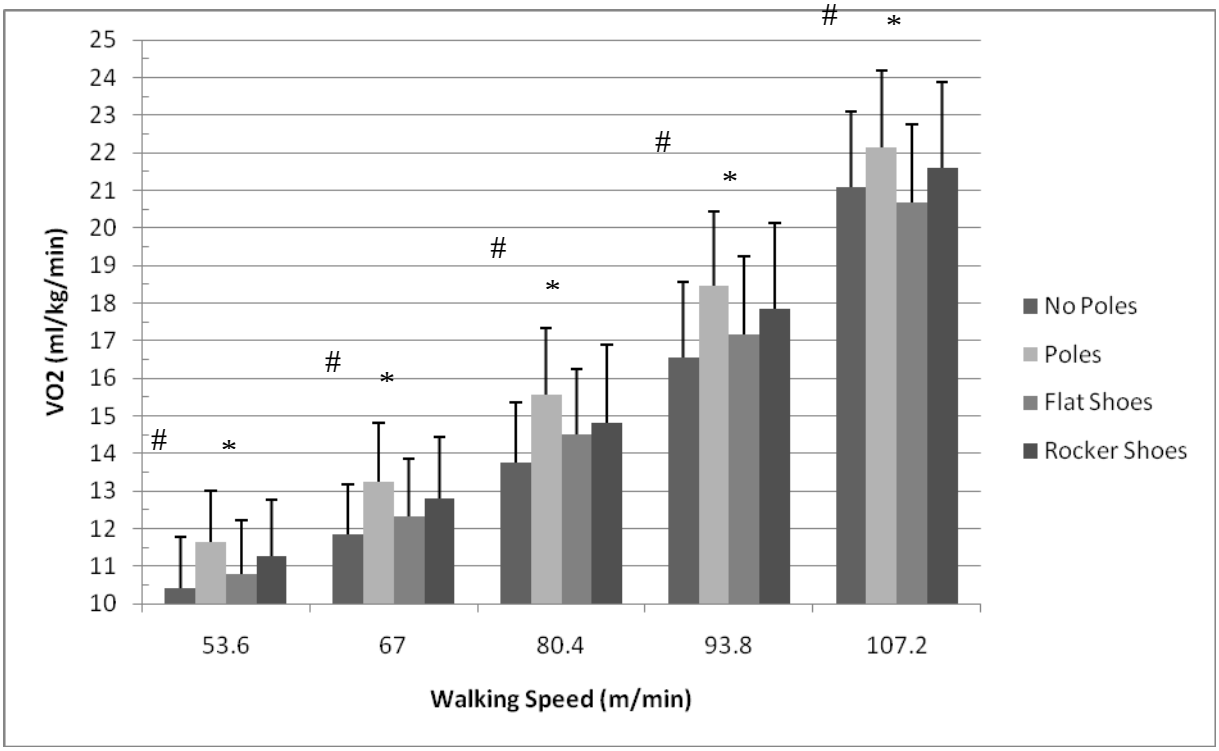
Application of these findings suggests that, compared with normal walking with flat-soled shoes, Balance Walking employing walking poles at approximately 25% of maximal effort would result in increasing energy expenditure by 62 kcal over a 60 minute walk on a flat grade at 93.8 m .min-I in an 80 kg person.

Note - This study was funded by Foot Solutions, Marietta, GA

Table 1 - Descriptive Statistics

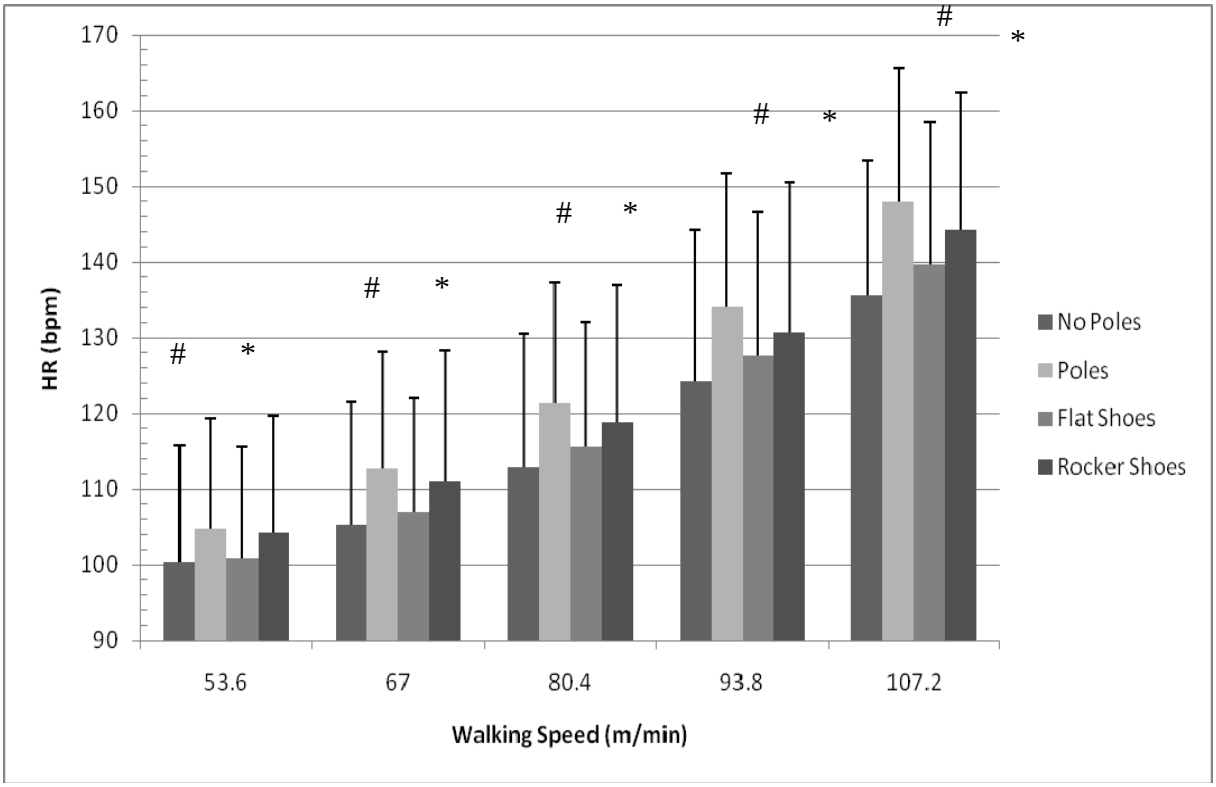
	All (N = 25)	*Men (n = 5)*	*Women (n = 20)*
Age (yr)	22.36 ± 3.93	22.80 ± 1.48	22.36 ± 4.35
Weight (kg)	64.82 ± 13.80	81.82 ± 22.95	60.57 ± 5.87
Height (cm)	167.89 ± 11.06	185.42 ± 7.18	163.51 ± 6.53
BMI (kg/m2)	22.88 ± 3.06	23.60 ± 5.45	22.70 ± 2.32
Body fat (%)	25.71 ± 8.09	18.08 ± 9.08	27.62 ± 6.80

Figure 1 - VO2 Main Effects



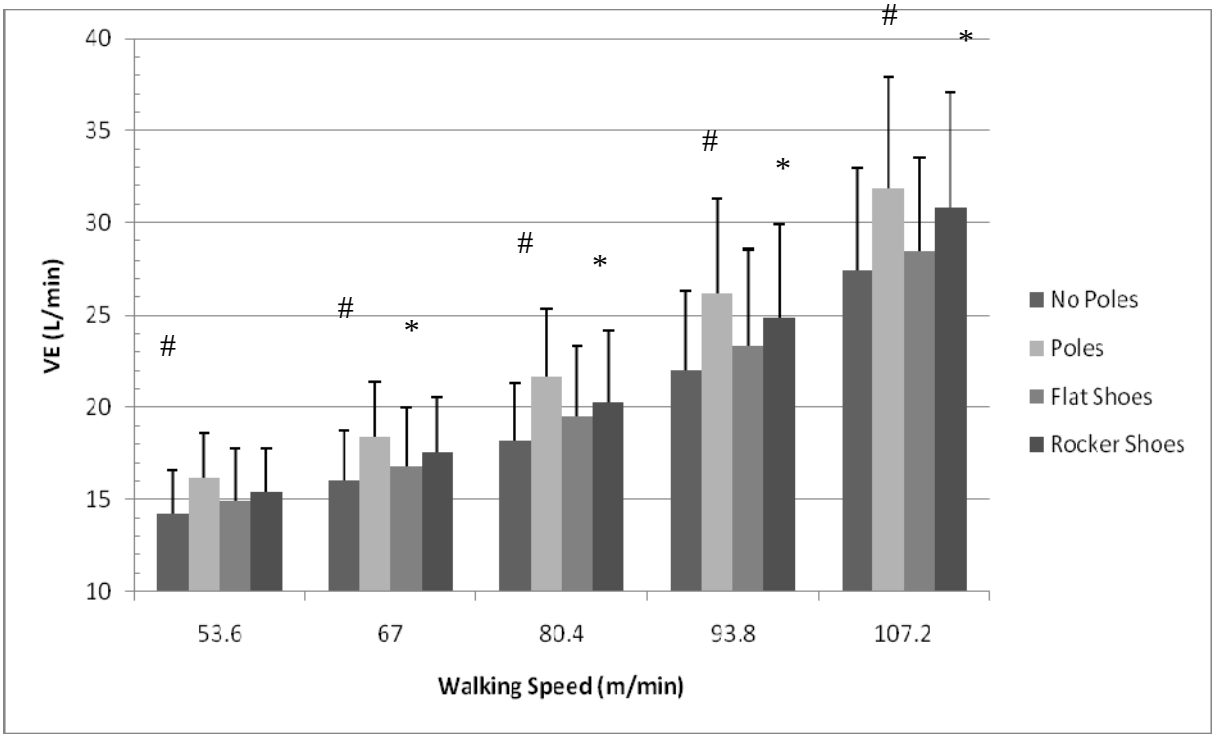
 # - Different from No Poles Condition; * - Different from Flat Shoes Condition

Figure 2 - Heart Rate Main Effects



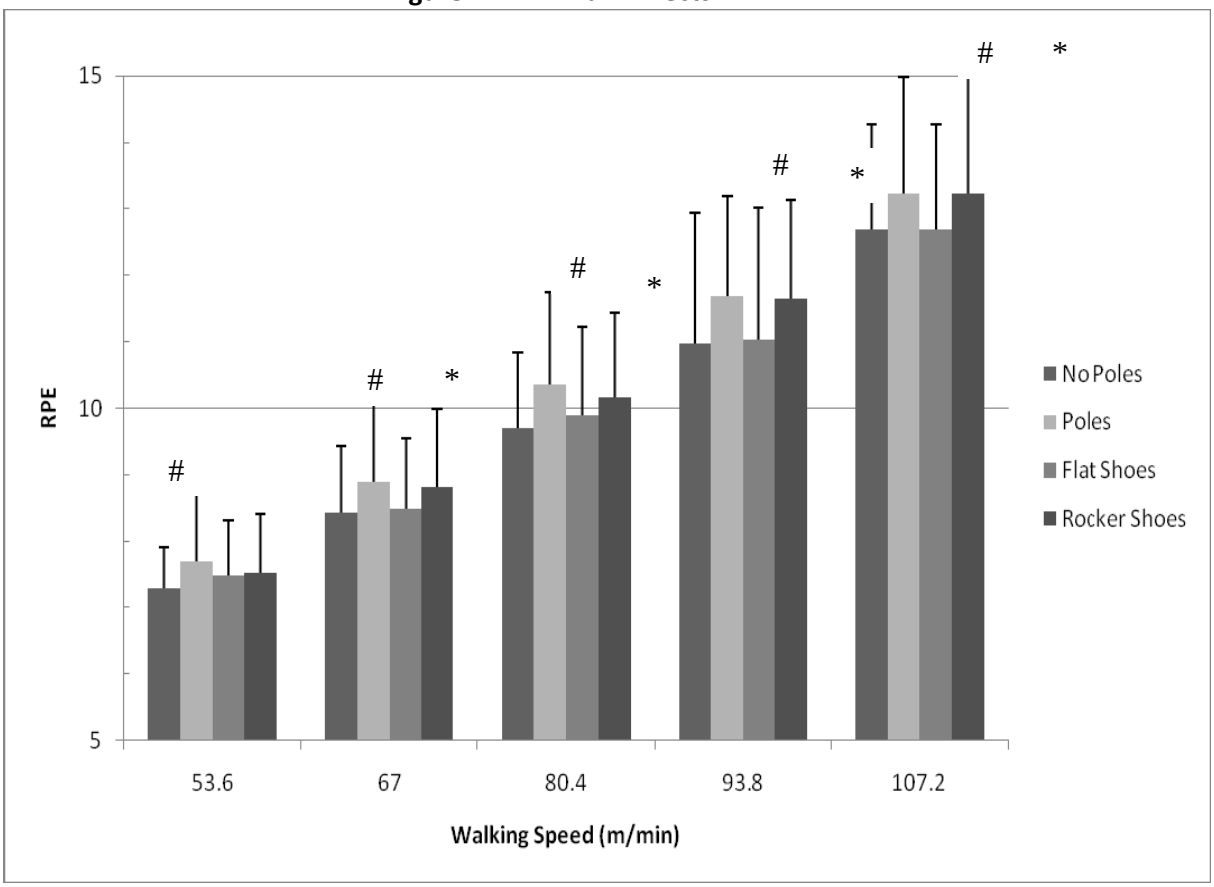
 # - Different from No Poles Condition; * - Different from Flat Shoes Condition

Figure 3 - Minute Ventilation Main Effects.



 # - Different from No Poles Condition; * - Different from Flat Shoes Condition

Figure 4 - RPE Main Effects.



1. **# - Different from No Poles Condition; * - Different from Flat Shoes Condition**

Figure 5a - Chung Shi Comfort Step Shoe

Figure 5b – Aetrex Walking Shoe

Walking versus Balance Walking
60-min Walk on Flat Grade Energy Expenditure Estimates
(measured in Calories at given Body Weight)*

Weight (lb)	130	140	150	160	170	180	190	200	210	220
Flat Shoes 2 mph 53.6 m/min	180	194	208	221	236	249	263	277	291	305
Balance Walking 2 mph 53.6 m/min	210	226	243	259	275	291	307	323	340	356
Flat Shoes 2.5 mph 67.0 m/min	207	223	239	255	271	287	303	319	335	351
Balance Walking 2.5 mph 67.0 m/min	241	260	278	297	315	334	352	371	389	408
Flat Shoes 3 mph 80.4 m/min	242	261	280	298	317	336	354	373	392	410
Balance Walking 3 mph 80.4 m/min	280	302	323	345	366	388	409	431	452	474
Flat Shoes 3.5 mph 93.8 m/min	288	310	332	355	377	399	421	443	465	488
Balance Walking 3.5 mph 93.8 m/min	334	360	385	411	437	462	488	514	540	565
Flat Shoes 4.0 mph 107.2 m/min	350	377	404	431	457	484	511	538	565	592
Balance Walking 4.0 mph 107.2 m/min	402	433	464	495	526	557	588	619	650	680

*Energy expenditure is estimated from average oxygen uptake
Buresh, 2010 (unpublished data).