Proceeding

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The evaluation of the differences in energy expenditure of adults walking

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ABSTRACT

Kouriklova, P., Kalima, T., & Bernacikova, M. (2015). The evaluation of the differences in energy expenditure of adults walking. *J. Hum. Sport Exerc., 9*(Proc1), pp.S404-S409. Introduction: This study describes differences between oxygen uptake (VO_2; $ml \cdot min^{-1} \cdot kg^{-1}$) and energy expenditure (EE; $kJ \cdot min^{-1} \cdot kg^{-1}$) during treadmill walking at various velocities (3, 4 and 5 $km \cdot h^{-1}$) and inclinations (0, +12 a -12 %). Six men [age 22,83 ± 2,23 y.o., weight (BM) 75,18 ± 4,83 kg, height 180,5 ± 4,51 cm; body fat (PBF) 15,3 ± 3,67 % of BM]. Anthropometric variables and walking test were been performed during one session. Walking test consisted of 5 minutes stages (all combination of 3 velocities and 3 inclination, total test length of 45 minutes) and at the last two minutes of each stage were collected EE and VO_2 in breath-by-breath analysis. Significant difference ($p < .05$) were discovered between the velocities at same inclination in VO_2 and EE except walking downhill at velocities of 3-4 ($p = .074$) and 4-5 km ($p = .116$, reps. $p = .106$). The most noticeable change is the diversity of VO_2 and EE between the various speeds at different treadmill inclinations. No significant relations were found between anthropometric variables and VO_2, resp. EE, with the only exception BM vs. EE at 3 $km \cdot h^{-1}$ +12% ($r = .84$). **Key words**: GAIT, FAT, MEN, BREATH-BY-BREATH, TREADMILL.

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INTRODUCTION

Walking is the most natural movement of human activity. Reduction of amount of physical activity (PA) is observed in recent decades in European countries (Hamrik, Sigmundová, Kalman, Pavelka, & Sigmund, 2014; Bassett, Pucher, Buehler, Thompson, & Crouter, 2008). This phenomenon is closely link with the epidemic of obesity and the risk of lifestyle diseases.

One component of the PA is walking, which can be understood not only as a type of transportation but also as a way of increasing energy expenditure during the day (Sedlacek, Sebera, Michalek, & Cacek, 2013). Total energy consumption in performing walk is dependent on the duration, distance, intensity (speed and incline) (Waters, Lunsford, Perry, & Byrd, 1988).

This study focuses on description of differences between oxygen uptake and energy expenditure during treadmill walking at various velocities and inclinations.

MATERIAL AND METHODS

Participants

The research was conducted in six selected males, non-athletes (not engaged in regular sporting activities), students of the Masaryk University. Participants' characteristics are shown in table 1. All students participated in the study voluntarily.

Table 1. Descriptive statistics of participants

	Mean	SD
Age	22,83	2,23
Weight (kg)	75,18	4,83
Height (kg)	180,50	4,51
Body fat (% of body mass)	15,31	3,67

In order to ensure respect for the use of information and integrity of patients, all athletes were informed of the type of study, the tests and potential risks. The approval on the use of the data was certified by signature and fingerprint.

All procedures were approved by the ethics committee of the Santo Tomás University and conform to the principles outlined in the Declaration of Helsinki, in the same way the tests to be performed are considered minimal risk in accordance with Article 10 of resolution 8430 of 1993 which apply to Colombia.

The total number of participants who met the criteria and participated signed the consent and took part in the assessment was 17 males, mean age 18.2 ± 1.8 years, weight 62.8 ± 7.4 kg, height 170.1 ± 5.8 cm. The overall characteristics are in Table 1.

Table 1. Physical characteristics of participants *n* = 17

	Average	SD
Age (years)	18.2	± 1.8
Weight (Kg)	62.8	± 7.4
Height (cm)	170.1	± 5.8
Fat percentage	10.0	± 1.7
Muscle percentage	52.3	± 4.4

Procedures

The test protocol consisted of three inclination of the running/walking treadmill (Catana, Lode, The Netherlands). Each inclination parts included three subparts in itself. These three parts differed speed of movement (3, 4 and 5 km/h). Completely nine subparts were performed in random order and with five minutes passive rest (5 minutes) after 3rd and 6th part. Each stage of test protocol lasted five minutes (total net time of walking test protocol: 45 minutes). During last two minutes of each stage, oxygen uptake (Metalyzer 3b, Cortex, Gemrnany), the breath-by-breath analysis, data were been collected. Body composition analysis were performed before test session (InBody 720, Biospace, Korea) according the manufacturer's recommendations. All participants underwent test protocol between 8 AM and 11 AM.

Figure 1. One of participants during test protocol (3 km/h and +12 % inclination of treadmill)

The testing was conducted at a constant temperature of 20 ± 1 °C. Day before the testing session the tested subjects were asked to refrain from any sports and exhausting activities. Before each measurement, the calibration of Metalyzer 3b was performed by a calibration syringe (3 Liter Calibration Syringe, Cortex, Germany).

Analysis

The obtained data were expressed as oxygen uptake (VO_2; $ml \cdot kg^{-1} \cdot min^{-1}$) and energy expenditure (EE; $kJ \cdot min^{-1} \cdot kg^{-1}$) and changes velocities were observed by Wilcoxon signed-rank test. Spearman rank order correlation coefficient was used for analysis of relation selected anthropometric variables (weight, height and percent of body fat) with EE and VO_2, respectively. The level of $p < 0.05$ was considered as statistically significant. The software program Statistica 12 (StatSoft, USA) was used for all statistical analyses.

RESULTS

Statistical significant difference ($p < .05$) were discovered between the velocities at same inclination in VO_2 and EE except walking downhill at velocities of 3 vs. 4 km/h ($p = .074$) and 4 vs. 5 km (VO_2 $p = .116$ and p = .106 EE, resp.). The most noticeable variances are present at VO_2 and EE among the various speeds during downhill (-12 % inclination) walking (see figure 2 and 3 and table 1 and 2).

Table 2. Results of oxygen uptake (VO_2) in different velocities and inclinations (result displayed as mean ± SD ml·kg-1·min-1)

	3 km·h-1	4 km·h-1	5 km·h-1
-12 %	9,65 ± 1,53	12,12 ± 3,66	12,68 ± 3,1
0 %	11,19 ± 0,98	12,13 ± 0,8	14,25 ± 2,08
+12 %	18,97 ± 0,93	22,81 ± 1,14	27,16 ± 1,22

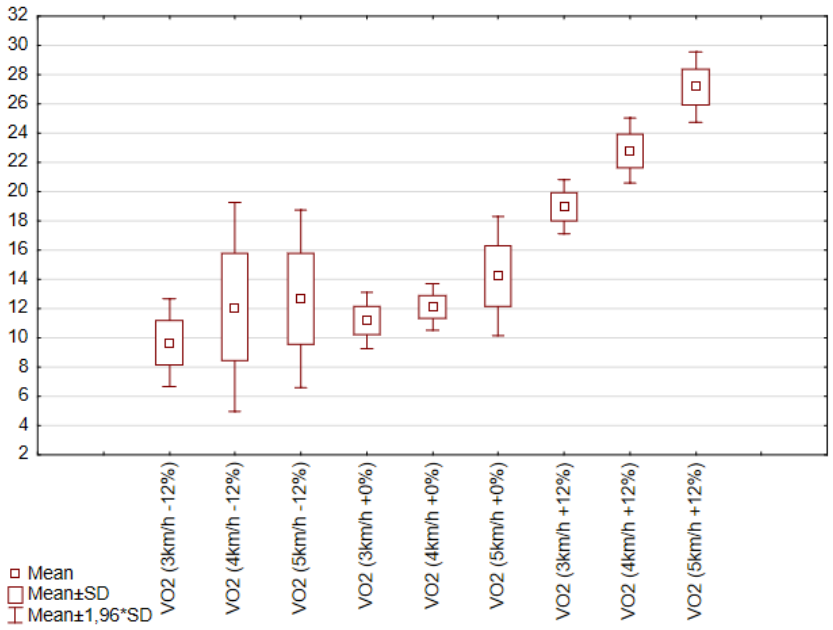

Figure 2. Results of oxygen uptake (VO_2) in different velocities and inclinations (result displayed in ml·kg^{-1}·min^{-1})

Table 3. Results of energy expenditure (EE) in different velocities and inclinations (result displayed as mean ± SD kJ·min^{-1}·kg^{-1})

	3 km·h-1	4 km·h-1	5 km·h^{-1}
-12 %	0,1933 ± 0,0288	0,245 ± 0,0706	0,2567 ± 0,0609
0 %	0,2233 ± 0,0151	0,245 ± 0,0138	0,29 ± 0,0405
+12 %	0,3817 ± 0,0147	0,4683 ± 0,0172	0,56 ± 0,0228

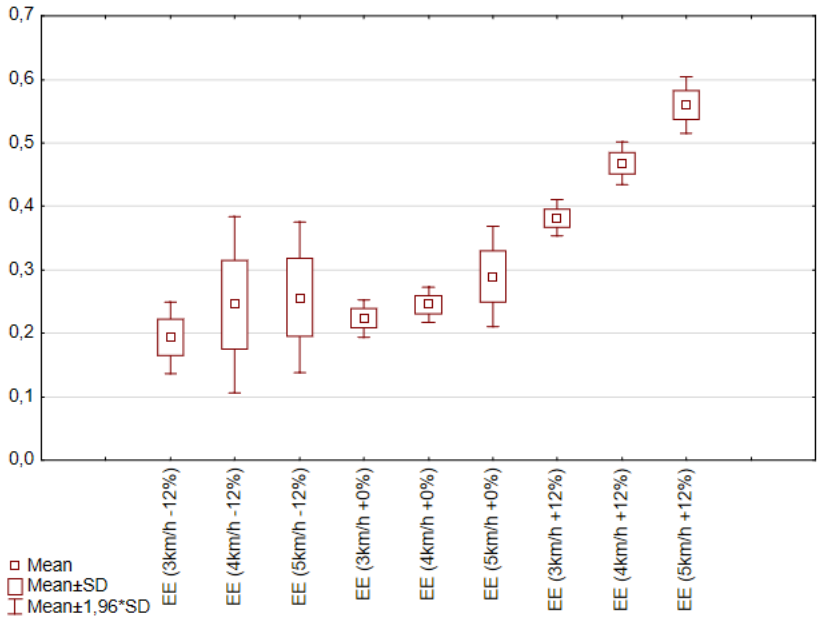

Figure 3. Results of energy expenditure (EE) in different velocities and inclinations (result displayed in $kJ \cdot min^{-1} \cdot kg^{-1}$)

No significant relations were found between anthropometric variables and VO_2, resp. EE, with the only exception BM vs. EE at 3 $km \cdot h^{-1}$ +12% (r = .84, p = .036).

DISCUSSION AND CONCLUSION

This study confirmed the expected differences between oxygen uptake (VO_2) and energy expenditure (EE) while walking on a treadmill at different speeds and inclinations. Noteworthy results of downhill walking, where there is a large variance in the results of a non-significant differences between similar speeds. This phenomenon can probably be attributed to differences in the time-spatial muscle involvement in the gait cycle. Furthermore, also confirmed the dependence between selected anthropometric characteristics and VO_2 and EE, respectively.

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