Effect of normobaric hypoxic walking training on mechanics and energetics of gait in obese adults [preliminary results]

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Introduction

The Net Energy Cost of Walking (NetCw) represents the energy expenditure per distance unit associated with walking movements. Recent studies have reported a higher absolute and relative value of NetCw (Browning et al. 2006) and slower preferred walking speed (PWS; Malatesta et al., 2009) in obese compared with normal weight subjects. This extra-cost of walking can be reduced with a decreased body mass but also with changes in the biomechanical parameters of walking [i.e., a lesser lower limb muscle work required to rise the center of mass (CM) with mechanical external work (Wext) unchanged after intervention; Peyrot et al., 2010].

In obese individuals, normobaric hypoxic training induced similar improvements in body mass loss, physical fitness and insulin resistance than normoxic training but using lower exercise intensity (Netzer et al., 2007; Weisner et al., 2008). This suggests that, in hypoxic walking training, PWS (appropriate walking intensity for weight management; Hill, 2006) can be slower reducing joint/muscle mechanic strain. However, the efficacy of this type of training has never been investigated in obese adults.

Purpose

The purpose of this study was to investigate the changes in mechanics and energetics of walking after a normobaric hypoxic training.

It was hypothesized that:

-The body mass loss and change in the mechanics of gait induced by the training program would decrease the NetCw, the levels in metabolic risk factors and insulin resistance and increase the PWS.

Methods

Subjects: n = 12 (2 Men, 10 Women; age: 33.9±4.7 yr; BMI: 34.2 ± 2.7 kg/m^2)

1)PreTest: 1) body mass and composition (DEXA); 2) blood samples [total cholesterol (TC), high-density lipoprotein (HDL), low-density lipoprotein (LDL), triglycerides (TG), plasma glucose, insulin concentrations and insulin resistance (HOMA-IR)]; 3) NetCw (OxyconPro, Jaeger) and mechanics of walking (HP-Cosmos 150MED, Arsalis; BTS Bioengineering) were calculated for speeds from 2, 3, 4, 5 and 6 Km/h and at PWS.

2) Training program: 9 training sessions (3 sessions per week) of 60 min of walking at PWS in normobaric hypoxic conditions (3000 m) in single-blind fashion.

3) PostTest: Idem PreTest.

Results

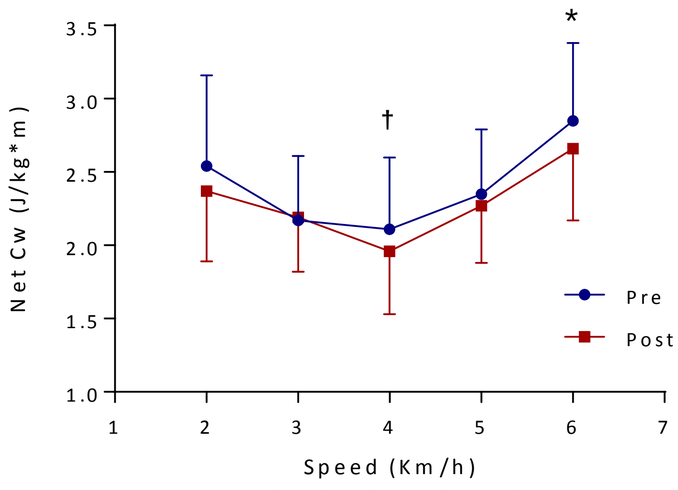

Fig.1. Net Energy Cost of Walking (NetCw) vs walking speed pre- and post-training. †Tendency (p=0.072) *Significant difference (p=0.005).

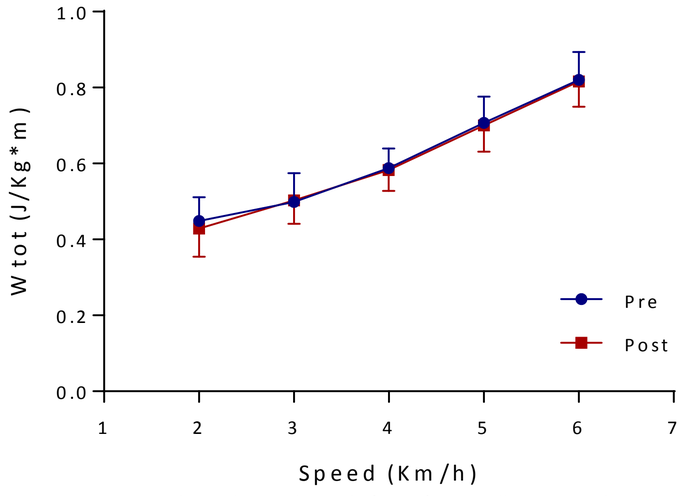

Fig.2. Total mechanical Work (Wtot) vs walking speed pre- and post-training.

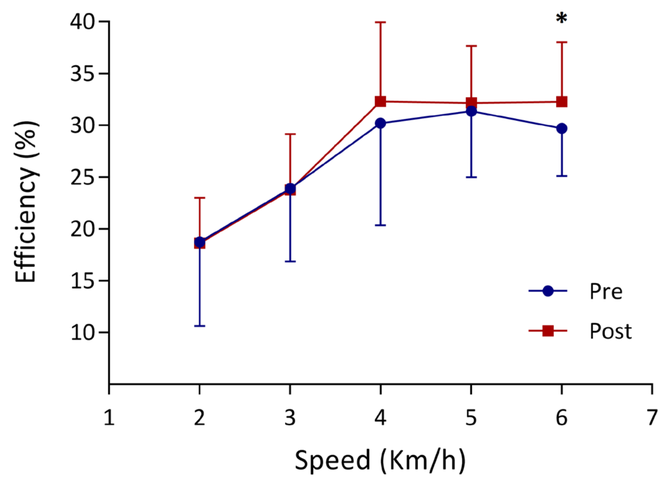

Fig.3. Mechanical Efficiency (Wtot/NetCw) vs walking speed pre- and post-training. *Significant difference (p=0.022)

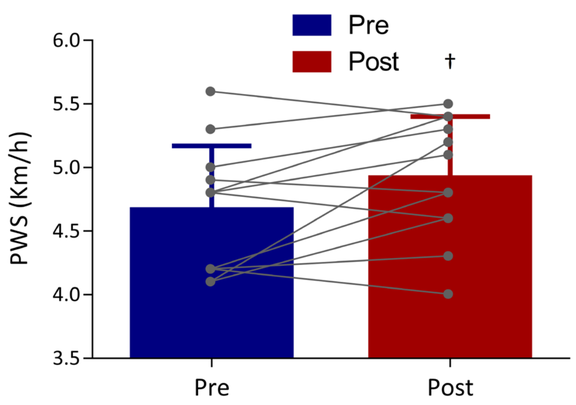

Fig.4. Preferred walking speed (PWS) pre- and post training. †Tendency (p=0.055)

- Spatiotemporal Parameters: there was no significant difference in single support, stance and stride duration, in stride frequency and length and in width step between pre- and post training (p>0.05).
- Body composition: total body mass tended to be lower after the training (Pre: 96.8±9.4 kg, Post: 96.3±9.8 kg; p=0.08) with a tendency in the reduction in fat mass of the lower limbs (p=0.084). There was no significant difference in body composition after the intervention (p>0.05)
- Blood samples: HDL concentration significantly decreased after intervention (Pre: 1.4±0.4 mmol/l, Post: 1.3±0.4 mmol/l; p=0.02) and LDL, glucose and TG concentrations tended to be lower in post- compared to pre-training (p<0.1). There was no significant difference in HOMA-IR between pre- (3.1 ±1.7) and post training (3.3 ±2.0; p=0.761).

Discussion / Conclusion

The training under hypoxic conditions did not imply major alterations in the biomechanics of walking in obese subjects. The lack of differences in Wtot, revealing no significant change in the gait pattern, along with a significant decreased of NetCw after the training, led to a significant increase in the mechanical efficiency at the highest speed. PWS tended to be increased after the intervention, attesting the efficacy of this training program.

Our results revealed a tendency to decrease in the total body mass probably due to a reduction in the fat mass of the lower limbs after the intervention. However, the second part of the study in normoxia conditions is needed to know whether these changes were due to the training *per se* (Gatteter et al., 2015) or to the hypoxic conditions.