SUBSTRATE UTILISATION FOR A SET AMOUNT OF WORK PERFORMED IN A HOT ENVIRONMENT; EFFECTS OF EXERCISE INTENSITY, DURATION AND TRAINING STATUS.
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Introduction
Individuals undergoing exercise programs for weight loss strive for increasing their energy expenditure and fat oxidation to improve body composition. In a thermoneutral environment, the exercise intensity that elicits the highest rate of fat oxidation ranges from 55 to 75% of VO2max (1). Exercising in the heat increases carbohydrate oxidation (2) and could alter the intensity for maximal rate of fat oxidation. The objective of this study was to investigate which combination of exercise intensity and duration maximizes energy expenditure and fat oxidation for a set amount of work performed in a hot environment. A secondary objective was to investigate if the best combination of exercise intensity and duration is similar for aerobically-trained and untrained subjects.

Methods
Ten aerobically-trained (T) and ten untrained (UT) subjects volunteered for this study. Each subject pedalled a cycle ergometer (Cardiotest 100, Seca, GE) in a hot-dry environment (36°C; 23% rh) at three different intensities (i.e. 40, 60 and 80% VO2peak). Exercise time was 110, 60 or 45 min, respectively, to achieve the same amount of work in all trials (658 ± 53 for T and 508 ± 35 kJ for UT). At rest and during exercise energy expenditure and fat oxidation were calculated using indirect calorimetry (Quark b2, Cosmed, IT). To account for the effect of resting metabolic rate (RMR) on trials with different duration, RMR was subtracted in all trials. ANOVA was used to detect differences between trials and groups.

Results
Total energy expenditure was higher at 40% than at 60% and 80% in both T (3358 ± 242 vs 3010 ± 186 and 3073 ± 204 kJ, respectively, P < 0.05) and UT (2651 ± 225 vs 2480 ± 168 and 2431 ± 169 kJ, respectively, P < 0.05). The maximal rate of fat oxidation was achieved at 60% for T (0.4 ± 0.1 g/min) and at 40% for UT (0.2 ± 0.1 g/min). However, when exercising at 40% for 110 min subjects oxidized more total fat than at 60% for 60 min or at 80% for 45 min in T (30 ± 5 vs 22 ± 4 vs 6 ± 2 g, respectively, P < 0.05) and UT (21 ± 4 vs 9 ± 2 vs 1 ± 1 g, respectively, P < 0.05).

Discussion
In a hot environment (likewise in a thermoneutral environments (3)) the highest rate of fat oxidation occurs at 60% VO2peak in T and at 40% VO2peak in UT (P<0.05). However, exercising at 40% VO2peak for 110 min increases by 10% total energy expenditure in comparison to the same amount of work performed at 60% or 80% VO2peak in T and UT. In addition, total fat oxidation is increased by 40-150% when exercising at 40% VO2peak in comparison to 60% or 80% VO2peak in T and UT. In summary, low intensity-long duration exercise (40% VO2peak; 110 min) is the best choice to maximize energy expenditure and total fat oxidation in trained and untrained men when given a set distance to complete.

References

Keywords: Fat Metabolism, Energy Expenditure, Weight Loss Programs