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ORIGINAL ARTICLE

Crossover and maximal fat oxidation points during running and cycling in sedentary subjects

Les points de croisement métabolique et de l'oxydation maximale des lipides lors de la course et du pédalage chez les sujets sédentaires

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Indirect calorimetry;
Metabolic indices;
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Summary
Objective. — The purpose of this study was to compare crossover and maximal fat oxidation points during cycling and running in healthy participants.
Methods. — Maximal oxygen uptake $\left(\dot{V}O_{2_{max}}\right)$, maximal aerobic power (MAP) and maximal aerobic velocity (MAV) were assessed in 12 sedentary participants (aged 20.5 ± 1.0 years), using a maximal progressive tests on a cycle ergometer and on a treadmill. Participants performed in random sequence, two submaximal graded exercise tests on a cycle ergometer (CE) and on a treadmill (TM), based on the measured MAP and MAV respectively. Respiratory parameters, the crossover (COP) and the maximal fat oxidation points ($LIPOX_{max}$) were measured during these submaximal protocols.

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Results. — There were no significant mean (±SD) differences in COP (CE: 46.4 ± 4.9%, TM: 47.4 ± 3.7%; $P = 0.36$) and in $LIPOX_{max}$ (CE: 40.0 ± 7.4%, TM: 40.2 ± 2.1%; $P = 0.92$) expressed in percentage of $\dot{V}O_{2\,max}$ between the two modes of exercise. The metabolic indices obtained on the CE and TM were significantly correlated (COP: $r = 0.85$; $P < 0.0001$ and $LIPOX_{max}$: $r = 0.79$; $P < 0.002$).

Conclusion. — Our data show that COP and $LIPOX_{max}$ measured during submaximal exercise (based on measured MAP or MAV) were not affected by the choice of ergometer. Both CE and TM yielded accurate and quiet similar metabolic indices that could be used to individualize training in healthy sedentary adults.

MOTS CLÉS
Calorimétrie indirecte ;
Indices métaboliques ;
Ergocycle ;
Tapis roulant

Résumé

Objectif. — Comparer les indices métaboliques mesurés durant l'exercice de pédalage sur ergocycle et durant la course sur tapis roulant chez des sujets sédentaires sains.

Matériels et méthodes. — La consommation maximale d'oxygène $\left(\dot{V}O_{2_{max}}\right)$, la puissance maximale aérobie (PMA) et la vitesse maximale aérobie (VMA) étaient évaluées à l'aide de deux protocoles progressifs sur ergocycle et sur tapis roulant chez 12 sujets sédentaires (20,5 ± 1,0 ans). Les sujets ont réalisé dans un ordre aléatoire deux exercices sous-maximaux sur ergocycle (CE) et sur tapis roulant (TM), basés sur PMA et VMA respectivement. Les paramètres respiratoires, et les points de croisement métabolique (COP) et d'oxydation maximale des lipides ($LIPOX_{max}$) étaient mesurés au cours de ces exercices sous-maximaux.

Résultats. — En moyenne, le COP (CE : 46,4 ± 4,9 % et TM : 47,4 ± 3,7 %) et le $LIPOX_{max}$ (CE : 40,0 ± 7,4 % et TM : 40,2 ± 2,1 %) ne différaient pas entre les deux modalités d'exercice ($p = 0,36$ pour le COP et $p = 0,92$ pour le $LIPOX_{max}$). Les indices métaboliques obtenus sur ergocycle et ceux mesurés sur tapis roulant étaient significativement corrélés (COP : $r = 0,85$; $p < 0,0001$ et $LIPOX_{max}$: $r = 0,79$; $p < 0,002$).

Conclusion. — Nos données montrent que les points de COP et de $LIPOX_{max}$ mesurés au cours de l'exercice sous-maximal (protocole basé sur la PMA ou la VMA mesurée) n'ont pas été influencés par le choix de l'ergomètre. L'ergocycle et le tapis roulant ont donné des indices métaboliques précis et assez similaires qui pourraient être utilisés pour individualiser l'entraînement chez les adultes sédentaires sains.

1. Introduction

Fat and carbohydrate (CHO) are the main substrates for energy production during exercise. The indirect calorimetric method is used to assess the relative contribution of fats and carbohydrate during submaximal effort [1,2]. Several studies on healthy and trained individuals have used this indirect technique [3—8] to determine such indices as the crossover point (COP) [1] and the point at which fat oxidation is maximal ($LIPOX_{max}$ or FAT_{max}) [9,10]. The relative utilization of fat and CHO depends in great part on the exercise intensity [11—14]. The rate of CHO oxidation increases as exercise becomes more intense [4,9,15]. CHO utilization is also influenced by dietary manipulations [16,17], the initial muscle glycogen content [18] and the fitness level of the participant [19—22]. In addition, the selected protocol is a major determinant of the variability of COP and $LIPOX_{max}$ [23]. In this context, some studies have shown that the step duration in a progressive test [10,24] and the type of ergometer [3,4,25—27] have an important impact upon the variability of these metabolic indices.

Thus, fat oxidation normalised to body mass was higher at 75% than at 55% of maximal oxygen uptake $\left(\dot{V}O_{2_{max}}\right)$ during running and cycling in athletes [27]. Achten et al. [5] also found that maximal fat oxidation was higher when walking/running than during cycling, over a wide range of intensities of effort in moderately trained athletes. Likewise, Lafortuna et al. [26] found that in obese adolescents, fat oxidation was higher during treadmill running than use of a cycle ergometer at any given intensity of effort. However, Mendelson et al. [3] found no significant differences in COP and $LIPOX_{max}$ between laboratory cycle ergometer and walking/running on a track.

To our knowledge, there are no studies that have assessed these metabolic indices using both a treadmill and a cycle ergometer under laboratory conditions. These conditions are in general controllable and allow having the same environmental conditions in terms of temperature, humidity, and wind speed when tests are assessed in many occasions. Moreover, there is little information on the metabolic responses of healthy individuals to submaximal exercise, based on their measured maximal aerobic power (MAP) or maximal aerobic velocity (MAV). Thus, the aim of the present