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REVIEW

Acute and chronic exercises: Effect on lipid metabolisms in obese individuals

Exercices chroniques et aigus : effet sur la mobilisation des lipides chez les individus obèses

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Obesity;
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Summary
Objectives. — The objective of this review article is to provide insight into the effects of acute and chronic exercises on lipid metabolisms in obese individuals.
News. — Generally, most authors suggest that physical training is the most valuable method to optimize fat loss by improving lipid metabolism processes in obese individuals, especially in adults. However, there is a lack of data specific to children due to ethical constraints associated with invasive techniques. Very often in adults, results indicate that endurance training, often consisting of moderate exercise, is one of the best strategies for obesity management. Recently, the impact of intense training intervals has been studied and has shown promising results in obesity management. Indeed, this training model improved lipid metabolism in obese individuals, and this by a shorter time than conventional training. Nevertheless, the impact of a long-term interval training on treatment of obesity remains to be determined.
Prospects and projects. — For children, some data provided from indirect calorimetry showed improvement of lipid oxidation use after a training period. However, more investigations are needed to improve our understanding of lipid metabolism in skeletal muscle during exercise for the benefits of healthy training children or those with diseases.
Conclusion. — Higher-intensity exercise (HIE) has been proposed as a viable alternative to improve lipid mobilization in overweight/obese sedentary men within a few weeks. However, there is still much debate to define the optimal form of HIE needed for the most favorable impact on lipid mobilization improvement.

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MOTS CLÉS
Obésité ;
Exercice aigu ;
Intensité

Résumé
Objectifs. — L'objectif de cette revue générale est d'apporter un éclairage sur l'effet de l'exercice aigu et chronique sur la mobilisation des lipides chez les individus obèses.
Actualités. — L'exercice physique est une des stratégies pour lutter contre les effets délétères de l'excès de la masse grasse chez les adultes obèses, et ce, en optimisant le métabolisme lipidique. Chez les enfants, les données restent peu nombreuses et moins spécifiques. L'exercice en endurance à intensité modérée est le modèle le plus utilisé pour la gestion de l'obésité. Récemment, l'impact des exercices intenses par intervalle a été étudié et démontre des résultats concluants quant à la mobilisation lipidique. Cependant, il reste à étudier l'impact chronique d'un tel exercice sur d'autres paramètres physiologiques.
Perspectives et projets. — Chez les enfants, certaines données démontrent une amélioration de l'utilisation des lipides suite à l'exercice physique. Toutefois, d'autres études seront nécessaires pour étudier plus spécifiquement les effets de l'exercice physique sur d'autres paramètres de santé.
Conclusion. — Aujourd'hui, l'exercice physique à très haute intensité (EHI) est considéré comme étant une alternative efficace pour améliorer la mobilisation des lipides auprès des individus obèses ou en surpoids, et ce, même en quelques semaines d'intervention. Toutefois, il reste beaucoup à faire quant à la détermination de la forme d'EHI la plus efficace favorisant une mobilisation optimale des lipides.

1. Introduction

Obesity is a disease defined by an accumulation of adipose tissue with adverse health consequences. Indeed, multiple complications may be associated with the accumulation of adipose tissue such as cardiovascular heart diseases, type 2 diabetes, hypertension, stroke and cancers in colon and breast [1]. From a purely thermodynamic point of view, obesity results from an imbalance of energy balance: an increase in energy uptake and a decrease in energy expenditure. The importance of physical activity in the treatment of obesity requires clarifying the interactions between physical exercise tasks and adipose tissue. This consists of studying the lipid mobilization profile in response to an acute and chronic physical exercise task.

2. Acute exercise

In a goal of reducing body weight, intensity and duration of exercises will be crucial to promote lipid mobilization and utilization by active muscles. Therefore, it seems important to address the effects of acute exercise, in relation to its intensity and duration, on lipolysis and lipid oxidation.

2.1. Acute intensity effects

Studies conducted in vivo showed an increased lipolytic response in abdominal subcutaneous adipose tissue with increasing exercise intensity [2,3]. This fact could be explained by increasing plasma catecholamines responses and reducing plasma insulin level, leading to increase lipolytic action of β-adrenergic receptors [3,4]. However, in obese subjects this phenomenon appears disturbed in adipose tissue due to increased sensitivity of antilipolytic α2-adrenergic receptors [5] and a decrease of lipolytic β-adrenergic receptors sensitivity [6]. Moreover, at rest the lipolysis is higher in obese subjects [5] leading to increase plasma concentrations of fatty acids that could be partly responsible for increasing cardiovascular risk in this category of individuals. Thus, the lower lipolytic response to exercise would be a protective factor against of excessive release of circulating fatty acids in this population [3].

The proportion of lipids contribution to energy yield depends on exercise intensity. Indeed, Brooks and Mercier [7] showed that more the intensity increases, the percentage of lipid oxidation decreases while that of carbohydrates increases [7]. More recently, some studies reported the existence of a 'zone intensity' in which the lipid oxidation would be optimal and this varies across body weight status [8,9]. Indeed, for Achten et al. [8] the high lipid oxidation rates appeared at intensity between 55 and 72% of maximal aerobic power (MAP) in normal-weight trained subjects. However, for overweight and sedentary persons, the higher contribution of lipids is situated at intensity corresponding to 30—50% of MAP [9].

Other authors suggested that in overweight and obese subjects higher intensity exercise (> 75% of MAP) could promote the lipid oxidation not during the exercise but at postexercise period [10]. Then, this model of exercise could be considered as a valuable strategy for obesity management. More recently, Pillard et al. [11] have observed this phenomenon in overweight subjects even after food intake. Indeed, the lipid oxidation rates following an intense exercise (75% of maximal oxygen consumption (VO_2max)) exceeds that of a moderate exercise (35% of VO_2max). For these authors, this fact could be related to a preferential use of lipids after the completion of exercise for 24 to 48 hours. In fact, carbohydrates are preferentially used to replenish intramuscular glycogen stores depleted during an intense exercise and muscle triglyceride content continued to decrease in parallel to spare the use of muscle glycogen stock [12].

Finally, the combination of an exercise model optimizing the lipids use during practice periods with high intensity exercises to increase in a long term the lipid oxidation

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