EFFECT OF AEROBIC VERSUS RESISTIVE EXERCISES ON ENERGY EXPENDITURE IN SEDENTARY MALES

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ABSTRACT

Purpose: The study was conducted to compare between the effect of aerobic versus resistive exercises on energy expenditure in sedentary overweight males**.** **Subjects**: Thirty overweight males with age ranged from 18-25 years, their body mass indices ranged between 25-30 kg/m^2. Methods: Subjects were randomly assigned to two equal groups. Aerobic training group and circuit weight training group. Both groups trained 3 times per week for 12 weeks. The aerobic training was in the form of interval training at 75-85 % of maximum heart rate, and the circuit weight training composed of 11 stations of resistive exercises performed at 70-80% 1RM with 30 seconds rest in between. The subjects underwent cardiopulmonary exercise test to measure VO_{2max}, energy expenditure and time to fatigue before and after the training programs. **Results**: For aerobic training group, there was a significant increase in VO_{2max} by 22%, energy expenditure by 24% and time to fatigue by 41% after training. For circuit weight training group, there was a significant increase in VO_{2max} by 16%, energy expenditure by 16% and time to fatigue by 29% after training. Regarding comparison between the two groups, the aerobic training group revealed a significant increase in all measured variables than the circuit weight training group. **Conclusion**: Both aerobic training and circuit weight training are effective interventions to increase VO_{2max}, energy expenditure as well as time to fatigue in overweight sedentary subjects. However, the aerobic training is more effective than circuit weight training in improving those variables for overweight sedentary subjects.

Key words: aerobic exercise, resistive exercise, energy expenditure, VO_{2max}, overweight sedentary males

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LIST OF ABBREVIATIONS

DIT	Diet-induced thermogenesis
RMR	Resting metabolic rate
REE	Resting energy expenditure
TEE	Total energy expenditure
VO_{2max}	Maximum oxygen consumption
CWT	Circuit weight training
RT	Resistance training
PHEE	Physical activity energy expenditure
KCAL	Kilocalories
EPOC	Excess post exercise oxygen consumption
BF%	Body fat percentage
FFW	Fat free weight
HR	Heart rate
TEF	Thermic effect of feeding
ATP	Adenosine triphosphate
CP	Creatine Phosphate
GH	Growth hormone
CO	Cardiac output

a-vO_2 dif	Arteriovenous oxygen difference
PFK	Phosphofructokinase
LDH	Lactate Dehydrogenase
BMI	Body mass index
WHO	World Health Organization
ACSM	American College of Sports Medicine
RM	Repetition maximum
CT	Continuous training
IT	Interval training
ADP	Adenosine Diphosphate
AMP	Adenosine Monophosphate
1-RM	One repetition maximum

تأثير التمارين الهوائية مقابل تمارين المقاومة على استهلاك الطاقة لدى الذكور غير النشيطين. أحمد مهدى أحمد، معيد بقسم العلاج الطبيعي لاضطرابات الجهاز الدوري التنفسي والمسنين، كلية العلاج الطبيعي، جامعة القاهرة. المشرفون: **أ.د./زهرة محمد حسن سرى**، أستاذ مساعد بقسم العلاج الطبيعي لاضطرابات الجهاز الدوري التنفسي والمسنين، كلية العلاج الطبيعي، جامعة القاهرة. **د/شيرين حسن مهنـي**، مدرس بقسم العلاج الطبيعي لاضطرابات الجهاز الدوري التنفسي والمسنين، كلية العلاج الطبيعي، جامعة القاهرة. درجة الماجستير – ٢٠١٠.

المستخلص

الهدف من هذا البحث هو مقارنة استهلاك الطاقة الناتجة عن التمارين الهوائية مقابل استهلاك الطاقة الناتجة عن تمارين المقاومة لدى الذكور غير النشيطين. وقد أجرى هذا البحث على ثلاثين طالباً مصابون بزيادة الوزن من كلية العلاج الطبيعي، جامعة القاهرة، تتراوح أعمارهم من ١٨ إلى ٢٥ سنة وقد تم تقسيمهم إلى مجموعتين متساويتين: مجموعة (أ) مجموعة التمارين الهوائية ومجموعة (ب) مجموعة تمارين المقاومة. وكانت مدة برنامج التمرينات فى كلتا المجموعتين ١٢ أسبوعاً بمعدل ٣ مرات أسبوعياً. وقد تم قياس أقصى معدل لاستهلاك الأكسجين واستهلاك الطاقة والوقت المستنفذ لحدوث الإرهاق من خلال اختبار الجهاز الدورى التنفسى قبل بدء الدراسة وبعد الانتهاء منها. وقد أثبتت النتائج زيادة ذات دلالة إحصائية فى كلتا المجموعتين بالنسبة لكل المتغيرات التى تم قياسها قبل بدء الدراسة، وبمقارنة النتائج بين المجموعتين معاً أثبتت الدراسة أن تأثير التمارين الهوائية له أفضلية ذات دلالة إحصائية على تمارين المقاومة فى زيادة أقصى معدل لاستهلاك الأكسجين واستهلاك الطاقة والوقت المستنفذ لحدوث الإرهاق.

الكلمات الدالة: التمارين الهوائية، تمارين المقاومة، استهلاك الطاقة، الذكور المصابون بزيادة الوزن، أقصى معدل لاستهلاك الأكسجين، الوقت المستنفذ لحدوث الإرهاق.

CHAPTER I
INTRODUCTION

Total energy Expenditure is made up of three components: resting metabolism, diet-induced thermogenesis (DIT), and physical activity. Resting metabolic rate (RMR) is defined as the energy expenditure necessary to maintain the physiological processes in the post-absorptive state and depending on the level of physical activity may represent approximately 60 to 70% of total energy expenditure. DIT refers to the increase in metabolic rate above resting levels due to food intake and corresponds to approximately 10% of total energy expenditure. Physical activity is a variable component and is related to the energy expenditure necessary for skeletal muscle activity. In sedentary individuals it represents approximately 15% of total energy expenditure, whereas in physically active individuals this can reach 30% **(Meirelles and Gomes, 2004).**

Resting energy expenditure (REE) is very important because it represents a significant share of the total energy expenditure. Up to 80% of daily energy expenditure occurs at rest and relative to adipose tissue, lean body mass has a high basal metabolic rate. Hence, preservation of or increasing lean body mass is an effective way of increasing daily energy expenditure and thereby decreasing fat mass **(Klijin et al., 2007).**

Overweight and obesity are important public health problems and are associated with many serious health conditions. The risk of developing overweight and obesity depends on lifestyle factors such as food intake and physical activity levels. Treatment for overweight and obesity therefore commonly involves diet and exercise. Exercise has been demonstrated to have a positive effect on body weight and cardiovascular disease risk factors in people with overweight or obesity. Exercise also improves health even if no weight is lost **(Shaw et al., 2006).**

Evidence indicates that weight loss is qualitatively more effective when obtained by physical activity rather than diet only. Any type of resistive exercise that improves lean body mass should elicit a reduction in body weight since this body composition component is positively associated resting energy expenditure (REE). On the other hand, aerobic exercise might be used to directly oxidize fat. In this respect, circuit weight training (CWT), a type of resistive exercise characterized by working different muscle groups on each using a mixed metabolism, and aerobic exercise are two types of exercise that can be used for the prevention or the treatment of obesity. CWT and aerobic exercises have been associated with weight loss, maintenance of (REE), and an increase in VO_{2max}. CWT is also related to strength gain **(Fett et al., 2009)**

Individuals who regularly participate in aerobic exercise have higher body composition-adjusted REE than those who are

sedentary, at least in part, because of increased sympathetic tone **(Hunter et al., 2006**).

Aerobic exercise training has been associated consistently with increased fat mass losses but has only a limited effect on maintenance of fat free mass **(Hunter et al ., 2008**).

Resistance training (RT) induces an increase in skeletal muscle mass, the primary tissue for glucose and triglyceride metabolism; therefore it contributes to the maintenance of or increases in basal or resting metabolic rate. Such an increase in metabolic rate may substitute for the increase in caloric expenditure produced by aerobic training, thus assisting in weight control. Conventional resistance training consists of lifting heavier weights with longer rest periods (a greater anaerobic component), whereas circuit weight training consists of lifting lighter weights with shorter rest periods between exercises, introducing a greater aerobic component to the workout **(Mark et al., 2007).**

Endurance exercise is traditionally viewed as the primary means of increasing aerobic capacity. Resistance exercise, in contrast, is not typically viewed as a primary means for improving cardiorespiratory endurance **(Vincent et al., 2002)**

Energy expenditure is transiently increased due to the direct and short term carryover effects of physical exercises. However, a body of literature has accumulated and suggested that exercise training