

Effects of the Retraining in Endurance on Anthropometric and Metabolic Profiles' Evolution of the Tunisian Obese Pubescent Boys

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Abstract: Fifty-three Tunisian obese pubescent boys (15.4 ± 1.7 years, 96.4 ± 13.2 kg, 1.71 ± 0.1 cm) were submitted to a retraining program in endurance for two months which includes three sessions of 45 minutes per week of pedalling on an ergometer cycle and this to assess the effects on anthropometric and metabolic profiles. Our results showed that the retraining in endurance beneficially affects the above parameters such as reflected by the reduction of BMI, and abdominal and hip perimeters decrease. These changes were also accompanied, firstly by the reduction of the levels of glucoses, total cholesterol, LDLc and triglycerides, and secondly by the increase of HDLc amount which has reduced the LDLc/HDLc ratio. A reduction in levels of pro-inflammatory cytokines namely the IL-6 and TNF- α was also observed. We conclude that the retraining in endurance reduces the weight load of the Tunisian obese pubescent boys and improves their metabolic profiles.

Keywords: Childhood Obesity; pubescent boys; retraining in endurance; anthropometric and metabolic profiles

I. Introduction

Obesity is considered more and more a global problem and affects both young people and older. It is characterized by overweight resulting from a surplus of energy consumption and lack of physical exercises (Must *et al.*, 1999). This anomaly often promotes a large number of diseases which are mainly metabolic, cardiovascular, endocrinologist and inflammatory orders even psychological, and worsening especially as the body mass index (BMI) becomes more important (Rossner and Hallberg, 1978; Cornier *et al.*, 2008).

Physical activity mainly in endurance plays an important role in weight control and thus promoting energy expenditure (Foshini *et al.*, 2007; Grier *et al.*, 2007). Indeed, the sensitivity of adipose tissue to lipolytic action increases thereby favoring the release of fatty acids and therefore their oxidation mainly in oxidative muscles. However, in children and pubescent, ages often characterized by the development of glycolytic muscles; thereby reducing aerobic capacity and therefore complicates the lipid oxidation and loss of weight (Zunquin *et al.*, 2006). Also, Ross *et al.* (2000), Dumortier *et al.* (2003) and Giannopoulou *et al.* (2005) reported that weight loss or abdominal fat caused by regular exercise and/or diet would improve the glucose intolerance as the insulin resistance in type 2 diabetics and obese people.

The objective of this study was to assess the effects of the retraining in endurance for eight weeks on anthropometric and metabolic profiles' evolution of the Tunisian obese pubescent boys.

II. Materials and methods

Participants

This study was approved in advance by the Regional Ethics Committee was carried out on a carefully selected population of 53 Tunisian obese pubescent boys (15.4 ± 1.7 years, 96.4 ± 13.2 kg, 1.71 ± 0.1 cm) and this to assess the effects of the retraining in endurance on an ergometer cycle on anthropometric and metabolic profiles. The inclusion criteria were a sedentary lifestyle, excess weight, age ranging from 12 to 18 years and a commitment to follow the program of physical activity in a weight room. The exclusion criteria were the absence of cardiovascular, hepatic, renal, endocrine or psychiatric pathologies, no taking medication affecting body weight, no restrictive regime during the previous year, a sufficient motivation to pass a test maximum effort (VO₂max) and no physical handicaps. The participation to the study was voluntary, anonymous and confidential. Throughout the period of submission to retraining program in endurance, athletes followed a life strict hygiene similar favourable to the decrease in weight and the preservation of lean body mass (Brandou *et al.*, 2003).

Physical tests and retraining in endurance

The selected subjects for the study were submitted to a retraining program in endurance during two months which includes three sessions of 45 minutes per week of pedalling on an ergometer cycle with intermittent relaxations of five minutes once the maximum heart rate for each individual is reached and is maintained for ten minutes. The maximum lipid oxidation level (LipoxMax) to the exercise was evaluated by the cardio-respiratory test (Brown *et al.*, 2007). It consists in determining on bicycle ergometer the appropriate levels of heart rate (FCLM) and VO_2 which the lipid oxidation of each subject is up following the increase in workload in increments of 6 minutes at 20, 30, 40, 50 and 60% of the theoretical maximum power. Anthropometric and metabolic profiles of the subjects were thus assessed as before and after physical retraining program.

Anthropometric and metabolic profiles

Anthropometric profile

The amounts of fat mass, lean mass and total body weight of each subject were determined by dual-energy X-ray absorptiometry method (DEXA) (version 6.1 0.0 19; General Electric Lunar Corporation, Madison, WI) (Pietrobelli *et al.*, 1996). The participant should remain lying on an examination table while an X-ray to low density swept his body for 10 minutes. The exposure amounts to 0.03 millirems for DEXA, which is less than the natural ambient exposure per day which is less than the maximum allowed dosage 5 millirems per year. The correlation coefficient for the fat mass and the lean body mass was 0.98 ($n = 53$). The standing height was measured using a stadiometer (Perspective Enterprises, Portage, MI).

The abdominal and hip perimeters were measured using a flexible and inelastic measuring tape with an accuracy of 0.5 cm. The abdominal circumference was measured above the iliac crests on each side of the participant body. However, the hip circumference was measured at the level of the symphysis pubis and the maximum circumference of the buttocks (Kim *et al.*, 2006). The measurements were taken three times and the average was retained unless value differs extremely from the other two. In this case, the value that was different was excluded and the average was made from the other two. The body mass index (BMI) was calculated as body weight (kg)/height (m^2) (Bertin *et al.*, 2000).

Metabolic profile

The blood tests were performed on an empty stomach between 7.00 and 7h30 min by a nurse using a venous catheter implanted in the antecubital vein. The samples were immediately aliquoted and stored at $-80^{\circ}C$ until analysis. The biology of routine was assayed at the Service of Biochemistry of the University Hospital Center of Habib Bourguiba, Sfax. The total cholesterol, triglycerides, glucose were determined by dry-chemistry assay (Ektachem 700, Kodak) (Yamada *et al.*, 2002), the HDL-cholesterol (HDLc) was also determined by the same method, after precipitation of the LDL with dextran sulfate 50 000 D, 0.9 g/l, in the presence of magnesium chloride, 45 mmol/l. The LDL-cholesterol (LDLc) was evaluated by the Friedewald formula for samples with triglyceride concentrations were below 4 mmol/l (Friedewald *et al.*, 1972). The levels of pro-inflammatory markers, interleukin-6 (IL-6) and Tumor Necrosis Factor-alpha (TNF- α) were determined by the ELISA technique (Hawkes, 1999).

Data analysis

The analysis of variance (ANOVA) of results was made following a randomly complete block design (Snedecor and Cochran, 1957) by the GLM procedure of the SAS statistical package (SAS Institute, 1989). Homogeneity of variance was verified by the standard Bartlett test (Anderson and McLean, 1974).

III. Results

The formatting programs of the Tunisian obese pubescent boys began by determining the levels of this LipoxMax and advocate for each of them a retraining program in specific endurance. The average values thereof were in the range of 125.8 ± 12.6 mg/min.

Table 1 shows the anthropometric profile of the subjects before and following the retraining program in endurance on an ergometer cycle for two months at the rate of three sessions of 45 min per week. Levels of body mass, BMI, abdominal and hip perimeters, and fat mass of the subjects decreased after two months of the retraining in endurance. However, the lean body mass increases. However, these variations are not statistically significant ($Pr \leq 0.05$).

The levels of glucose, triglycerides, total cholesterol, LDLc of the patients decreased following the retraining program in endurance on an ergometer cycle for two months at the rate of three sessions of 45 min per week against that of the HDL that increases. However, these variations are not statistically significant ($Pr \leq 0.05$).

Table 1. Mean values \pm standard deviations of anthropometric profile of the Tunisian obese pubescent boys measured before and following

the retraining program in endurance on an ergometer cycle for two months at three sessions of 45 min/week.

Profiles	Retraining in endurance	
	Before	After
Body mass (kg)	97.4 ± 11.2	92.3 ± 10.9
Height (m)	1.7 ± 0.1	1.7 ± 0.1
BMI (kg/m²)	33.6 ± 4.1	31.9 ± 3.2
Abdominal perimeter (cm)	102.2 ± 11.0	98.2 ± 11.2
Hip perimeter (cm)	117.9 ± 11.5	114.1 ± 9.0
Fat mass (kg)	35.3 ± 8.0	31.3 ± 8.8
Lean mass (kg)	61.6 ± 10.4	62.0 ± 9.1

Table 2. Mean values ± standard deviations of metabolic profile of the Tunisian obese pubescent boys measured before and following the retraining program in endurance on an ergometer cycle for two months at three sessions of 45 min/week.

Profiles	Retraining in endurance	
	Before	After
Glucose (mmol/L)	4.96 ± 0.3	4.58 ± 0.4
Total Cholesterol (mmol/L)	3.9 ± 0.7	3.1 ± 0.7
HDLc (mmol/L)	0.9 ± 0.1	1.2 ± 0.1
LDLc (mmol/L)	2.7 ± 0.7	2.1 ± 0.7
LDLc/HDLc	2.8 ± 0.7	2.0 ± 0.7
Triglycerides (mmol/L)	1.4 ± 0.4	0.9 ± 0.3

The levels of IL-6 and TNF-α of the subjects decrease following the retraining program in endurance on an ergometer cycle for two months at the rate of three sessions of 45 min per week (Table 3). However, these changes were not statistically significant ($P \leq 0.05$).

Table 3. Mean values ± standard deviations of pro-inflammatory profile of the Tunisian obese pubescent boys measured before and following the retraining program in endurance on an ergometer cycle for two months at three sessions of 45 min/week.

Profiles	Retraining in endurance	
	Before	After
Interleukine-6	9.71 ± 3.28	8.9 ± 2.2
Tumor Necrosis Factor alpha	11.40 ± 3.25	10.3 ± 2.2

IV. Discussion

Childhood obesity is defined as abnormal or excessive fat accumulation. It has become nowadays a global problem most often connected to social-economic development of the countries concerned and is a true marker of the cardiovascular prevalence risk and other diseases (Speiser *et al.*, 2005). This metabolic abnormality involves genetic factors whose expression is often favoured by a sedentary lifestyle and changing dietary habits in obese (Dietz *et al.*, 1994; Wiecha *et al.*, 2006). Regular physical activity associated with caloric restriction can often increase daily energy expenditure and reduce overweight subjects (Eliakim *et al.*, 1996; Lemmens *et al.*, 2008).

We have recommended in our study a specific rehabilitation program for each Tunisian obese pubescent boys participating as a result of the determination of the LipoxMax levels and this to further enhance the beneficial effects of the retraining program in endurance. Our study showed that retraining in endurance positively affects the anthropometric and metabolic profiles of the Tunisian obese pubescent boys. Indeed, a reduction in body weight and therefore the BMI of patients resulting from the decrease in fat mass was observed at the end of physical retraining program period on ergometer cycle. These changes were also accompanied by the abdominal and hip' perimeters decrease and the preservation of the patients' lean body mass. Such observations have been reported by Goran *et al.* (1999) and Ben Ounis *et al.* (2008) on obese children following the training effort. Thus, Pouchain *et al.* (2007) reported that the increase in the size of abdominal perimeters in

children results from the accumulation of fat, which may cause metabolic complications such as insulin resistance, diabetes, dyslipidemia and atherosclerosis (NHLBI, 1998).

Our study showed that the retraining in endurance reduces the levels of glucose, total cholesterol, LDLc and triglycerides, while it increases that of HDLc. This induced the reduction of the LDLc/HDLc ratio. Such results are consistent with those reported by Meyer *et al.* (2006), Natarajan *et al.* (2003) and Schmitz *et al.* (2002) who also indicated that the control of these metabolites by physical exercise significantly reduces the problems of atherosclerosis and diabetes in obese. Indeed, aerobic exercise which operates at a level of maximum LipoxMax promotes the lipid oxidation and its derivatives as well as of the glycogen (Brandou *et al.*, 2003; Steinberger and Daniels, 2003; Zunquin *et al.*, 2006).

Our study showed that the concentrations of IL-6 and TNF- α , two pro-inflammatory cytokines produced mainly in adipose tissue, decreased in obese subjects following the retraining program in endurance. Such results have been reported by Clements *et al.* (2004). These two substances have always been associated with cardiovascular disease, stimulation of the hepatic secretion of triglycerides, reducing of the effects of insulin etc. in the obese (Arnaud, 2006).

In conclusion, this study shows that the retraining in endurance on an ergometer cycle reduces the weight load of the Tunisian obese pubescent boys and improves their metabolic profiles.

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