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Training at Different Intensities as a Means of Preventing Overweight and Obesity in Children

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Abstract

This study aims to determine the effectiveness of a training programme designed to reduce excess weight and prevent obesity in children. A training programme consisting of exercises of varying intensity, mainly based on high-intensity interval training (HIIT), to reduce excess weight and prevent obesity in children. The programme was intended for children under the age of 17 (boys and girls). We worked with a sample of 30 children (15 boys and 15 girls). The programme ran for 10 weeks, with an average of 4 sessions per week. It targeted body composition (fat mass and lean mass) and aerobic power. The research results confirm that HIIT (High-Intensity Interval Training) is very effective in combating obesity in young people because it burns a lot of fat, including visceral fat, improves cardio-metabolic fitness, increases muscle mass (which consumes more energy), and can even improve self-esteem, but it must be adapted to age and physical condition.

Keywords: *HIIT, Children, Fat Mass, Lean Mass, Overweight, Obesity, VO2 max*

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Introduction

The widespread increase in the prevalence of obesity has been described as an 'epidemic' by the World Health Organisation (WHO, 2003; Inserm, 2000). This worrying situation affects industrialised and developing countries, adults and young people alike. Because it helps to regulate energy expenditure, physical activity appears to be an essential factor in counteracting the energy imbalance that leads to weight gain and the development of obesity. In this area, particularly among adults, current data indicate that the amount of physical activity required to prevent weight gain or prevent weight regain after weight loss is higher than that obtained by applying the physical activity recommendations for the general population. However, physical activity has beneficial effects on health regardless of its effects on body weight itself, and this applies to people who are already overweight or obese.

The gradual increase in body weight leading to obesity is, broadly speaking but inevitably, the result of a long-term imbalance in energy intake and expenditure. This positive energy balance reflects an imbalance between energy intake and energy expenditure. This situation is primarily the result of changes in the most immediate mediators of energy balance, namely dietary habits and physical activity patterns (WHO, 2000). It should be emphasised that this apparent simplicity in no way reduces the complexity of the pathophysiology and clinical management of obesity. Indeed, the many factors at play – biological, behavioural and environmental – can be considered as modulators of the energy balance that determine variations in weight and body composition.

Even minor but prolonged changes in the usual level of physical activity or dietary intake can have significant consequences for body weight and the prevalence of obesity in the population (Hill et al., 2003). For example, according to calculations by Hill et al. (2003), an increase in energy intake or a decrease in

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energy expenditure through physical activity of only 100 kcal per day could theoretically be sufficient to explain the average weight gain in the United States over the last ten years. However, such minimal changes are difficult to measure using existing methods, particularly the survey instruments available for assessing dietary habits and physical activity patterns in the population.

Time spent in sedentary activities, regardless of usual levels of physical activity, is associated with weight gain over time, as indicated by the results of various prospective studies. For example, in the US Nurses' Study, it was shown that an additional two hours spent watching television was associated with a 25% increase in the risk of becoming obese after six years of follow-up.

Importantly, this association was independent not only of usual levels of physical activity but also of dietary intake. However, it is likely that the influence of sedentary behaviours on weight gain is mediated, at least in part, by associations between sedentary behaviours and other health behaviours such as smoking and alcohol consumption, which are known to tend to cluster together.

Research on Children

Dr Antoine Périe states that the relationship between sedentary lifestyles and obesity in young people has been the subject of a recent literature review by Must and Tybor (2005), which concluded, based on prospective studies, that increased physical activity and reduced sedentary behaviour protect children and adolescents from weight gain. Although the relative risk of developing obesity, represented by the odds ratio, is not always significant, the study by Gortmaker et al. (1996) shows that the risk of being overweight is 4.6 times higher for children who watch television for more than 5 hours a day compared to children who spend less than 2 hours a day in front of the screen. Similarly, among young Australian children (aged 6), the risk of becoming overweight by the age of 8 increases by 40% for each additional hour spent watching television (Burke et al., 2005). This relationship remains significant after adjusting for birth weight, maternal body mass index, maternal smoking status and level of physical activity. The link between declining physical activity and increasing obesity has been widely observed (Kimm et al., 2005).

Furthermore, several cross-sectional and longitudinal studies support the link between physical inactivity and fat mass, confirming the relationship between physical inactivity and obesity in young people and the inverse relationship with physical activity; although weak, the statistical relationships are mostly significant (Marshall et al., 2004; Must and Tybor, 2005; Wareham et al., 2005). Abbott and Davies (2004) observed an inverse statistical relationship between physical activity levels and overweight (BMI: $r=-0.45$, $p<0.001$ and fat mass: $r=-0.43$, $p<0.002$) in children aged 5 to 10 years. Furthermore, this inverse association between physical activity and obesity is more strongly demonstrated with the intensity of physical activity than with the total amount of activity (Ness et al., 2007). The Framingham longitudinal study reports, after 1 year and 8 years of follow-up of children aged 3 to 5 years at the start of the study, lower body size and adiposity in the most active children compared to the most sedentary children (BMI: 18.6 versus 20.3 and sum of skinfolds: 74.1 versus 95.1 respectively) (Moore et al., 1995 and 2003). Thus, it has been proven that obese children are less active than their normal-weight counterparts regardless of gender (Page et al., 2005). However, the studies used in meta-analyses (Marshall et al., 2004) or in review articles (Must and Tybor, 2005)

Physical Activity and Obesity:

Wareham et al., 2005) do not allow us to determine whether reduced physical activity is the cause or consequence of excess weight in children and adolescents. Further studies are needed to establish the real relationships between physical activity, sedentary lifestyles and obesity in children and adolescents.

Recently, Taveras et al. (2007) studied the possible relationships between indicators of sedentary behaviour, such as hours spent watching television, and physical activity in pre-adolescents aged 10 to 15. The results show no significant relationship between changes in sedentary behaviour (reduction in hours spent watching television) and physical activity. Thus, one hour less per week spent watching television results in only a small increase (2 minutes) in moderate to vigorous physical activity.

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These findings reinforce the idea that physical activity and sedentary behaviour are indeed different concepts and that an effective strategy requires intervention to reduce sedentary behaviour and increase physical activity (Ekelund et al., 2006).

A high level of cardiorespiratory fitness during childhood or adolescence is associated with a lower percentage of body fat and a lower cardiovascular risk profile (Brage et al., 2004). According to a recent review (Must and Tybor, 2005), data from prospective studies in young people suggest that increased physical activity and decreased sedentary behaviour protect against weight gain during childhood and adolescence. However, these effects were considered to be modest in magnitude. Interestingly, some data suggest that the usual level of physical activity during childhood or adolescence is associated with body composition in adulthood (Wareham et al., 2005).

Some longitudinal studies suggest that low cardiorespiratory fitness during childhood and adolescence is associated with various cardiovascular risk factors later in life, such as high blood pressure, dyslipidaemia and obesity. Taken together, these data argue in favour of implementing preventive measures at an early stage.

The problem of overweight and obesity is growing steadily and affecting increasingly younger populations, regardless of a country's economic status. One of the main causes is lack of physical activity. The reason often cited by patients with weight problems is lack of time.

Physical activity is part of the weight loss process. Maintaining good physical condition and preserving muscle mass are key to a successful diet.

HIIT training In recent years, studies in exercise physiology have led to a broadening of possible recommendations for useful practices in the management of obesity. Some recent approaches suggest focusing on a negative lipid balance achieved during exercise only. They propose performing exercises at an intensity that maximises fat oxidation, or Fatmax . The rate of lipid oxidation follows an inverted U-shaped curve depending on the intensity of the exercise: it increases at low intensity, reaches a maximum at low to moderate intensity corresponding to 40-60% of VO2 max, then decreases again. The problem, however, lies in the wide variability of the maximum lipid oxidation rate, which is close to 1 g/min in some endurance athletes and barely exceeds resting values, sometimes less than 0.1 g/min, in sedentary individuals. Physical activity prescriptions must therefore be tailored to the patient's physiological and metabolic profile, requiring an assessment of their physical abilities during ergometry and measurement of various biophysical and metabolic parameters.

This individualised, hyper-rationalised protocol approach tends to break group dynamics and offers very little playful creativity in terms of training variables. It appears to be of little relevance to the objective of reinvesting in HDJ practice and regular physical activity for adolescents. Other studies appear more interesting and explore the effects of high-intensity interval training (HIIT). The term 'high-intensity interval training' refers to any training that alternates between short, intense periods of effort and periods of active recovery or total rest. There are many ways to structure HIIT training with exercise and recovery phases of varying lengths. There is no consensus on the optimal form, but there are several empirical protocols, such as the 'Tabata' method, which consists of a 4-minute workout comprising 8 cycles of 20 seconds of intense effort and 10 seconds of rest, or the 'Little' method, which is an 18- or 27-minute workout consisting of 8 or 12 cycles of 60 seconds of sustained effort and 75 seconds of rest. 'Little' method, which is an 18- or 27-minute workout consisting of 8 or 12 cycles of 60 seconds of sustained effort and 75 seconds of rest.

To increase fat loss, there is a special type of exercise called HIIT. An acronym for High Intensity Interval Training, this method consists of short, high-intensity training sessions alternating with periods of rest. Combining HIIT training with fat loss is a real winner. Thanks to this training, your metabolism continues to burn fat after physical exertion.

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This physical exertion brings your heart rate to its maximum, forcing your body to draw on its reserves long after the exercise is over.

The sessions are short, even very short for the Tabata method, lasting between 4 and 30 minutes. They promote muscle building and calorie loss in record time.

HIIT exercises have an impact on health in various areas: -Loss of surface fat;

-Reduction of visceral fat;

-Decrease in BMI (body mass index);

-Decreased insulin resistance.

-Afterburn effect (burns calories after the session).

-Decreased bad cholesterol levels.

-Regulation of blood glucose levels.

-Decreased blood pressure.

-Maintains motivation as part of a low-calorie diet.

-Improved blood circulation.

-Preservation of muscle mass.

The time savings are significant compared to traditional aerobic training, but what about its effectiveness in terms of fat loss?

Objective

The objective of our study is to determine the effectiveness of a proposed HIIT protocol on fat mass loss.

Method

Over a period of 10 weeks, 30 overweight 17-year-olds participated in this experimental protocol. They were divided into two groups: a 'training' group (n = 15) and a 'control' group (n = 15).

The control group did not engage in any physical activity during the study period. The training group exercised four times a week. Each session consisted of alternating 8-second sprints and 12-second active recovery periods for 20 minutes on a cycle. The workload was equivalent to 80-90% of HRMAX at a pedalling cadence of 120-140 rpm. During the recovery phase, participants had to pedal at the same resistance but at a pedalling cadence of approximately 40-50 rpm. All participants were instructed not to change their eating habits during the study.

To study the impact of this type of training, all participants underwent tests at 0, 3, 6, 9 and 10 weeks into the protocol. All the tests performed are described below:

-Fasting blood test: Lipid profile (cholesterol, triglycerides), insulin levels, blood sugar levels and measurement of insulin resistance index (HOMA-IR).

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-VO2MAX: Measurement of maximum oxygen consumption.

- Basal metabolic rate: Energy expenditure at rest, resting heart rate, oxygen and carbon dioxide flow.

-Body composition: Measurement of body mass, total lean mass, total fat mass, abdominal fat mass and trunk fat mass.

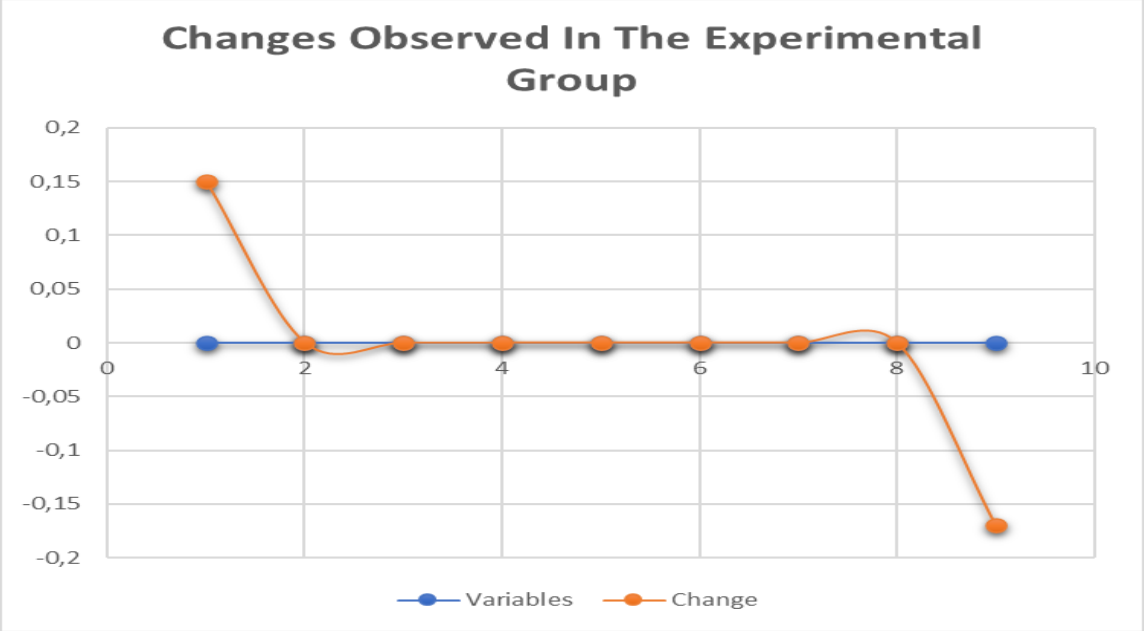
Results

After 10 weeks of HIIT training consisting of 8 seconds of exercise and 12 seconds of recovery for 20 minutes, the main results of this study in overweight young men are presented in the table below.

Tableau 01. Changes Observed in the Experimental Group

	Variables	Change
1	VO2MAX (ml·kg-1·min-1)	15%
2	Total body mass	- 2.5% (- 1.5 kg)
3	Total lean mass	+ 2.6% (+ 1.2 kg)
4	Lean body mass	+ 2.5 % (+ 0.6 kg)
5	Lean leg mass	+ 2.4 % (+ 0.5 kg)
6	Total body fat	- 6.9 % (- 2.2 kg)
7	Abdominal fat mass	- 7.5 % (- 0.23 kg)
8	Trunk fat mass	- 9.1 % (- 1.6 kg)
9	Visceral fat mass	- 18.5 %

Source: Researcher



Source: Researcher

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Discussions

The HIIT protocol led to a significant improvement in body composition (e.g. a decrease in fat mass and an increase in lean mass) and aerobic power. With only 3 x 20 minutes of exercise per week, the gains in terms of visceral fat loss are comparable to a study that lasted months at a rate of 5 hours of aerobic training per week. It has been shown that the reduction in visceral fat mass was associated with an improvement in carbohydrate and lipid metabolism and a reduction in the risk of cardiovascular disease.

The significant gain in lean mass in the legs and trunk is an additional positive argument for encouraging sedentary populations and/or those who are overweight or obese to follow such protocols. Muscle mass loss is generally observed during calorie-deficient diets. It is assumed that this gain in muscle mass may be linked to improved insulin sensitivity.

Finally, the results show a significant decrease in resting heart rate. And although no significant difference was observed in basal metabolism, the 'Training' group showed 15% higher lipid oxidation and lower carbohydrate oxidation.

Moreover, Antoine Périe states that numerous studies now demonstrate the superior effectiveness of interval training methods such as HIIT compared to other aerobic training methods for improving physical fitness. A recent meta-analysis of 264 subjects aged 6 to 17 who were overweight or obese showed that HIIT was the most effective training method in terms of changes in biological parameters.

A high level of cardiorespiratory fitness during childhood or adolescence is associated with a lower percentage of body fat and a lower cardiovascular risk profile (Brage et al., 2004). According to a recent review (Must and Tybor, 2005), data from prospective studies in young people suggest that increased physical activity and decreased sedentary behaviour protect against weight gain during childhood and adolescence. However, these effects were considered to be modest in magnitude. Interestingly, some data suggest that the usual level of physical activity during childhood or adolescence is associated with body composition in adulthood (Wareham et al., 2005).

Some longitudinal studies suggest that low cardiorespiratory fitness during childhood and adolescence is associated with various cardiovascular risk factors later in life, such as hypertension, dyslipidaemia and obesity. Taken together, these data argue in favour of implementing preventive measures at an early stage.

Conclusion

HIIT (High-Intensity Interval Training) is very effective in combating obesity in young people because it burns a lot of fat, including visceral fat, improves cardio-metabolic fitness, increases muscle mass (which consumes more energy), and can even improve self-esteem. but it must be adapted to age and physical condition, incorporating exercises without jumping if necessary and combining it with a balanced diet and psychological support for comprehensive and sustainable management.

Furthermore, HIIT targets total fat mass, subcutaneous fat and, above all, visceral fat, which is linked to cardio-metabolic risks.

It improves cardio-respiratory capacity and resting heart rate.

It stimulates lean mass, which increases basal metabolism, as muscles burn more calories at rest than fat.

Non-impact versions (without jumping) are available, suitable for beginners and younger people who are heavier, reducing the risk of injury.

Success in exercise programmes boosts teenagers' self-confidence.

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This study once again demonstrates the benefits of HIIT training in improving cardiovascular capacity, but above all it highlights the benefits of intermittent exercise on body composition (reduction in subcutaneous and visceral fat) without changing eating habits. In addition, the short duration of a session is a significant advantage when it comes to getting sedentary people to adhere to a fitness programme with a view to improving their health.

It seems illusory to still believe in the urban legend that fat loss is only possible after 40 minutes of continuous low-intensity exercise.

Fat loss is mainly determined by increased activity of the oxidative and glycolytic systems, which is generally observed with high-intensity interval training.

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