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## Rating of Perceived Exertion and Serum Leptin Responses to Maximal Exercise in Obese Female Adolescents: Effects of Exercise Training Intensity

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### Abstract

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Intensive exercise is one of the rarely used solutions to avoid obesity. This study aimed to examine the intensity effect [high-intensity interval training (HIIT) vs. moderate-intensity interval training (MIIT)] in severely obese female adolescents. Twenty one participants (age =  $15.7 \pm 0.9$  years, percentage body fat (%BF) =  $40.0 \pm 1.5\%$ ) were assigned to HIIT: 100%; MIIT: 80% of Maximal Aerobic Speed (MAS) or control group (CG). Training program lasted 12 weeks, with sessions performed 3 times/week on the track. Running distances lasted 15 sec, interspaced with 15 sec active recovery. Body composition was assessed by Bioelectrical Impedance Analysis; blood pressure and rating of perceived exertion (RPE) were measured. Blood samples were collected at fast, and peak oxygen uptake ( $\dot{V}O_{2peak}$ ) was measured breath-by-breath using a calibrated portable telemetric system. All values were taken before starting and after the last training session in the intervention. Both exercise training programs enhanced positively; body composition (body mass, BMI-Z-score, %BF), cardiovascular fitness (blood pressures, resting heart rate,  $\dot{V}O_{2peak}$ ). Both exercise groups decreased plasma glucose ( $p < 0.05$ ), insulin ( $p < 0.01$  and  $p < 0.05$ ; HIIT and MIIT) and leptin ( $p < 0.01$ ). HIIT-group noted greater values in RPE score to maximal exercise (-29.0%,  $p < 0.001$ ) compared to MIIT-group (-14.9%,  $p < 0.05$ ). Overall, HIIT and MIIT induced beneficial changes in leptin sensitivity independently of exercise intensity. However, HIIT can be considered an efficient approach in decreasing the RPE score compared to MIIT, which may reduce the effort hardness and the drop-out from exercise in severely obese female adolescents.

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**Keywords:** Enjoyment; post exercise; energy expenditure; satiety; obesity.



## 1. Introduction

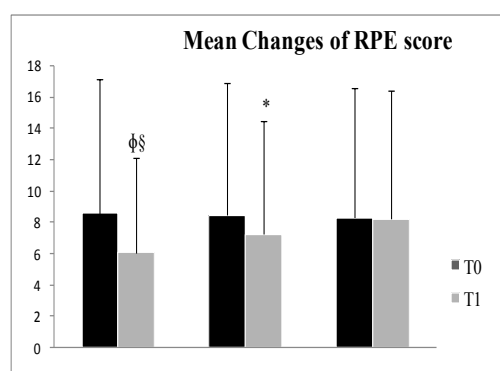
Previous studies on adolescents reported that interval training (IT) has proven to be the preferred method compared to long constant intensity endurance training (Boutcher, 2011; Crisp et al., 2012). The optimal exercise intensity prescription for achieving body fat loss and thereby decreasing leptin level for the obese has not yet been identified. In addition, the effectiveness of a training program depends on the level of participants' adherence. Recent studies have shown that RPE method is useful (Haddad et al., 2013, 2014). Therefore, the use of RPE method could help trainers to determine the optimal intensity for exercise and to increase the participants' motivation, which could help to avoid the dropping out. The purpose of this study was to investigate whether high-intensity interval training (HIIT) might be an effective intensity for obesity management in severely obese girls, by means of an adaptation of leptin response and the perception of maximal effort as being of lesser hardness.

## 2. Materials and methods

Twenty one obese healthy adolescent females (age =  $15.7 \pm 0.9$  years; Z-score of body mass index (BMI-Z-sc) =  $3.5 \pm 0.5$ ; percentage of body fat (%BF) =  $40.0 \pm 1.5$ ) were assigned to HIIT (n = 7), HIIT (n = 7) and control group (CG, n = 7). Duration-matched sessions were performed in both training groups. The %BF was assessed using bioelectrical impedance analysis (TBF-300, Tanita®, Tokyo, Japan), and resting blood pressures were measured. Rating of perceived exertion (RPE) method (Foster et al., 2001) was used 30 minutes after the achievement of each testing session. Plasma glucose, insulin, and leptin levels were measured in all participants before and after training.

## 3. Results

In both groups, measurements elicited significant post intervention decreases in BMI ( $p < 0.05$ ), %BF ( $p < 0.01$ ) and BMI-Z-score. WC was decreased only in HIIT group (ES = 0.49,  $p < 0.05$ ). Systolic and diastolic blood pressures also decreased in both groups. The RPE score decreased significantly by -29.0% and -14.4% in HIIT and MIIT groups, respectively (Fig. 1).



**Fig. 1.** The mean change of RPE score over 12-weeks in the three groups  
Significantly different within each group in comparison to the pre-test: \* $p < 0.05$

HIIT group decreased the glucose level ( $p < 0.05$ ), leptin, insulin and HOMA-IR ( $p < 0.01$ ), while MIIT group significantly decreased glucose, insulin concentration ( $p < 0.05$ ), leptin and HOMA-IR ( $p < 0.01$ ), as shown in Table 1).

**Table 1.** Blood variables (mean  $\pm$  SD) before (pre) and after (post) the interventions

	HIIT ( $n = 7$ )			MIIT ( $n = 7$ )			CG ( $n = 7$ )		
	Pre	Post	p value	Pre	Post	p value	Pre	Post	p value
Glucose (mmol l <sup>-1</sup> )	4.8 $\pm$ 0.5			4.9 $\pm$ 0.2			4.6 $\pm$ 0.4		
	4.6 $\pm$ 0.4		0.036	4.7 $\pm$ 0.2		0.047	4.6 $\pm$ 0.4		NS
Leptin (ng ml <sup>-1</sup> )	24.1 $\pm$ 3.5			25.0 $\pm$ 3.1			21.0 $\pm$ 2.1		
	18.6 $\pm$ 2.1		0.008	19.1 $\pm$ 3.6		0.001	21.4 $\pm$ 2.4		NS
Insulin ( $\mu$ U ml <sup>-1</sup> )	22.0 $\pm$ 1.9			21.6 $\pm$ 2.1			20.0 $\pm$ 1.95		
	16.3 $\pm$ 0.84 <sup>§</sup>		0.001	17.3 $\pm$ 1.5		0.018	19.2 $\pm$ 1.96		NS
HOMA-IR	4.71 $\pm$ 0.74			4.67 $\pm$ 0.54			4.11 $\pm$ 0.62		
	3.34 $\pm$ 0.41 <sup>§</sup>		0.002	3.6 $\pm$ 0.4 <sup>§</sup>		0.005	3.92 $\pm$ 0.63		NS

*p* value: significantly different within each group, before vs. after program

HOMA-IR: homeostasis model assessment index for insulin resistance

Significantly different from control:  $p < 0.05$

#### 4. Discussions and conclusions

The findings of the present study attested that both training groups decreased their plasma leptin levels significantly. Moreover, RPE score decreased for both training groups and this decrease was significantly higher in HIIT than in MIIT group.

Importantly, peak oxygen uptake was enhanced in both groups due to training intensities which could help obesity management. However, the significant decrease in %BF shown in both training groups is congruent to the results shown in the study of Buchan et al. (2011). This decrease was based more on the intensity and training duration, as evocated by Paoli et al., (2012). Such a decrease is important at that age, since it was followed by a blood pressure decrease related to low insulin resistance (Montani et al., 2002); this suggests a possible reduction of hypertension prevalence in obese adolescents. Further, both training modalities enhanced positively the plasma leptin levels which were based on supplementary energy expenditure leading to the body fat mass decrease. As recently demonstrated (Alkahtani et al., 2013), the interval training intensity in the current study (HIIT and MIIT) helped to decrease fasting plasma glucose levels in both groups. This is due to the enhancement of insulin sensitivity (Host et al. 1998), shown in the following study by a decrease in HOMA-IR. Further, the results of the present study demonstrate that obese participants prefer the short running distances which are interspaced by recovery periods. Hence, both groups' participants were able to perceive maximal exercise intensity as less difficult compared to the beginning of the intervention. This noted decrease encourages obese participants to adhere to exercise practice. In this context, we have to note that HIIT group had the greater decrease in the RPE score, which corroborates with the findings of a recent study (Alkahtani et al., 2013).

Therefore, we can conclude that the two types of training program reflected a decrease in plasma leptin levels. Furthermore, both training models seem to be effective in triggering of leptin adjustments and may be used as an efficient and safe strategy to prevent obese youth of being affected by type-2 diabetes and cardiovascular diseases. However, it may be helpful for young obese to practice HIIT, as significant improvements in exercise enjoyment can occur. Particularly, HIIT might be a reasonable approach to strengthen the enjoyment for the long term in severely obese adolescent females compared to the MIIT.

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