

HIGH INTENSITY INTERVAL TRAINING DOES NOT CHANGE THE AREA IN THE ADIPOCYTES OF THE EPICARDIUM OF FAT RATS

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Abstract

The obesity due to high caloric ingestion is related to the accumulation of body fat and predisposes cardiovascular diseases. Recent studies about the High Intensity Interval Training (HIIT) evidence benefits of its practice in patients that maybe carrying this disease, mainly because of the reduction of comorbidities associated with obesity. This present study has the objective of evaluating the HIIT effects on the adipocytes' changes of the epicardium adipose tissue in fat animals induced by the consumption of high-fat diet. It was used male rats of Wistar lineage fed daily with HFD and trained by HIIT three times a week for 8 consecutive weeks. The animals were weighted during the training sections and, after its euthanasia, were realized histological analyses of the epicardium adipose tissue. The results showed that HFD increased the body weight of the animals and the side view of the adipocytes. However, the HIIT did not change the area of the adipocytes of the epicardial adipose tissue, even though the diet had been a hypertrophy factor of this tissue. Then, we can conclude that HIIT contributes to avoid the body weight gain but was not capable of reducing the area of the adipocytes of the epicardium adipose tissue.

Keywords: Adipose Tissue, Epicardial Fat, Physical Exercise

1. Introduction

The obesity is considered a chronic disease, derived of the disbalance between food ingestion and caloric spent. It is directly related to the crescent ingestion of high caloric food (with exacerbated grease content and sugar) such as the Fast Food and it has been considered one of the main risk factors for many diseases, mostly the cardiovascular ones¹. In general, the heart diseases are related to the events which compromise the blood flow to the heart, considering that the most common etiology is that irrigate this organ². Among the heart layers, excess fat (atheroma) is placed in a subendothelial region in the arteries the epicardium (visceral



pericardium) is mainly constituted by an adipose tissue which can have its thickness increased by obesity, associated to cardiovascular diseases³. Furthermore, the HFD has been very used in animal's models, turning itself efficient for the study of the physiopathology of the related complications due to obesity, such as cardiovascular diseases⁴.

An efficient strategy in the control of obesity is the regular practice of physical exercises⁵, because it improves the corporal composition and endurance the cellular mechanisms that prevent cardiac damages, benefiting the heart function. Among the several types of exercise, the HIIT is highlighted⁶, because it favorably regulates many metabolic functions, causes prominent body weight loss and reduces the adipocytes' length in the inguinal subcutaneous adipose tissue⁷. Its practice comprehends the realization of high intensity exercises, intercalated to low or medium intensity exercises^{6,7}. In this context, the objective of this study was to analyze the HIIT effect above the morphological aspects of the epicardium adipose tissue in the 12-months-old rats under HFD.

2. Material and methods

This study was previously approved by the Ethic Committee of Animal Use of Universidade Estadual de Maringá (CEUA-UEM) under opinion n° 5230050620. 12-months-old male Wistar rats were divided into 4 groups (n=7): TCG (trained control group, fed with standard animal food and trained by HIIT), SCT (sedentary control group, fed with standard animal food and sedentary), HFD-TG (HFD-trained group, fed with HFD and trained by HIIT), HFD-SG (HFD-sedentary group, fed with HFD and sedentary). The training sessions occurred three days a week on alternate days, for 8 weeks. During and after the experimental time, the animals were weighted and thoracotomized to the heart collection, which was removed and fixed in paraformaldehyde at 4% for 48 hours. Next, it was submitted to histological process routine, in order to measure the area of 100 adipocytes belonging to epicardial adipose tissue in each animal in histological sections stained in Hematoxylin/Eosin (HE) and using an image system of analysis (image Pro-Plus 4.0)⁸.



The data were presented as medium \pm standard deviation and were analyzed by variance analysis (ANOVA two-way) only to compare the training effects and diet. The post test of *Tukey* was used to the comparison between the groups, by means of the GraphPad Prism 8® program, values of $p < 0.05$ were considered significant.

3. Results and discussion

3.1 Body weight

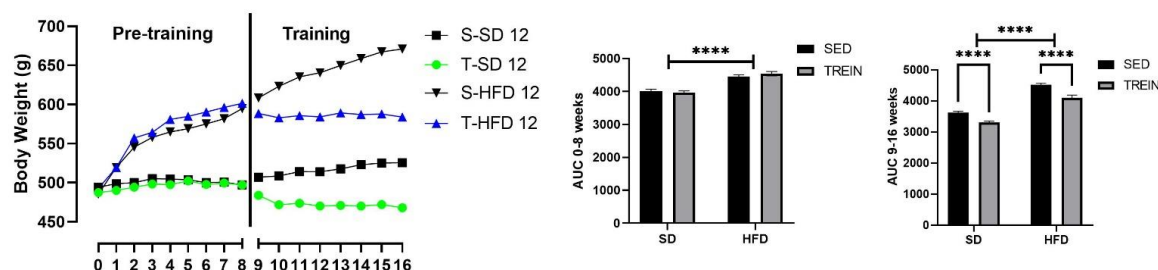


Figure 1. A: Body weight curve before and during the training period. B: Medium \pm standard deviation graph of the area under the curve of the body weight before the training. C: Medium \pm standard deviation graph of the area under the curve of the body weight during the training. ANOVA *two-way* with post-test of *Tukey*, (****) $p < 0.0001$.

Related to the animal weight, the diet and the exercise generated influence in the weight variation curve. It is observed that in the figure 1B the body weight gain of the animals who received the HFD (HFD- TG and SG) comparatively to the animals of standard diet (TCG and SCG) ($p < 0.0001$). Furthermore, during the training period (Figure 1C), there was influence of HIIT, in a way that the trained animal group (TCG and HFD-TG) presented minor body weight when compared to their respective sedentary groups (SCG and HFD-SG) ($p < 0.0001$).

It is worth highlighting that the HIIT was able to suppress the body weight gain of the animals, considering that the trained and HFD animals showed minor body weight. The efficient physical exercise in avoiding the gain of body grease can occur as a consequence of increasing of the lipolysis and β -oxidation of fatty acids, making the organism to use the fat stocks as energetic substrate, mainly in the muscular cells. Furthermore, studies show that after the practice of physical exercises, it is induced the increasing of lipolysis in the adipocytes^{9,10}.



Even though the lipolytic action, the HFD animals still presented bigger body weight during all the experimental period in comparison to the standard fed animals. In general, our results collaborate to other studies which show that the HFD as capable of increasing the tax of lipogenesis and initiate the extra subcutaneous and visceral adipose tissue ^{9,11}.

3.2 Morphometrical analysis of the adipocytes of the epicardium adipose tissue

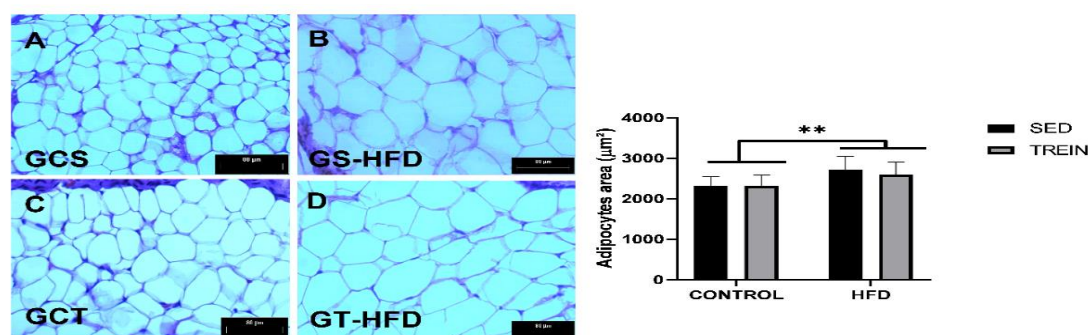


Figure 2. Photomicrography of the unilocular adipocytes of the epicardium adipose tissue stained by Hematoxylin/Eosin (HE) in the objective of 20x. Medium \pm standard deviation graph of adipocytes (μm^2). Anova two-way with post test of Tukey (**) $p < 0.005$.

In relation to the adipocyte area present in the epicardium adipose tissue, also occurred a significant difference to the effect of the diet, in other words, the HFD-SG and TG presented bigger adipocytes than SCG and TCG ($p < 0.005$). In fact, the consume of a grease rich diet as HFD, besides increasing the body weight like previously discussed, can cause hypertrophy in the adipocytes¹². Our data corroborate to the recent study¹³ made by cardiac magnetic resonance and electroanatomic mapping that showed direct relation between obesity and the increasing of the epicardium adipose tissue in all the heart of fat patients and with the systematic review and meta-analyses¹⁴ where the study compares the reduction of the epicardium adipose tissue by exercises, diet and weight loss strategies by bariatric surgery, where it was demonstrated significant reduce of the epicardium adipose tissue due to diet and bariatric surgery but not due to exercise.

4. Conclusion

The data obtained in the present study allow us to conclude that the HFD diet promotes body mass gain and an increase in the area of adipocytes, and that the HIIT training methodology, for 8 weeks in 12-month-old rats, is capable of preventing mass gain. body, however, is not effective in reducing the area of adipocytes. New other studies must be realized in order to elucidate the mechanisms which influence the fat reduction in adipocytes in the epicardium adipose tissue.

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