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# Impacts of combining aerobic exercises with resistance training on chemerin level in obese undergraduates.

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## Abstract

**Introduction: The study compared the impacts of aerobic exercises with the combination of aerobic exercises and resistance training for 16 weeks on chemerin level and blood-fat metabolism in the obese undergraduates, so as to reveal the possible mechanisms of weight loss by exercises.**

**Methods: 36 obese undergraduates were randomly assigned into control group, aerobic exercises group, and combining aerobic exercises with resistance training group.**

**Results: After 16 weeks exercise intervention, the levels of W, BMI, FM. And %F in the two intervention groups lessened much, as well as the levels of serum TG, TCH, LDL-C and chemerin reduced significantly, but the level of serum HDL-C rose much. In addition, the levels of FM, %F and serum chemerin in the combining aerobic exercises and resistance training group decreased more. With correlation analysis, we found that the level of chemerin was correlated positively with Weight (r=0.587, p=0.004), BMI (r=0.623, p=0.003), FM (r=0.722, p=0.004), %F (r=0.586, p=0.002), TG (r=0.514, p=0.013), TCH (r=0.478, p=0.032) and LDL-C (r=0.545,p=0.033) but negatively with HDL-C (r=-0.585, p=0.037).**

**Conclusion: Consequently, the combination of aerobic exercises and resistance training has better effects on weight loss.**

**Keywords:** Aerobic exercises, Resistance training, Obese undergraduates, Chemerin level.

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## Introduction

Some researches discover that adipose tissue can secret a variety of adipocytokines with bioactivity, such as leptin, adiponectin, ghrelin, and visfatin. Chemerin is a new adipocytokine found recently, also called retinoic acid receptor response 2 or tazarotene-induced gene 2, which plays a key role in the development of adipose cells, energy metabolism, and process of inflammatory responses of the obese [1]. As chemerin hasn't been explored in the area of sports area, this article studies the relationship of the obese undergraduates' serum chemerin with their body shape, body fat distribution, blood fat metabolism and the intervention of combining aerobic exercises with resistance training for chemerin level, to provide references for weight loss in the obese undergraduates by exercises.

## Objects and Methods

### *Objects*

We selected 36 obese freshman volunteers (BMI ≥ 28 kg/m$^2$) in Inner Mongolia Medical University. They were randomly assigned into control group (group C), aerobic exercises group (group A) and combining aerobic exercises with resistance training group (group A+R), 12 people a group, and received exercise intervention for 16 weeks. Apart from attending the physical education class demanded by the university, the group C wouldn't take any other exercises, but the other two groups underwent sport intervention in accordance with the exercise scheme.

### *Methods*

**Exercise scheme:** The exercise scheme consisted of aerobic exercises and resistance training. The group A took aerobic exercises only, but the group A+R also took aerobic exercises as well as resistance training. The specific scheme was below:

The group A took aerobic exercises such as aerobics and jogging between 19:30 ~20:30, of which exercise intensity was controlled under 60%-70% of maximal heart rate, three times a week, 60 min per times (5 min warm-up, 50 min exercises, 5 min cool-down). They were monitored with heart rate chart and self-detected their pulse.

While the group A+R took 40 min aerobic exercises and 20 min resistance training, 60 min in total. The resistance training included flexion and extension of shoulder joints, elbow joints, hip joints, knee joints, and muscles of trunk, with a density of 60%-70% repetition maximal load, three groups a time. Each group comprised 6 movement links, and each link repeated 6-8 times. This research was approved by the human ethical committee of our institution.

**Measurement of weight (W), body mass index (BMI), body fat percentage (%F) and fat mass (FM):** We measured the participants W. BMI, %F and FM at the day before the intervention and the second day after the intervention.

**Measurement of blood fat indexes and serum chemerin:** The participants in three groups under fasting were collected venous blood 5 ml in the morning of the day before the 16 weeks exercise and the second day after the exercise end. With separated serum, the blood samples were stored at -60°C. The serum Triglyceride (TG), Total Cholesterol (TCH), High Density Lipoprotein Cholesterol (HDL-C), and Low Density Lipoprotein Cholesterol (LDL-C) were tested by an automatic biochemistry analyzer, and the testing kit was supplied by Nangjin Jiancheng Biotechnology Co., Ltd.

### *Statistical analysis*

All data were analyzed by software SPSS 17.0. The comparison of intragroup before and after the interventions were conducted with t-test and P<0.05 was defined as statistical significance; the comparison among groups were analyzed by ANOVA, while correlation analysis was performed for the changes of serum chemerin, weight, BMI, FM, %F, TG, TCH and LDL.

## Results

### *Changes of W, BMI, FM and %F*

After 16 weeks exercise intervention, compared with the group C, the levels of W, BMI, FM and %F in the group A+R and group A reduced much more (P<0.05). Compared with the group A, the level of FM and %M in the group A+R lowered significantly (P<0.05). While there was no difference between W and BMI, also, there was no difference in each indexes of the control group before and after 16 weeks exercises (Table 1).

### *Changes in the levels of blood fat indexes and chemerin*

After 16 weeks exercise, compared with the control group, the level of TG, TCH, and LDL-C in the other two groups reduced much more (P<0.05), but that of HDL-C augmented significantly, and that of chemerin decreased markedly (P<0.05). Compared with the group A, the level of chemerin in the group A+R lowered significantly (P<0.05), while there was no difference in the other indexes, there was also no difference in each indexes of the control group before and after 16 weeks exercise (Table 2).

### *Correlation between serum chemerin and other indexes*

Before and after the exercise intervention, the changes in chemerin level were correlated positively with the changes of weight, BMI, FM, %F, TG, TCH and LDL-C, while negatively with the changes of HDL-C (P<0.05) (Table 3).

### *Changes in weight, BMI, fat percentage, and fat mass before and after 16 weeks exercises*

Long-term aerobic exercises are one of optimal schemes for weight loss by exercises and in recent years, some study suggests that the combination of aerobic exercises and mild-moderate resistance training has better effect on weight loss. Qiang finds that the body composition, C-reactive protein, and blood fat of 50 obese male students in the exercise group has got marked improvements through 12 weeks comprehensive exercises mixed aerobic training and strength training, three times a week [2].

***Table 1.*** *Changes in W, BMI, FM and %F before and after 16 weeks exercises.*

| Group | Experiments | W/kg | BMI/(kg/m$^2$) | FM/kg | %F/% |
|---|---|---|---|---|---|
| Group C | Before experiment | 57.15 ± 13.24 | 30.47 ± 4.12 | 31.47 ± 2.57 | 28.14 ± 2.98 |
| | After experiment | 58.01 ± 9.58 | 28.35 ± 3.14 | 31.98 ± 2.58 | 28.99 ± 3.54 |
| Group A | Before experiment | 57.78 ± 11.43 | 31.09 ± 3.98 | 31.87 ± 2.89 | 28.78 ± 2.65 |
| | After experiment | 52.43 ± 7.67$^{*\#}$ | 26.65 ± 2.76$^{*\#}$ | 26.45 ± 3.68$^{*\#}$ | 25.01 ± 2.67$^{*\#}$ |
| Group A+R | Before experiment | 59.0 ± 10.13 | 29.43 ± 3.65 | 32.34 ± 2.43 | 29.26 ± 3.67 |
| | After experiment | 51.58 ± 8.56$^{*\#}$ | 25.21 ± 2.43$^{*\#}$ | 24.65 ± 3.98$^{*\#\Delta}$ | 23.51 ± 2.98$^{*\#\Delta}$ |

Notes: $^*$There was statistical difference within groups before and after the exercise interventions (P<0.05); $^\#$Compared with the group C, there was no difference in the group A+R and group R (P<0.05); $^\Delta$Compared the group A+R with the group A, there was no difference (P<0.05).

***Table 2.*** *Changes in TG, TCH, HDL, C, LDL-C and chemerin content of serum before and after 16 weeks exercise.*

| Group | Experiments | TG/(mmol/L) | TCH (mmol/L) | HDL-C/(mmol/L) | LDL-C/(mmol/L) | Chemerin/(ng/mL) |
|---|---|---|---|---|---|---|
| Group C | Before experiment | 3.31 ± 0.61 | 5.27 ± 1.24 | 1.11 ± 0.56 | 1.31 ± 0.47 | 82.21 ± 10.25 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | After experiment | 3.28 ± 0.64 | 5.30 ± 1.52 | 1.17 ± 0.61 | 1.39 ± 0.55 | 84.32 ± 11.03 |
| Group A | Before experiment | 3.06 ± 0.46 | 5.08 ± 1.32 | 1.20 ± 0.56 | 1.31 ± 0.47 | 82.21 ± 10.25 |
| | After experiment | $2.34 \pm 1.09^{*\#}$ | $3.12 \pm 1.32^{*\#}$ | $1.35 \pm 0.43^{*\#}$ | $1.15 \pm 0.62^{*\#}$ | $63.54 \pm 8.85^{*\#}$ |
| Group A+R | Before experiment | 3.23 ± 0.87 | 5.09 ± 1.43 | 1.18 ± 0.70 | 1.65 ± 0.54 | 87.89 ± 12.76 |
| | After experiment | $2.43 \pm 1.13^{*\#}$ | $3.68 \pm 1.54^{*\#}$ | $1.42 \pm 0.57^{*\#}$ | $1.12 \pm 0.60^{*\#}$ | $56.67 \pm 9.67^{*\#\Delta}$ |

Notes: $^{*}$There was statistical difference within groups before and after the exercise interventions (P<0.05); $^{\#}$Compared with the group C, there was no difference in the group A+R and group R (P<0.05); $^{\Delta}$Compared the group A+R with the group A, there was no difference (P<0.05).

***Table 3.*** *Correlation between serum chemerin and the changes of body composition and blood fat metabolism.*

| Indexes | Coefficient | Weight | BMI | FM | %F/% | TG | TCH | LDL-C | HDL-C |
|---|---|---|---|---|---|---|---|---|---|
| Chemerin | r | 0.587 | 0.623 | 0.722 | 0.586 | 0.514 | 0.478 | 0.545 | -0.585 |
| | P | 0.004 | 0.003 | 0.004 | 0.002 | 0.013 | 0.032 | 0.033 | 0.037 |

The density of aerobic exercises in this study is 60%~70% of the maximal heart rate of the participants. In order to maximize the stimulation on mobilization and decomposition of adipose tissue, it is commonly recommended that the exercise time shouldn't be less than 30 min. The exercise duration in the study is designed as 60 min. After 16 weeks exercise interventions, the weight, BMI, %F and FM in the group A and group A+R all reduce markedly, which may be related with that under exercises stimulation, the adipose tissue in the body of the obese undergraduates quickens mobilization, decomposition, and oxidative energy supply, while the anabolism of adipose declines, in 16 weeks aerobic exercises and resistance training. This study shows that compared with the group A, the levels of FM and %F in the group A+R is much lower, but there is no difference in the levels of W and BMI, which may be caused by that strength training reduces fat but adds muscles to increase the weight of the obese students significantly.

Combining moderate aerobic exercises with strength training can improve weight loss more effectively, of which possible mechanism is that aerobic exercises are able to validly accelerate the consumption of heat, but cannot raise the body's basal metabolic rate for a long time after it finished and while combining with strength training may increase the total volume of muscles and lean body mass, so as to improve the basal metabolic rate, which can further add energy consumption of the body under rest state.

## *Changes of blood fat indexes before and after 16 weeks exercise intervention*

It is debated that long-term aerobic exercises have effects on blood fat metabolism. Zhiyong et al. reported that after 7 weeks aerobic exercises, in the rats with hyperlipemia, HDL-C level raises markedly, while the levels of TCH, TG and LDL-C reduce distinctly [3]. Yaru claims that the weight, body fat, lean body weight, TCH, and LDL of the obese adolescents decrease obviously, while their HDL increases after 4 weeks exercises [4]. Lei states that the weight, body fat, TCH, and LDL-C of the obese mice reduce after long-term swimming, while their HDL-C increase [5]. However, some researchers don't agree with them. Guo et al. pointed out that after 4 weeks aerobic exercises, the LDL and TC of the obese children decrease markedly, and the HDL-C reduces few without significant difference [6].

In this study, after 16 weeks exercises, compared with the group C, the level of TG, TCH, and LDL-C in the other two groups reduce markedly (P<0.05), but that of HDL-C raises obviously (P<0.05). We believe that there may be several causes for the changes of blood fat metabolism before and after the trails: First, long-term aerobic exercises can promote the transportation and decomposition of TG to reduce the level of serum TG and TCH; Secondly, it can enhance the counter-transportation of TCH to decrease LDL-C and increase HDL-C. The changes of metabolism described above occur simultaneously in the group A+R and group A, suggesting that whatever aerobic exercises only or the combination of aerobic exercises and resistance training can give rise to a favourable improvement in the blood fat metabolic disorder in the obese undergraduates. Also, we discover that compared the group A +R with the group a, there is no difference in blood fat indexes, which may be associated with that blood fat is sensitive to aerobic exercises but not strength training, or that 16 weeks are too short to reflect the efficacy of strength training. That needs to be confirmed by the following researches.

## *Correlation between serum chemerin and other indexes before and after 16 weeks exercises*

Chemerin, an adipokine affirmed firstly by Bozaoglu et al. using signal sequence acquisition technologies in 2007, is a protein with 163 amino acid residues, which secretes as a form of pro-protein, and then shows bioactivities under the hydrolytic activation of cysteine protease and serine protease [7]. Chemerin expresses in human's adipose tissue, adrenal glands, lungs, liver, pancreas, ovaries, placenta and skin and it mainly originates from adipose tissue, particularly white adipose [8]. In the group of obesity, they have more adipose tissue than the normal individuals so that the level of chemerin *in vivo* of them is higher than that of the normal persons. Chemerin, with three receptors including chemerin receptor 1, mastocyte chemokine receptor 2 (CCRL2) and GPR1 that is a member of CPCRS family, regulates the metabolism of adipose cells through autocrine and paracrine secretion, meanwhile, it participates in the inflammatory responses of adipose tissue. What's more, it plays an important role in the pathogenesis of metabolic syndromes like obesity, and diabetes accompanied by insulin resistance. Some study figure out that the metabolic syndromes in the individuals with obesity or diabetes or animal have closely relationship with the level and expression of chemerin, which may be associated with that chemerin can regulate sugar and fat metabolisms, which includes that it promotes the differentiation of adipose cells, increases the decomposition of adipose tissue, and enhances the stimulation of insulin [9]. By the means mentioned above, chemerin takes part in the developments of obesity, diabetes, and metabolic syndromes, but its mechanism of action and signal transduction pathway for sugar and fat metabolisms in the obesity are still vague.

On the relationship between chemerin and long-term aerobic exercises, Yan et al. design a study in which rats, as the study objects, go swimming 60 min a day, 5 d a week and 6 weeks later, they find that compared with the control group, the chemerin level in the fatty tissue of obese rats expresses less, especially, that in the viscera fatty tissue reduces markedly, but they don't say anything about the influence of long-term exercises on the chemerin level *in vivo* [10]. In this study, whatever the group A or the group A+R, the obese undergraduates' chemerin level decreases largely after 16 weeks of exercise interventions ($P<0.05$), and compared with the group A, the level of chemerin in the group A+R lowers significantly with statistical difference ($P<0.05$). Through correlation analysis, it is known that the level of chemerin in the obese undergraduates is associated negatively with HDL-C, but positively with weight, BMI, %F, FM, TG, TCH and LDL-C. There are a few reports about the relationship between chemerin and blood fat in the obesity, but fewer studies about the relationship between chemerin and exercises. BMI, %F and FM are closely related to various diseases associated with obesity. We deem that chemerin in the obesity may greatly affect metabolic disorders. In addition, the majority of obese people have inflammatory responses, while the inflammatory responses in the body of obese undergraduates relieve after 16 weeks exercises. Chemerin refers to a new inflammatory chemotactic factor, and its reduction may be linked to that the inflammatory responses *in vivo* of the obesity are alleviated by the intervention of exercises.

Therefore, we can infer that the level of chemerin can reflect the degree of obesity and the efficacy of reducing weight. However, there are few researchers about the relationship between chemerin and exercises, so the relevant mechanisms should be further explored, which is the shortage of the study.

## Conclusion

(1) 16 weeks of aerobic exercises only or combining aerobic exercises with resistance training have favourable effects on reducing weight and improving body composition in the obese undergraduates, meanwhile, they play a certain role in regulating the blood fat metabolic disorders of obese undergraduates. What's more, both of them can decrease the level of chemerin.

(2) Compared with aerobic exercises only, the combination of aerobic exercises and resistance training improves the obese student's FM and %F and reduces chemerin more markedly, but has no difference in the improvements of weight, BMI, TG, TCH, and LDL-C.

(3) The changes in chemerin level have positive correlations with the changes of weight, BMI, FM, %F, TG, TCH, and LDL-C, while negative correlations with the changes of HDL-C ($P<0.05$).

## References


1. Li J. Effects of combining aerobic exercises with resistance training on cardiovascular function of obese male adolescents and its possible mechanisms. Sport Sci 2013; 33: 37-42.
2. Yao Q. Effect of additional exercise on Nanjing college students with obesity. Sport Sci Tech 2010; 31: 104-106.
3. Ji ZY, Du XP, Fu Q. Effect on body fat and blood-fat of high-fat diets rats. J Shenyang Sport Univ 2010; 29: 37-39.
4. Haung YR, Ji H, Ge XC. Effects of exercise and diet intervention on body composition, serum lipid and the regulatory mechanisms in overweight adolescents. Chin Sport Sci 2013; 9: 46-48.
5. Jia L, Nie XJ, Xiao W. Experimental study into intervenient effects of sphallerocarpus gracilis polysacchorides and swimming on levels of serum lipid and leptin in seit-induced obese mice. J Xi'an Inst Phys Edu 2011; 28: 710-714
6. Guo Y, Chen PJ, Chen WH. Effect of weight reduction on the somatometric measurements, blood lipid and blood insulin of obese children and adolescents through diet and exercise. Chin J Sports Med 2011; 30: 426-431.
7. BozaoGluK, BohonK, MemillanJ. Chemerinisanoveladipokineassociatedwithobesityandmetabolicsyndrome. JBiolChem 2007; 148: 4687-4694.
8. GoralskiKB, MccarthyTC, HannimanEA. Chemerin, anoveladipokinethatregulatesadipogenesisandadipocyte metabolism. JBiolChem 2007; 282: 28175-28188.
9. StejskalD, KarpisekM, HanulovaZ. ChemerinisanindependentmarkerofthemetabolicSyndromeinaCaucasian population-apilotstudy. BiomedPapMedFacUnivPalackyOlomoucCzechRepub 2008; 152: 217-221.
10. Liu Y, Dai W, Wang CJ. Effects of swimming and metformin on the protein expression in obese rats. Acta Univ Med Anhui 2013; 48: 1527-1529.

11. Dong SW. Effects of winter sports on the enhancement of physical as well mental wellbeing in students. Chin Winter Sports 2004; 42.
12. Yang SR. Life styles and winter sports culture in the Northern. J Harbin Inst Phys Edu 2000; 1-5.
13. Ma X. Stimulating effect on the development of Chinese winter sports from "Bidding for the Olympics ". Chin Winter Sports 2015; 37: 68-72.
14. Zhao J, Yan YD. Planning and development of human resources reserve for winter sports in China. J Shandong Inst Phys Edu Sports 2015; 31: 51-54.
15. Tao YJ, Zhang Q. Industrialization of Winter Sports. Chin Winter Sports 2004; 66-67.

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