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Research Article

Research on Effect of Aerobic Exercise and Nutrition Intervention on Food-borne Obesity

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Abstract: With the development of social economy and the improvement of people's living standards, the incidence of obesity is increasing year by year. The main purpose of this study is to study the effect to food-borne obese rats combined aerobic exercise with soybean peptide and L-carnitine. The objects of this experiment are the SD obese rats which are successfully modeling, with 6-week training on treadmill and lavaging 10% of nutrient solution everyday (600 mg/ (kg·day) L-carnitine and 15 mg/ (kg·day) soybean peptide). But for the obese rats in the control group, they will be lavaged with 2 mL of distilled water. During this experiment, we observed the body weight, body length of the obese rats and calculate Lee's index, detect the index of body weight, body length and the concentration of apolipoprotein. After the experiment, the exercise intervention group, the nutrition intervention group and exercise plus nutrition intervention group, Lee's indexes of them are obviously lower than obese control group. The differences between two are all significant ($p<0.05$), but there is no difference between three experimental groups ($p>0.05$); Nutrition intervention, exercise intervention group and sport plus nutrition intervention all significantly decreased the levels of apoB ($p<0.05$); the difference of effect on apoA between exercise intervention and nutritional interventions are not significant ($p>0.05$), but sport plus nutrition intervention effect on apoA of obese rats has significant difference ($p<0.05$). Through the analysis of these results, the experiment shows that feeding high fat and sugar fodder can successful establish obese rats model. Exercise and nutrition intervention can improve lipid metabolism, significantly decreasing apoB concentrations of obese rats, increasing apoA concentrations.

Keywords: Aerobic exercise, food-borne obesity, L-carnitine, nutritional intervention, soybean peptide

INTRODUCTION

Obesity can cause many diseases, seriously threatening to human health and quality of life. Obesity has gradually become the major issue of international community concern (Yanli *et al*., 2013). Nowadays, the favorable method of losing weight is still a healthy lifestyle. Aerobic exercise, its effective fitness effect of losing weight is tangible (Nana *et al*., 2011). In the study that 4-week aerobic exercise can affect the body shape, blood lipid and blood insulin, Yin *et al*. (2011) with others indicated it can significantly decrease blood insulin level of obese children and teenagers, if they keep the 4-week moderate or low intensity exercise with alimentary control to lose weight. It also can improve the indexes of blood lipid and boy shape, especially the body fat percentage and the weight of fat which can be the top index for evaluation of losing weight (Xue and Zheng, 2010).

However, because the intensity of simple aerobic exercise is too strong and not easy to insist, Wang Wenxiang, et al. researches the effect of nutritional intervention to obesity losing weight and found that the improved protein proportion that ensures to intake normal protein can do good to keep protein and muscle weight; fully replenishing water (daily water drinking > 1800 mL) is beneficial to keep the water in body; vitamin and mineral substances (calcium, magnesium, etc.) supplementation plays an important role in maintaining bone mineral and inorganic salt (Wenxiang *et al*., 2012). Hong Xiaoqin with others did the research about the effect which is combined aerobic exercise with nutrition intervention to overweight obese teenager's physical fitness. The result shows that it is scientific to design the exercise and comprehensive nutrition intention, on the basis of physical and mental characteristics of overweight obese teenagers. It has obvious effect to control weight and promote the development of physical quality (Xiaoqin and Hua, 2010).

This study aims to observe the effect to Lee's index and concentration of apos after gavaging the mixed liquor of L-carnitine and soybean peptide and 6-week aerobic exercise by establishing food-borne obese rats' models.

MATERIALS AND METHODS

Reagent and fodder: L-Carnitine and L-Tartrate (levocarnitine. vitamin BT) and soybean polyamine are provided by Guangzhou Zhongyuan Biology Science

Table 1: Composition of fodders

Element	Ratio of high calorie and sugar fodder (%)	Ratio of basal fodder (%)
Fat	38.5	4.5
Protein	13.5	21.0
Carbohydrate	41.9	62.6
Other	6.1	11.9

and Technology limited company. Fifty normal male SD rats whose weight are170±g, basal fodder and high calorie and high sugar fodder are provide by Nanchang University Medical College Animal House. We can see the formula in Table 1.

Preparation method and preservation condition of nutrient solution: Compound L-carnitine 600 mg (kg·day) with soybean peptide 15 mg (kg·day) into 10% mixed solution which is large dose and keep it avoiding lights in heated house.

Experimental animals and grouping: Select 50 healthy SD rats, from which randomly choose 8 rats as normal control group, fed with basal fodder. And the rest 42 rats should be fed with nutrition diet. They are fed with 13 g nutrition fodder for first 7 days, increasing 2 g weekly. During experiment time, SD rats can drink freely. During the period of model preparation, measure the weight of rats by electronic scale on the last day of a week, ensuring to normally model. After 8 weeks it is defined to be successful if the weight is over 20% heavier than normal rats group. Take 32 those rats whose average weight is (354.9±28.2) g and age is 4 months old. Randomly divided them into four groups: nutrition intervention group, simple exercise intervention group, sport plus nutrition intervention group and obesity control group, 8 rats in each group. There is one rat died accidentally in exercise plus nutrition intervention group.

Experimental scheme: First of all, each rat in each group will be given 20 g normal fodder, allowing them drinking water freely at the same time. On the basis of that, exert exercise intervention of treadmill training for six weeks and the running platform slope is 0°C, running speed of 25 m/min, training once for 60 min/day. Train them 6 days a week and take rests on Sundays. Using l-carnitine and soybean peptides to prepare nutrient solution, we can make nutrition intervention to rats by nutrient solution, lavaging them everyday. Each one in obese control group will be lavaged with 2 mL distilled water at around 5 PM everyday. The environment should be controlled under the temperature (20+2)°C and relative humidity 50~60%.

Observation target:

Measuring of body weight, length and lee's index: During experiment, measure each rat's weight on Sundays' morning and before its death. In the meantime, measure its body length from nose to anus by fixing it on a fixator on the basis of Lee's index formula:

$$\text{Lee Index} = \left[\sqrt[3]{\text{Weight (g)}} / \text{Body length (cm)} \times 1000\right]$$

Measuring of apoA and apoB: We will measure apoA and apoB with the semiautomatic biochemistry analyzer from Italy. The reagents in this experiment are bought from Shandong Weifang Biology Project Company. It should be strictly to operate following the introduction.

Statistics method: Using the SPSS 12.0 statistical software to deal with the data which should be expressed with average±standard deviation. Take the interblock t to check out the difference. $p<0.05$ means there is significance on the difference and $p<0.01$ means there is super significance on the difference.

RESULTS

The effect of exercise and lavaging l-carnitine and soybean peptide on rats' losing weight: After 1-2 weeks' implementation of exercise and nutrition intervention, compared with obese control group, there is no significant difference happening to rats' weight in intervention group and nutrition intervention group ($p>0.05$). When it comes to the sixth week, compared with obese control group, the weight of rats in exercise intervention group, the nutrition intervention group and exercise plus nutrition group of obesity rats weight is lower. There is significant difference on exercise and nutrition intervention group ($p<0.05$), while sports plus nutrition intervention group has super significant difference ($p<0.01$). The weight of rats in sport plus nutrition intervention group was significantly lower than the exercise intervention and nutrition intervention group, with significant difference ($p<0.05$), as shown in Table 2.

After experiment, Lee's indexes of exercise intervention group, nutrition intervention group and exercise plus nutrition intervention group are obviously lower than obese control group. Compared with obese control group, there is significant difference ($p<0.05$), but there is no difference between three experimental groups ($p<0.01$). We can see it from Table 3.

The effect of exercise and L-carnitine and soybean peptide on apaA and apoB of obese rats: From this experiment, the research about apoA and apoB expresses that nutrition intervention, exercise intervention and exercise plus nutrition intervention obviously decrease the level of apoB ($p<0.05$); Exercise intervention and nutrition intervention has no significant effect on apoA ($p>0.05$), but exercise plus nutrition intervention has significant effect on apoA ($p<0.05$). We can see it from Table 4.

Table 2: Effect of exercise and nutrition intervention on weight of rats ($\bar{x}$±s)

	Weight (g)			
Groups	Before test	After 2 weeks	After 4 weeks	After 6 weeks
Obese control group	370.8±15.6	386.8±14.6	393.8±19.6	408.8±14.6
Exercise intervention group	370.7±15.7	381.6±20.5	388.9±19.4	384.6±20.2*Δ
Nutrition intervention group	360.6±16.3	380.6±18.6	386.6±20.4	392.6±24.6*Δ
Exercise plus nutrition intervention group	371.6±15.8	381.6±16.8	384.6±18.7	378.6±20.4**

*: Compared with obese control group, p<0.05; **: Compared with obese control group, p<0.01; Δ: Compared with exercise plus nutrition intervention group, p<0.05

Table 3: The effect of exercise and nutrition breeding on Lee's index of rats ($\bar{x}$±s)

	Weight (g)			
Groups	Before test	After 2 weeks	After 4 weeks	After 6 weeks
Obese control group	370.8±15.6	386.8±14.6	393.8±19.6	408.8±14.6
Exercise intervention group	370.7±15.7	381.6±20.5	388.9±19.4	384.6±20.2*Δ
Nutrition intervention group	360.6±16.3	380.6±18.6	386.6±20.4	392.6±24.6*Δ
Exercise plus nutrition intervention group	371.6±15.8	381.6±16.8	384.6±18.7	378.6±20.4**

*: Compared with obese control group, p<0.05; Δ: Compared with exercise plus nutrition intervention group, p>0.05

Table 4: The change of apoA and apoB of rats in each group after test (μg/mL, $\bar{x}$±s)

Groups	n	apoA	apoB
Obese control group	8	0.39±0.12	0.56±0.24
Exercise intervention group	8	0.48±0.10*	0.55±0.21
Nutrition intervention group	8	0.49±0.16*	0.36±0.16*
Exercise plus nutrition intervention group	7	0.53±0.14*	0.35±0.12*

*: Compared with obese control group, p<0.05

DISCUSSION

Studies have shown that (Wenxiang *et al*., 2012), using high fat and sugar fodder to feed rats, can cause a large number of fat accumulation which is the important factor causing obesity. At the same time, because of its reducing body length, Lee's index becomes larger, it is widely used to determine whether the weight of animal fat or not and Lee's index from the shape of animals.

The result shows that there is significant difference between exercise intervention group and obese control group. The result also proved that the aerobic exercise is an effective way to lose weight. Compared with the weight of rats in control group, there is significant difference in rats of nutrition intervention group (p<0.05). Compared with obese control group, exercise and nutrition intervention group has great significant effects on obese rats weight (p<0.01). The result shows that the effect of aerobic exercise combined with nutrition intervention is more significant than aerobic exercise or nutrition intervention.

Carrier of the fatty acid oxidation-l-carnitine, has good improvement effect for central obesity and dyslipidemia of metabolic syndrome. For example, it has great effect on high density lipoprotein in the blood, making it rise so that it can significantly decreased cholesterol and three acyl glycerint to protect blood vessels. Due to the lack of carnitine in the body, fat metabolism disorders, not only making the muscle function insufficient, the body fatigue and causing associated cardiovascular disease. Besides, it is possible to accumulate the and lipid in muscle fibers and the liver, which can lead to obesity and fatty liver. Eating low calorie food and exercising can reduce weight, but at the same time, it could reduce l-carnitine. Researches suggested that l-carnitine is helpful to reduce weight and improve the function of ischemic myocardium (Minfang, 2010; Weisen *et al*., 2014). Therefore, it has important meaning to see l-carnitine as nutrients for obesity nutrition intervention.

It is widely believed that low energy intake, sports activities and other methods can achieve the purpose of reducing weight, but usually people reduce their weight with a variety of diseases. Because the method of low energy diet will lead to physical deterioration. Thus, in the process of losing weight, it is important to keep the balance of the nitrogen. Soybean peptide can not only hinder the absorption of fat, but also can promote the lipid metabolism. On the basis of enough intake of peptide, it can minimize the rest energy components to reduce fat storage in order to achieve the purpose of losing weight and guarantee the body's physical fitness. Japanese experts feed mice with soybean peptide and result shows that it can stimulate the activity brown adipose tissue BAT and promote energy metabolizing (Baohua, 2010).

Because lipid cannot be directly dissolved in aqueous solution in body, it must combine with some elements which can be united with lipid and fat soluble substances. The element which has that function is called apo. ApoA and apoB are major apolipoprotein of serum High-Density Lipoprotein (HDL) and Low Density Lipoprotein (LDL). They all have the function of carrying and operating cholesterol. Therefore, concentrations of apoA and apoB in serum have close connection with lipid metabolism. ApoA mainly exists in the HDL. But there is a small quantity of apoA existing in CM, VLDL and LDL. Thus, the serum apoA can represent the HDL levels; in normal situation, about 90% apoB (mainly apoB-100) distributes in LDL and

IDL. Therefore, apoB in serum mainly represent LDL level, which obviously has positive correlation with LDL-C.

This study of apoA and apoB has shown that nutrition intervention and exercise and nutrition intervention significantly decreased the level of apoB ($p<0.05$). Exercise intervention has no obviously change ($p>0.05$); Exercise intervention and/or nutrition intervention has significant effect on apoA of obese rats ($p<0.05$).

For the apolipoprotein of this test getting good change, the effect of movement on apolipoprotein can manifest in the following aspects:

- Exercise leads to the increase of the apoA, so that it increases the concentration of HDL, combining with cholesterol ability.
- Exercise leads to the increase of enzymatic activity of lecithin cholesterol phthalein transferase in new HDL cholesterol so that it can be easier to combine cholesterol outside the liver with lecithin of HDL becoming cholesterol vinegar, forming into mature spherical HDL.
- Exercise leads to increase the degradation ability of cholesterol in the liver, strengthen the ability of acid eduction.

The soybean peptide in this test may reduce LDL and VLDL of obese rats, but it cannot reduce HDL so that apolipoprotein of obese rats can get good change. There are some animal experiments indicating that, when obese rats are lavaged with soybean protein peptide of 5~15 mg/ (kg·day), it can significantly reduce serum cholesterol and three oil esters of hyperlipidemia rats. Compared with high fat group, there is significant difference ($p<0.01$). The effect of soybean protein peptide reducing serum cholesterol mainly manifests in increasing HDL-c and decreasing LDL-c.

CONCLUSION

This study further reveals the effect of exercise and nutrition intervention on food-borne obese rats. The author talks about the possible mechanism mainly from the effect on lipid and sugar metabolism with exercise and nutrition intervention. From the experimental result, we can conclude that exercise is a safe and effective way to lose weight. Combining l-carnitine and soybean peptide mixture with sports can better lose body fat and keep lean body mass. We can see that it is visible l-carnitine and soybean that play an important role in losing weight. It will provide the groundwork to the development of health care products. But due to lack of funding and hasty time, this experiment cannot deeply reveal the possible mechanism from cellular level and molecular level, which will become the direction of future research.

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