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Research Article

Impact of Nutrition and Health Education Intervention and Aerobic Exercise Intervention on the Weight Loss of Overweight College Students

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Abstract: This study discussed the impact of general elective course education and aerobic exercise intervention on the weight loss of overweight students. 12 (5 males and 7 females) overweight students of Southwest University attended the study of their own accord and experienced 12 weeks of course learning and group aerobic exercise intervention with the average age of 19.8±3.3 and average BMI of 25.6±3.1 kg/m². Within the 12 weeks, the average weight loss of each member was 3.88 kg, their body fat rage, BMI and waistline decreased obviously ($p<0.05$) while their waist-hip ratio did not change obviously ($p>0.05$); the indexes of their sit-up, sit and reach and 3 min stair-climbing improved greatly ($p<0.05$); within the impact on weight loss effect, the effect of diet control accounted for 55.6% of the calorie consumption while the effect of sports accounted for 44.4% of calorie consumption. The conclusion indicated that the combination of general elective course learning of "Sports and Health" and aerobic exercise is helpful for weight loss and improving physical fitness of college students.

Keywords: Aerobic exercise, nutrient education, weight loss

INTRODUCTION

According to the report of related literature, the overweight had 4.70 times of the probability of the normal in suffering from metabolic syndrome; while the obese had 30.60 times compared to the normal (Li, 2013; Katzmarzyk *et al*., 2005; Nabel, 2003). Therefore, the increase of the obese resulted in more and more metabolic syndrome cases. The risk of suffering from metabolic syndrome stems from the high correlation between metabolic syndrome and the risk factor of type II diabetes and cardiovascular disease. The 8-year study of Wilson *et al*. (2005) indicated that as for the relative risk of metabolic syndrome turning into diabetes, male was 6.9 times and female was 6.90 times of that of the normal; as for the relative risk of suffering from cardiovascular disease in the future, male was 2.8 8 times and female was 2.25 times of that of the normal. Therefore, we can conclude that weight control is very significant. Whaley *et al*. (1999) divided the cardio respiratory fitness of male subjects and female subjects into three classes of low, medium and high. The result of comparing the incidence rate of metabolic syndrome among the subjects indicated that the probability of male subjects with low cardiorespiratory fitness in suffering from metabolic syndrome was 3 times of that of the subjects with medium cardiorespiratory fitness, the probability of subjects with low cardiorespiratory fitness in suffering from metabolic syndrome was 10.1 times of that of the subjects with high cardio respiratory fitness and the probability of subjects with low cardiorespiratory fitness in suffering from the death caused by cardiovascular disease was 8 times of that of the subjects with high cardiorespiratory fitness.

It is thus clear that diet control and weight loss were both significant for improving the health of the obese. Although some studies of scholars (Jakicic *et al*., 2002) indicated that the impact of diet for weight loss was more significant than sports, unstable changes would occur of weight only by diet control and the individual fitness would not be improved either. Many studies (Fett *et al*., 2005; Luo *et al*., 2012; Jiong and Chenli, 2012) indicated that the combination of diet control and sport training could improve the mass indexes and rates of waist and hip of the overweight, besides, it could improve each physical fitness index significantly. The study aimed to discover the change rule of the physical fitness of the subjects while reducing weight through the mechanism of dual action of diet control and sport consumption.

MATERIALS AND METHODS

Subjects: The program invited 12 college students with BMI≧24 kg/m² and without heart disease or metabolic syndrome among the students selected the general

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elective course of “Exercise Plan and Health” of their own accord.

Experimental procedure: The judgment criteria of metabolic syndrome: waistline of female ≧80 cm, waistline of male ≧90 cm; systolic pressure ≧130 mmHg, diastolic pressure ≧85 mmHg; fasting blood-glucose ≧100 mg/dL; high-density lipoprotein <50 mg/dL, triglyceride ≧150 mg/dL. (people with metabolic syndrome meet at least three items).

The teaching period of general selective course lasted 12 weeks, subjects accepted 12 weeks of aerobic exercise for weight loss during this period. Besides, they completed the test of physical fitness before and after intervention.

The learning content of the general elective course of “Exercise Plan and Health” mainly included: teaching the objects to understand calorie counting, diet record, food selection, calorie contained in food, etc.; The content of aerobic exercise included 4 times of exercise each week (2 performed under teacher monitoring+2 performed by themselves) with 60 min of each time (5 min for warming up+50 min for aerobic exercise+5 min for relaxation and the intensity standard of target heat rate (target heart rate = the maximum heart rate×65%). Rating of perceived exertion was adopted to further guarantee the safety of each time of training during the aerobic exercise.

Test indexes were the indexes of body composition, sit and reach, sit-up and 3 min stair-climbing tests. Korean body composition analyzer In body 5.0 (with error within 1.50%) was adopted for the test of body composition and other indexes were tested based on national basic operation plan of physical fitness test.

Subjects were required to record their diets based on the 24-h recall method. They completely recorded the food taken in the day, food types, food portion sizes and cooking methods of any two days during Monday to Friday and either day of Saturday and Sunday and submitted these records to the person in charge of the research group each week to make confirmation of subjects. Then the calories taken in were counted by dividing the feeding calories of the 3 days in a week into three to get the result as the calories taken in each day of the week. These activities were performed as above for 12 weeks.

Calorie should be taken, namely Essential Energy (EE) = Basal Energy Expenditure (BEE)×activity factor×stress factor, BEE was calculated based on the method of Harris-Benedict with the unit of weight of kg and unit of height of cm: BEE of female = 655 + 9.60 × weight) + (1.70×height) -4.70 × age and BEE of male = 66 + 13.70 × weight)+5.0 × height) -6.80 × age). Activity factors were divided into three classes of staying in bed, slight activity and medium activity. The objects of the study were college students, therefore slight activity was adopted. The method of differentiating stress factors was to judge whether the subject was suffering from disease and the stress would be confirmed as normal stress if he was without disease. The subjects required to take in calorie of 200 Kcal (1kg weight loss requires calorie consumption 7700 Kcal).

Data processing: SPSS for Windows 17.0 was used in this study, all significant level was set at $p = 0.05$.

RESULTS AND DISCUSSION

Analysis on features of weight change: Figure 1 indicated that: the study found out that the weight parameters of the 6 periods could be divided into four subsets, the weight changes indicated in the same subset had no statistical significance and the weight changes indicated in different subsets indicated significant differences through one-way analysis of variance and multiple comparisons with S-N-K based on the dynamical change curve drawn according to the results of subject weights measured every 2 weeks during the 12 weeks of health education and aerobic exercise intervention. Therefore, it was easy to find out the following rules:

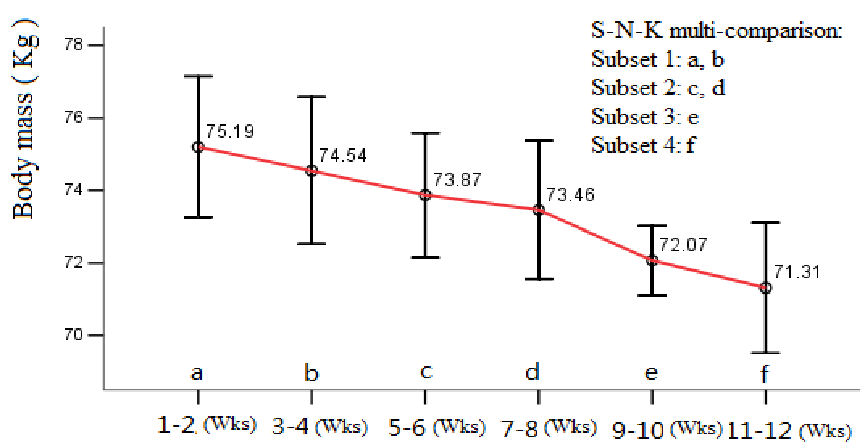

Fig. 1: BMI change during 12-week health education and exercise intervention

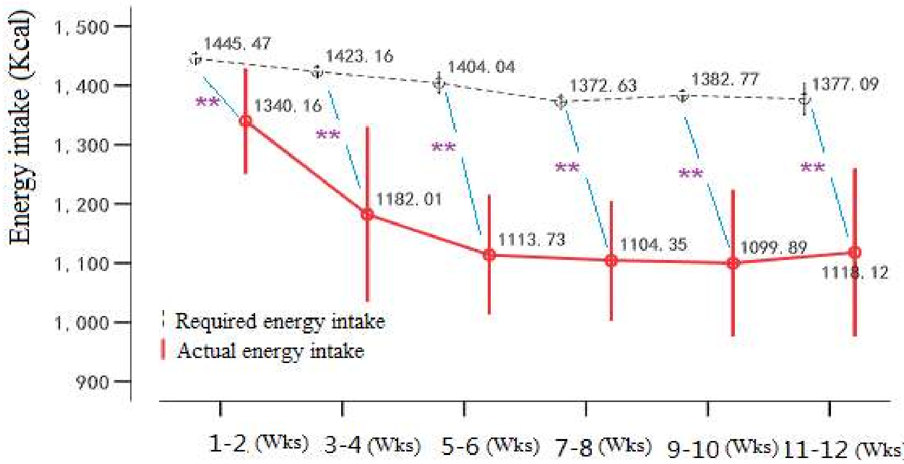

Fig. 2: Energy consumption difference between different modes during 12-week exercise intervention

- The weights were in the same subset during the first weeks of 1-2 and weeks of 3-4 of the intervention and the reduction of weights from an average of 75.19 kg to 74.54 kg only indicated that their weights had a reduction trend.
- The weights were in the same subset during weeks of 5-6 and weeks of 7-8, which showed that the weights had a significant downtrend with statistical significance after 4 weeks; but there came a plateau phenomenon, i.e., weights in weeks of 5, 6, 7 and 8 changed very little, which meant that the weights decreased quite slowly from 73.87 kg to 73.46 kg.
- During the weeks of 9-10 and weeks of 11-12 of the intervention, the weights continuously decreased significantly with the weights in the weeks of 9-10 and the weights in the weeks of 11-12 in their own subsets, the average weight in the weeks of 9-10 was 72.07 kg, while the average weight in the weeks of 11-12 decreased to 71.31 kg. The average weight of subjects decreased 3.88 kg with obvious effect from the overall intervention process.

Analysis on the features of energy consumption: Four interventions (2 fit aerobics+2 walking and jogging) were performed in the study and the weights were measured uniformly before training. Medium intensity was adopted for either fit aerobics or walking (jogging) of subjects. The estimation of energy consumption of fit aerobics was performed based on the weight change of each week, which was the result of 0.08 Kcal/1 kg/min multiply the weight of the week and exercise time; the training of walking (jogging) was performed under the leadership of the instructor. The speed of at least 5.50 km/hr was required, so the estimation of calorie consumption was 5.60~7.00 Kcal/kg/h. Figure 2 was drawn based on the estimation of energy consumption of 1 h walking of subjects of the study.

The following information would be drawn from Fig. 2:

- When the amount of exercise and intensity of exercise are basically equal to each other, the energy consumption of walking (jogging) were higher than that of fit aerobics. If the energy consumption were counted twice each week, then the exceeded energy consumption of walking (jogging) to fit aerobics for weeks of 1-2, 3-4, 5-6, 7-8, 9-10, 11-12 were 245.60, 237.4, 237.8, 207.0, 228.4 and 236.0 Kcal, respectively.
- With the time of intervention, the energy consumption of the two sport modes were on a declining curve without obvious statistical significance. Energy consumption of 849.60 Kcal for twice walking (jogging) in the weeks of 1-2 decreased to 787.60 Kcal in the weeks of 11-12; while energy consumption of 604.00 Kcal for twice fit aerobics in the weeks of 1-2 decreased to 551.00 Kcal in the weeks of 11-12. Especially in the last two weeks, the energy consumption of the two training method decreased significantly.

Analysis on the calorie intake condition of subjects: Figure 3 was drawn based on the average calorie should be taken from the diet of each subject with unit of two weeks based on the calculation formula of Harris-Benedict. It was easy to find out that during the whole period of intervention, the calories of subjects should be taken of was lower than the actual calorie taken, the corresponding difference between them (average per day) of weeks of 1-2, 3-4, 5-6, 7-8, 9-10, 11-12 were 105.31, 241.15, 290.31, 268.28, 282.88, 258.97 Kcal, respectively (the average difference was 241.15 Kcal); except for the unsatisfying control of actual intake in the first four weeks, the calories actually taken in the latter 8 weeks were stable, which indicated that the dietary behaviors of subjects were under effective control.

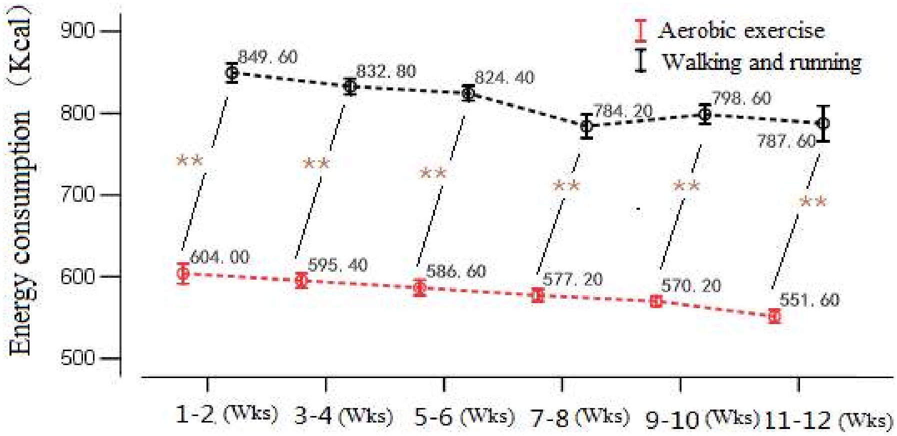

Fig. 3: Characteristics of dynamic change of energy intake during 12-week exercise intervention

Table1: The changes of physical fitness parameters between pre- and post-intervention

	BMI (kg/m^2)	Body fat (%)	Waist circumference (cm)	Waist-hip ratio	Sit-up (times/Min)	Sit and reach (cm)	cardio respiratory fitness index
Pre	25.16±3.01	30.36±4.27	87.25±8.66	0.86±0.07	15.15±3.69	28.14±8.25	42.25±15.15
Post	22.56±2.77	27.33±3.21	81.58±9.15	0.85±0.08	19.26±5.14	36.29±7.58	51.59±13.37
T	p<0.00	p<0.00	p<0.000	p>0.05	p<0.01	p<0.01	p<0.01

Analysis on the change condition of physical fitness of subjects before and after intervention: In Table 1, the 12 weeks of intervention combining health education and aerobic exercise was effective, which resulted in significant decrease of BMI (25.16±3.01 vs. 22.56±2.77, $p<0.05$), significantly decrease of body fat rate (30.36±4.27 vs. 27.33±3.21, $p<0.05$), waistline significantly increase (87.25±8.66 vs. 81.58±9.15, $p<0.05$), increase of number of sit-ups (15.15±3.69 vs.对19.26±5.14， $p<0.05$), significant improvement of the achievement of sit and reach (28.14±8.25 vs. 36.29±7.58, $p<0.05$), significant increase of cardiovascular endurance index compared to the condition before the intervention (42.25±15.15 vs. 51.59±13.37, $p<0.05$) and only the rate of waist and hip had no obvious change before and after the intervention (0.86±0.07 vs. 0.85±0.08, $p>0.05$).

DISCUSSION

The result of 12 weeks of intervention consisting of education of general selective course “Sports and Health” and appropriate aerobic exercise indicated that the average weight of subjects (overweight college students) decreased 3.88 kg, indexes of body composition, body fate rate and waistline were on a significant declining curve, only the rate of waist and hip had no obvious change. The result of the study was similar to the study result performed by Melanson *et al*. (2004) and other scholars. Okura *et al*. (2005) and some other scholars performed an intervention control experiment to overweight women of diet group and diet+sport group and they found out that diet+sport group could reduce weight and abdominal fat. Andersen *et al*. (2002) performed an intervention control experiment to adults with BMI≥30 of daily activity group and daily activity+ aerobic exercise group through the method of reducing 500 Kcal of diet each day and they found out that both groups decreased weight of 6.70 and 8.40%, respectively. It could be concluded that diet control+aerobic exercise had better effect than diet control. The rate of waist and hip had no obvious change in the study, the mainly reason might be that the downtrend of waistline and hip line were similar to each other, therefore, there was no obvious change of the rate.

The indexes of 1 min sit up, sit and reach and 3 min stair-climbing (cardiovascular endurance) obtained in the were basically in consistent with the studies of many scholars. During the teaching of diet control, the teachers mainly guided subjects to understand calorie and nutrients contained in food, how to keep a balanced ingestion, eating-out, counting method of calorie should be taken per subject, etc. Meanwhile, the teacher required subjects to keep diet record of at least three days a week and grasp some concepts for adjusting calorie should be taken per day. The study indicated that the nutrient course would help subjects to reduce about 241.15 Kcal of intake in average. On the other hand, as for the sport intervention mode, subjects took exercises 4 times a week, in which the energy consumption of walking (jogging) was 392.1-424.8 Kcal and the energy consumption of fit aerobics was 275.8-302.00 Kcal. Therefore, the accumulated energy consumption of twice fit aerobics and twice walking (jogging) was a great data and the decrease of weight was the result of calorie intake reduction and increase of energy consumption from body activities. The goal of the study was to reduce 200 Kcal calorie from the diet per day and to consume 250 Kcal calorie by exercise. In the weeks of 7-8, the diet intake and the calorie consumption by exercise were nearly the same with those in other weeks, but the decrease of weight was obviously slower and the decrease of weight became significant after the weeks of 9-10, from which we could infer that the weeks of 7-8 were the plateau period (plateau phenomenon) of weight loss and it was to be further discussed about the reason of the plateau phenomenon.

CONCLUSION

As for overweight college students, if they reduce 200 Kcal calorie from diet each day and perform four times of aerobic exercise each week for three months, their weights would decrease 3.88 kg in average.

General knowledge course of "Sports and Health" with the intervention of aerobic exercise can effectively decrease the body fat rate, BMI, waistline of subjects and has significant effect on the abdominal muscle endurance of sit-up, flexibility of sit and reach and the cardiovascular endurance of 3 min stair-climbing, but it has no significant effect on the reduction of rate of waist and hip.

The study found out that if subjects reduce 200 Kcal calorie from diet each day with extra consumption of about 1400 Kcal by performing four times of aerobic exercise each week, their weights would decrease 3.88 kg after three months. Therefore, it can be concluded that the effect of diet control accounted for about 55.7%, while the effect of sports accounted for about 44.43%.

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