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Plasma lipid, lipoprotein levels and blood glucose: The effects of combined aerobic-resistance training on morbid obese men

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ABSTRACT

The purpose of the study was to treat morbid obese males whose body mass index was 40kg/m^2 and more with combined aerobic and resistance training to determine how the body mass, lipids, lipoproteins, and glucose are affected. 30 morbid obese males between 18-35 years selected at the start of the program and divided into an experimental group and a control group. The training was for 12 weeks, 5 days a week and for 90 minutes per session. The training program consisted of 4 methods namely treadmill walking, cycling, aquatic and resistance exercises. Blood samples were tested before and after the 12 weeks of training for the total cholesterol, high density lipoproteins, low density lipoproteins, triglycerides and blood glucose. The data was analyzed statistically using paired 't' test and independent t test. The level of significance was fixed at0.05 level of confidence. The results showed that there was no significant difference between the groups in all physical characteristics (P > 0.05), but a significant difference was observed when the post test scores were compared with the pretest of the experimental group in body mass and body mass index(-8.54 ± 4.14 ; -2.66 ± 2.36 kg, p < 0.05) respectively. There were significant difference in LDL of experimental group (-7.20 ± 4.26 ml/dl; P < 0.05). It was found that the experimental group had shown significant difference when the post test scores were compared to the pretest in body mass, body index and the LDL.

Keywords: Obesity, Aerobic, hypo kinetic diseases, BMI

INTRODUCTION

Obesity has been a major public health problem all over the world. Studies have linked obesity as the result of positive energy balance. The accumulation of fat is a visible manifestation that more food energy has been stored than expended. Many studies have concluded that obesity leads to hypo kinetic diseases like increased risk of diabetes, hypertension, cardiovascular diseases, dyslipidaemia and certain type of cancer. Recent studies have suggested that obesity may hinge more on a decrease in energy expenditure than on an increase in calorie intake. Accordingly exercise or increased physical activity should be a key component of gradual weight control program. The specific roles of diet and exercise during weight reduction have been the focus of considerable research. In addition, obesity is associated with an increased risk of very low density lipoprotein (VLDL) cholesterol, low density lipoprotein (LDL) cholesterol, triglycerides, blood pressure, glucose tolerance and a decrease in high density lipoproteins (HDL) cholesterol and physical activity [4]. Several studies have investigated the effects of dieting and exercise training independently or in combination on obese subjects [26]. Obesity may be caused by a number of social, cultural, behavioural, physiological, metabolic, and genetic factors that are beyond the person's control. Symptoms of obesity usually show up in the form of breathing trouble, excess accumulation of fat, insulin resistance, and increase in size or number of fat cells, rise in blood pressure, high cholesterol levels and back pain. It is also said that obesity is a chronic metabolic disease in which excess body fat has accumulated to the extent that it may have detrimental effect on human life expectancy, leading to multiple health problems like metabolic syndrome, hypertension, heart diseases, stroke, gout, kidney disease and even cancer. Nowadays the disease is

reaching epidemic propositions around the world, being specially reinforced in the Western industrialized world [26].

It is estimated that an average individual burns 1200 to 2000 calories per day with normal activities of daily living. 2.2 lbs. of fat store 9000 calories of energy. In order to gain 2.2 lbs. a person needs to eat 9000 calories more than he burns. In order to lose 2.2 lbs. a person needs to burn 9000 calories more than he eats. It is very easy to gain 9,000 calories and very hard to lose 9,000 calories in any cultural environment. The average fast food meal is over 1000 calories while thirty minutes of jogging at an eleven minute mile burns 200 calories [18]. Physical activity has a potential to attenuate the rate of growth of the obesity epidemic and contribute to efforts to bring it under control. The health benefits and habitual physical activity are irrefutable.

There are innumerable studies in the research field who have ventured to correct obesity pandemic through various programs. Some studies have investigated the effects of resistance training on lipid-lipoproteins on obese and overweight male and female subjects [11,10,25, 19,12,17,14,27]. Some studies compared the effects of combined aerobic and resistance training on lipid and lipoprotein on obese and overweight male and female subjects [3,24].

Several studies compared changes in an exercise-only group to a control group on blood lipids and lipoprotein on obese individuals [7,8,13,6,16,20,22] but none reported a significant group difference. However, few studies reported significant effects in lipid and lipoprotein [5,15].

Exercise is commonly recommended in the treatment of obesity as a means of increasing energy expenditure. Most investigators have limited their exercise studies with obese individuals to either walk / jog or stationary cycling exercise programs. Although, aquatic exercise is frequently cited as being potentially advantageous for obese individuals but its use has been rarely done. This study was an attempt to treat morbid (severe) obese males using exercise without diet restriction and maintaining the daily energy expenditure and find out the effects on the physiological variables. To our knowledge, the literature does not have any investigation that studied the combined aerobic and resistance training program which includes aquatic training on morbid obese subjects whose BMI is 40 kg/m^2 or more and using several training methods. In a way this study was unique and innovative as it was dealing with the highly morbid obese subjects. Therefore, the purpose of this study was to evaluate the effects of combined aerobic and resistive training on the time course of changes in lipids, lipoproteins, and glucose in sedentary morbid obese males.

MATERIALS AND METHODS

Thirty healthy sedentary morbid obese males between the ages of 18 to 35 years were recruited from volunteers who answered to the advertisement in the local newspapers and the notice circulated in the King Fahd University of Petroleum & Minerals (KFUPM) campus. The selection criteria of the subjects for the study were based on the BMI, and the subjects were required to have BMI of 40 kg/m^2 and above. This was decided after taking the weight of the subject in kilo grams and dividing by height in $meters^2$. After the conclusion of height, body mass, and body mass index measurements, only the obese subjects; whose BMI is 40 kg/m^2 or more were allowed to participate in the study. The subjects also had to pass a physical examination, and qualify as having a sedentary life style as indicated by the laboratory of Physiological hygiene activity. The selected criterion variables were tested with relevant criterion measures through a pilot study. Subsequently, the selected subjects were divided into two groups. Each group consisted of 15 subjects. Group 1 was exposed to Aerobic-Resistance training, and group 2 was designated as control group. The control group was instructed to maintain their regular daily activities and to avoid any additional strenuous physical activity during the study. These subjects were also asked not to participate in any type of aerobic and resistance training along the study. The subjects in the experimental group were instructed to perform exercise in each training session with gradually mild effort. The subjects were also instructed to maintain their normal dietary practices throughout the study. The investigator held series of meetings with the subjects after the formation of the groups and explained the objective and purpose of the study.The participants were requested to cooperate and participate actively as subjects for the study. The willingness of the subjects was ascertained for their voluntary participation during the training program. The subjects were informed to withdraw their consent in case they felt any discomfort during the period of their participation. The following variables were selected to assess the influence of aerobic-resistance training program on the subjects selected for the study. Age, height, body mass, body mass index, Fasting blood Glucose, total cholesterol, HDL-C, LDL-C, Triglyceride, HR peak during sub-maximum exercise. The training program for the experimental group was administered for a period of 90 minutes 5 times per week. The duration of the total training period was twelve weeks. The training program consisted of 4 methods called treadmill walking, cycling, aquatic (swimming pool), and resistance (machines). All the subjects were tested prior to and after twelve weeks of aerobic-resistance training. The test procedure administered was verbally explained and practically demonstrated. Quarries and doubts were answered if any. Exercise energy

expenditure was calculated per day for each subject in the training group only during walking, cycling, and aquatic and resistance exercises. The total energy expenditure of 12 weeks was calculated for the purpose of prediction of weight loss at the end of the training program. Energy intake was calculated for all subjects in the training group only using self-report method for 3 days including one weekend day before exercise training and at 4, 8 & 12weeks. The ethics committee of research KFUPM was approached for its approval. Subjects who developed any medical or orthopedic problems and complications during the course of the study were asked to withdraw. Statistical analysis was performed using SPSS version 16.0 software. Mean and standard deviations were calculated for all values. Paired t-tests were used to identify any significant differences within each group when the pre-test was compared with the post test for the dependent variables. Magnitude of changes in the training group was compared using independent t test on the difference (post-test minus pre-test) scores for the dependent variables. The alpha level was set at 0.05 in order for the difference to be considered significant.

RESULTS

Table 1 Physical Characteristics Means ± SD of the Training Group and the Control Group Measured pre and post training

Variables	Tests	Training Group (n=5) Mean ± SD	Control group(n=5) Mean ± SD	P value
Age (y)	Pre	26.60 ± 9.23	20.80 ± 2.04	NS
H (m)	Pre	1.76 ± 0.02	1.76 ± 0.08	NS
BM (kg)	Pre	132.92 ± 14.26	143.72 ± 36.33	NS
	Post	124.38 ± 16.66	145.38 ± 36.86	NS
	Post - Pre	-8.54 ± 4.14	1.6 ± 1.90	001*
BMI (kg/m^2)	Pre	42.70 ± 4.78	46.24 ± 10.63	NS
	Post	40.04 ± 3.33	46.75 ± 10.94	NS
	Post - Pre	-2.66±2.36	0.65±0.79	.03*

*H: height; BM: body mass; BMI: body mass index; y: year; m: meter; kg: kilograms; Pre: before training; Post: after training; SD: standard deviation; kg/m^2: kilogram per square meter; n: number of subjects; NS: not significant; *: significant*

It can be seen from table 1 that there were no significant differences ($p > 0.05$) between groups for all physical characteristics variables before and after training except the body mass. The training group showed significant decrease in body mass mean difference (post – pre) in respect with the control group (-8.54 ± 4.14 vs. 1.66 ± 1.90 kg; $p < 0.001$, respectively). Paired t-test also illustrated no significant differences within groups when post-test was compared with pre-test in all physical characteristics variables except for body mass. Body mass in the training group decreased significantly by 6.4% (132.92 ± 14.26 vs. 124.38 ± 16.66 kg; $p = .01$) after training, which is illustrated in figure 1.

Figure 1 showing the body mass means ± SD for pre and post-test for training group and control group

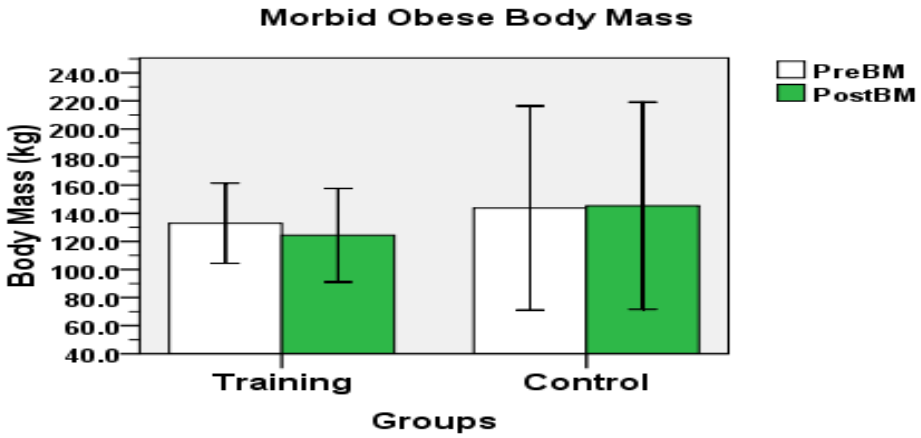

Table 2 indicated that there were no significant differences in all blood tests between groups ($p > 0.05$) using independent t-test. The training group showed significant decrease by 5.8% in the mean difference of LDL – Cholesterol when post-test was compared with pre-test (117.00 ± 13.19 vs. 124.20 ± 16.30 mg/dl;$P< 0.02$, respectively) using paired t-test.

Table 2 showing the pre and post Blood Test Means ± SD of the Training Group and the Control Group

	Training Group (n=5)			Control Group (n=5)		
Blood Tests	**Pre-Test**	**Post-Test**	**Differ**	**Pre-Test**	**Post-Test**	**Differ**
TC (mg/dl)	183.25 ± 27.01	170.82 ± 12.43	-12.42 ± 20.90	187.40 ± 41.71	199.46 ± 37.99	11.90 ± 29.11
HDL (mg/dl)	34.80 ± 7.15	38.17 ± 7.30	3.42 ± 6.08	39.50 ± 7.23	41.97 ± 5.25	2.47 ± 2.48
LDL (mg/dl)	124.20 ± 16.30	117.00 ± 13.19	-7.20 ± 4.26*	126.40 ± 40.48	144.20 ± 39.15	17.80 ± 39.48
TG (mg/dl)	98.80 ± 38.54	98.31 ± 53.07	-0.50 ± 26.85	126.80 ± 41.64	128.33 ± 30.00	12.62 ± 29.37
FBG (mg/dl)	87.80 ± 6.61	92.14 ± 4.95	4.36 ± 5.16	90.60 ± 5.54	95.76 ± 3.06	5.16 ± 4.60

*TC: total cholesterol; HDL: high density lipoprotein; LDL: low density lipoprotein; TG: triglycerides; FBG: fasting blood glucose; Pre-Test: before training; Post-Test: after training; Differ: mean differences; n: number of subjects, *: significant*

DISCUSSION

The main findings of this study have shown some interesting observations with regard to the physical characteristics and also the bio-chemical variables. With regard to the physical characteristics, when the mean difference of the body mass between the experimental and control groups was compared, it did not yield any significant result. But on the other hand when the post test scores were compared with the pretest, it elicited significant difference in the experimental group. This difference may be attributed to the training effect where in the weight loss was observed due to the protocol, which was strenuous enough exceeding the normal prescribed schedule of 3 days of 60 minutes of moderate intensity exercise per week, whereas the study program load was scheduled for 5 days per week for a period of 90 minutes per session of moderate to high intensity exercise.

Further it is also noted that since there was a significant effect on the body mass, the comparison of the post test scores of the experimental group with regard to the body mass index showed significant differences which indicate that the morbid obese had a beneficial effect of the training program which corroborated the studies done by[23,9,29].

All these studies have resulted in the reduction of BM of the training groups making it very clear that aerobic training combined with the resistance training and aquatic training will certainly be a factor in weight loss program for the obese males.

The bio-chemical variable in which the tests were conducted for the morbid obese were total cholesterol, high density lipoproteins, low density lipoproteins, triglycerides and fasting blood glucose. It is pertinent to note here that obesity is associated with an increased risk of low density lipoproteins, triglycerides, glucose intolerance and a decrease in high density lipoproteins. The loss of body mass in obese subjects has shown to elevate the concentration of HDL cholesterol and decrease the LDL cholesterol. The results of the study have shown that all the variables under the study did not yield any significant difference between the post and pretest of the experimental and control group except the LDL cholesterol. The training group has shown significant decrease in the LDL cholesterol which is in line with the earlier studies of [4,1,2,28,11,5,26]. The decrease in LDL is a good sign as the evidence suggests that low LDL levels are of a healthy nature. The total cholesterol, HDL, triglycerides and fasting blood glucose did not show any significant effect in the training group even though the training was of very intensive nature of five days per week, for 90 minutes per session for twelve weeks. The influence of the regularity in training might have had made the difference as the average attendance of the training group was 44 sessions out of 60. This apart one of the main causative factor in not yielding any change in the bio-chemical variables between the groups and within the groups may be that all the subjects had a normal range of values in the bio-chemical variables at the commencement of the training protocol.

Another feature of this study was that the protocol did not restrict the consumption of daily nutrition. Many studies have combined aerobic training and diet control for the weight loss program. The present study did not monitor the diet as it was to find out how the weight loss can be accomplished without the influence of diet. The results have indicated that there was not much significant change in the bio-chemical variables with training only.

Studies on the morbid obese whose BMI was 40 and more are rare as not a single study used BMI >40 kg\m^2 to find out the effect of the combined aerobic and resistance training on the physical characteristics and bio-chemical variables on such a strata and that too training with 90 minutes per session, five days a week for 12 weeks without diet restrictions. Apart from the reasons quoted earlier for the insignificant result, there is a possibility that the number of subjects in the experimental group being very low might have influenced the result. The study commenced with around 30 morbid obese subjects in the experimental and control group. It continued with satisfaction till the middle of the period of the program. But later due the heavy load of training there were musculo-skeletal injuries which adversely affected the total number of subjects in the experimental group. The injuries were

so intense that they had to discontinue the training program and the recovery took a very long period. All of such subjects were not considered for the post test after the completion of the program.

Hence, the scheduling of the program for such a group of obese males should be taken care. The protocol should not stress the joints of the subjects specially the lower extremities to much as the knees feel the toll of the weight and lead to musculo skeletal problems. Although the results had some beneficial effect, the present study has thrown some light on monitoring of the program intelligently.

CONCLUSION

It was concluded that there was significant difference in the body mass and body mass index of the experimental group when the post test was compared to the pretest. It was also observed that there were no significant changes in all the bio-chemical variables of experimental and control group. Further it was found that the LDL was the only bio-chemical variable that showed the significant difference in the experimental group. The major conclusion of the study was the scheduling of the program for morbid obese which has to be monitored intelligently for taking up the weight loss program.

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