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The Comparison of EMS and Resistance Training in Reducing Cholesterol Level in Overweight People

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Abstract: The aim of this study was to determine the effects of Electro Muscle Stimulation (EMS) in comparison with Resistance Training (RT) on reducing cholesterol levels of university students. To do this, 90 male students were participants of this study. They were classified into 3 groups as EMS (n = 30), RT (n = 30) and control (n = 30). The analyses of these groups after 16 weeks exercise revealed that RT was more effective to reduce CK.

Key words: Resistance training, cholesterol levels, electrical muscle stimulation, RT, CK

INTRODUCTION

Overweight has several negative consequences such as blood pressure (hypertension), stroke, heart disease, hyperlipidemia, non-insulin-dependent diabetes mellitus, osteoarthritis, mood disorders, sleep disorders, eating disorders, gout, gall bladder, some cancer and most importantly body deformity that so many people suffer from which has physiological consequences by itself. That is why almost all fat people seek for the way which can help them overcome this problem efficiently.

One way to decrease weight is adhering to a diet. Diet has several negative outcomes such as a decrease the rate of metabolism and set point, psychological effect. Furthermore, in the case of stopping the diet the possibility of returning to the past condition is high (NHLBI, 1998).

Second way to deal with fatness is taking medication including acupuncture in this way people trying to lose weight using chemical drugs such as fat burner or even surgery. These also have their own side effects such as liver disorder, infection and related problems.

The third way to decrease weight is doing exercise (National Institutes of Health). There are two types of exercises, anaerobic and aerobic. Typically, the most common exercise regime used in an overweight or obese population is steady-state aerobic exercise. In the anaerobic methods such as resistance exercise and weight training one should exercise at least three times a week for 30 min. Although, this method is useful in decreasing weight, it has several consequences such as time consuming, cost consuming and related injuries in the case of inappropriate exercise. Moreover, an aerobic exercise builds power and muscle mass but its fat burning is not satisfactory. In the aerobic type of exercise, one should exercise continuously activities in rhythmic nature, 3-6 times a week for at least 30 min such as running, jogging and bicycling and related aerobic exercises. For fat people this method is difficult and harmful because it many affect their knee joint and in the case of aged people, it can affect their heart as well and as a result, it increases the chance of heart attack.

The fourth and the most popular way to lose the weight is the mixed method. In this method, people take the mixed diet, medication and exercise but this method also has the problem of all methods for overweight people as well.

Electro muscle stimulation: Electro stimulation can be used for muscle toning, muscle building, prevention of muscle atrophy, building stamina and strength or for medical reasons such as pacemakers. An efficient stimulation would be one of three ways: low intensity, low rate and long time; medium intensity, medium rate and medium time; strong intensity, high rate and short time. Various electric muscle stimulation devices are available today, in transcutaneous devices, in which the electrodes are placed on the skin; implant devices, in which the electrodes are placed inside the body (one example is a pacemaker); percutaneous (acupuncture) devices which clone natural motor signals and put them into peripheral nerves; functional movement devices which are used when there is damage to nerve cells in the brain or the spinal cord and magnetic induction which uses high intensity magnetic fields to generate electricity for the stimulation of motor nerve fibers. Eriksson and Haggmark (1979) and Gibson *et al.* (1989) in their study have shown despite the fact that EMS training produces similar effects to resistance training (e.g., increases in muscle strength and size) or minimises muscle atrophy caused by disuse.

Fujita reported that the combined using of electrical stimulation and resistance isometric contraction on muscle could prevent atrophy in the rat tibialis anterior muscle.

Other researchers have determined the electrical muscle stimulation has positive result on perceived body satisfaction and tone of the subjects.

Objectives: Taking the above concerns into consideration, the main objective of the study is to estimate and compare the effects of EMS and resistance exercise on cholesterol levels.

Hypothesis: The EMS is effective for reducing cholesterol levels than resistance training.

Significance of the study:

- This study will help provide information about losing weight by EMS device is propagated on television and in magazines
- Coaches can use these results to structure and implement specific workout and gain more knowledge about overweight
- This study will compare resistance training and electro muscle stimulation to estimate the level of cholesterol

Literature review

Lifestyle and inactivity role of overweight: Progress in all aspect of life and innovate new machines for comfort and better life, cause human not only inactive but also fatter. The dependence on the automobile for nearly all transportation needs is a significant factor in physical inactivity and therefore the current epidemic of overweight and obesity.

Street and community design features of suburbs privilege automobile safety and have shown to discourage walking and bicycle riding activities both for daily errands and recreation.

Also, there has been much research on the relationship between television viewing, physical activity and body composition of adults (Jeffery and French, 1998; Mokdad *et al*., 1999; Buchowski and Sun, 1996).

Lifestyle interventions for weight loss that combine reductions in energy intake with increases in energy expenditure through exercise and other forms of physical activity typically result in an initial 9-10% reduction in body weight (Wing *et al*., 1998). However, physical activity appears to have little impact on the magnitude of weight loss observed across the initial 6 months intervention compared with reductions in energy intake (NHLBI, 1998). Thus, the combination of modest reductions in energy intake with adequate levels of physical activity is necessary to maximize weight loss in people with overweight and obesity (NHLBI, 1998).

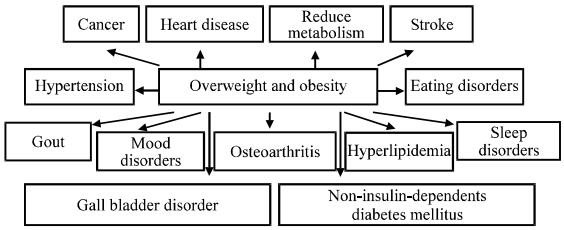

Fig. 1: Problems associated with overweight and obesity

Consequences of overweight and obesity: Overweight is a common health problem in many countries because of its increasing prevalence, association with serious medical diseases (Fig. 1), psychosocial aspects and considerable economic impact.

Health risks associated with being overweight or obese: Above an initial BMI of 20 kg/m^2, morbidity for a number of health conditions increases as the BMI increases. Higher morbidity in association with overweight and obesity has been observed for hypertension, type II diabetes, Coronary Heart Disease (CHD), stroke, gallbladder disease, osteoarthritis, sleep apnea and respiratory problems and some types of cancer (endometrial, breast, prostate, colon) (NHLBI, 1998).

Overweight and obesity is also associated with complications of pregnancy, menstrual irregularities, hirsutism (presence of excess body and facial hair), stress incontinence (urine leakage caused by weak pelvic floor muscles), psychological disorders (depression) and increased surgical risks (NHLBI, 1998).

The nature of overweight-related health risks is similar in all populations, although, the specific level of risk associated with a given level of overweight or obesity may vary with race/ethnicity and also with age, gender and societal conditions. The absolute risk of morbidity in chronic conditions such as CHD is highest in the aged population while the relative risk of having CHD in obese versus non-obese individuals is highest in the middle adult years (Feinleib, 1985).

High total cholesterol: At each BMI level, the prevalence of high blood cholesterol is greater in women than in men. Higher body weight is associated with higher levels of total serum cholesterol in woman at levels of BMI >25 (Denke *et al*., 1994). Several large longitudinal studies also provide evidence that overweight, obesity and weight

gain are associated with increased cholesterol levels (Ashley and Kannel, 1974; Shekelle *et al*., 1981). In addition, the pattern of fat distribution appears to affect cholesterol levels independently of total weight. In women, the incidence of hyper-cholesterolemia also increases with increasing BMI (Manson *et al*., 1990). Total cholesterol levels are usually higher in persons with predominant abdominal overweight, defined as a waist-to hip circumference ratio of ≥0.8 for women and ≥1.0 for men (Reeder *et al*., 1992).

Low levels of high-density lipoprotein cholesterol: High Density Lipoprotein (HDL)-cholesterol levels at all ages and weights are lower in men than in women (NHLBI, 1998). There is a strong negative correlation between plasma HDL and relative weight (proximity to ideal weight). HDL increases during weight reduction in the obese. Exercise also increases HDL which reinforces the importance of physical activity in weight reduction. A 10% decrease in weight typically decreases cholesterol by 11 mg/100 mL (National Cholesterol Education Program Expert Panel, 1994).

Normal to elevated low-density lipoprotein cholesterol: The link between total serum cholesterol and CHD is largely due to Low-Density Lipoprotein (LDL). A high-risk LDL-cholesterol is defined as a serum concentration of ≥3.4 mmol L^{-1}. This lipoprotein is the predominant atherogenic lipoprotein and is therefore the primary target of cholesterol-lowering therapy (NIH, 1998). According to extensive epidemiological data, a 10 mg/100 mL rise in LDL-cholesterol corresponds to approximately, a 10% increase in CHD risk over a period of 5-0 years (Law *et al*., 1994).

MATERIALS AND METHODS

Subjects: A group of 60 overweight male between the ages of 19-25 years randomly selected from the Islamic Azad University of IRAN those selected should not have been involved in any recruitment program for at least 6 months prior to the study, not had any injury in their body. Subjects were required to be physically suitable for a program of Electrical Muscle Stimulation (EMS) and program of resistance training performed in the Gym's university. So, prior to final selection they are checked out by a physician.

During the experimental period, subjects were asked not to change their diet habits and not to take any medicines. They had to avoid consuming caffeine and alcohol one day before the EMS session and not indulge in any physical activity during the experimental period.

Procedure: All potential subjects were provided with detailed written and oral descriptions of the study procedures. They were familiarized with the facilities and equipment to be used. The following specific exclusion criteria were applied:

- A history of orthopedic, cardiovascular, pulmonary or metabolic disease, hypertension, epilepsy, neurological and neuromuscular disorders which could have contra-indicated exercise testing
- Diabetes for those who could not follow the test
- Vegetarianism and the presence of specific food allergies
- Medication usage

Study design: In order to achieve the goal of the study to evaluate the effect of Electro Muscle Stimulation (EMS) and resistance training to know which training method is beneficial to lose cholesterol levels in overweight people; subjects were randomly assigned to one of the following three groups:

Group EMS (N = 20) (electro muscle stimulation groups): Subjects received electric muscle stimulation of 6 muscle groups (rectus abdominis, internal and external obligue, transvers abdominal obligue, gluteal, quadriceps, hamestring) with 60-70% maximum tolerated intensity, 1 h session (30 min for waist area and 30 min for hip area), 3 time per week for 16 weeks).

Group RT (N = 20) (Resistance Training groups: Subjects were trained at 60-70% maximum strength. The 6 muscle groups (rectus abdominis, internal and external obligue, transvers abdominal obligue, gluteal, quadriceps femoris, hamestring) will exercise with 3 sets of 10 repetition in each muscle group, 1 h session, 3 times per week for 16 weeks.

Group control (N = 20) (control group): In order to enhance compliance, personal follow-up phone calls were made and a motivation session was conducted every Thursday evening over the duration of the study.

RESULTS

Repeated measure ANOVA revealed a significant decrease in cholesterol units from 185.84-163.61 mg dL^{-1} from pre-testing to 16 weeks irrespective of the group which was statistically significant. F-value of 60.416 was found to be significant at 0.000 level. Further, when the decrease in cholesterol was verified across 3 different groups-EMS, RT and control; again a significant F-value was observed ($F = 15.008$; $p = 0.000$) indicating a differential decrease among groups from pre-testing to

Table 1: Mean cholesterol scores of EMS RT and control groups from pre testing to 16 weeks

	PRE		4 weeks		8 weeks		12 weeks		16 weeks	
Groups	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
EMS	186.50	27.24	166.50	36.90	168.30	31.70	159.20	31.93	160.07	31.97
RT	186.07	29.45	176.30	33.85	165.10	35.35	156.03	31.00	149.20	28.87
Control	184.97	30.60	184.53	33.68	184.97	34.26	183.13	37.39	181.57	37.97
Total	185.84	28.81	175.78	35.23	172.79	34.55	166.12	35.34	163.61	35.46

Table 2: Results of repeated measure ANOVA for mean cholesterol scores of EMS RT and control groups from pre testing to 16 weeks

Source of variation	Sum of squares	df	Mean square	F-values	p-values
Within subject effects					
Change	27724.413	4	6931.103	60.416	0.000**
Change x Group	13773.920	8	1721.740	15.008	0.000**
Error (change)	39923.267	348	114.722		
Between subject effects					
Intercept	13441421.176	1	13441421.176	2703.676	0.000
Group	27432.658	2	13716.329	2.759	0.069^{NS}
Error	432523.567	87	4971.535		

F: Fisher's value; P: Probability; **Sig. at 0.01 level; NS: Non-Significant

16 weeks. From the mean values, it is clear that EMS group reduced its cholesterol by 26.43 mg dL^{-1} from pre-testing to 16 weeks (from 186.50-160.07 mg dL^{-1}), RT group reduced its cholesterol by 36.87 mg dL^{-1} (from 186.07-149.20 mg dL^{-1}) and lastly control group decreased its cholesterol by just 3.4 mg dL^{-1} (from 184.97-181.57 mg dL^{-1}). On the whole we find that RT group reduced its cholesterol maximum followed by EMS group and control least from pre testing to end of the 16 weeks (Table 1 and 2).

In between subject effects, a non-significant difference was observed between 3 groups where F-value of 2.759 was found to be statistically non-significant ($p = 0.069$).

DISCUSSION

The resistance training was more effective in reducing cholesterol levels than EMS and control groups. Research hypothesis (the EMS is effective for increasing cholesterol levels than resistance training) formulated for comparison of effectiveness of EMS and RT groups for cholesterol is rejected. A significant decrease in cholesterol was seen in EMS 26.43 mg dL^{-1} and RT 36.87 mg dL^{-1}. The reduction found in RT group is higher than the RT group (10.44 mg dL^{-1}). Thus, EMS was not much effective in decreasing cholesterol than RT group.

Studies conducted on reduction of cholesterol could be summarized as below. A researcher found that resistance training was effective in lowering lipid concentrations however others report less clarity on the efficiency of resistance training in reducing cholesterol levels. Another one found no change in level of cholesterol with electro muscle stimulation group. Prabhakaran *et al.* (1999), studied the effects of 14 weeks resistance training programme, found a decrease in the total cholesterol. Javier Ibanez have shown that a 16 weeks whole-body resistance training program decrease cholesterol level in obese women. Others worked on 32 obese Iranian men (BMI≥30) and found a significant decrease in cholesterol after whole body resistance training. Bishop *et al.* (2004) in his study found that cholesterol significantly decreases in aerobic group than resistance training groups. Barbara in their study found that RT may result in favorable changes in cholesterol levels in men and women. Dessein *et al.* (2000) in their study on 13 obese males during 16 weeks diet recorded a decrease in cholesterol level.

CONCLUSION

An increased of lipid level in the blood is termed hyperlipidemia. Cholesterol and triglycerides are the two most common lipids associated with Coronary Heart Disease (CHD) risk. These fats do not circulate freely in the blood plasma but they are rather transported in combination with a carrier protein to form a lipoprotein. Serum cholesterol represents a composite of the total cholesterol contained in the different lipoproteins. The distribution of cholesterol among the various types of lipoproteins may be a more powerful predictor of heart disease than simply the total quantity of plasma lipids. The quantity of LDL and HDL as well as the specific ratio of these plasma lipoproteins to each other and to total cholesterol, may provide a more meaningful signal than cholesterol per se in predicting the probability of contracting coronary heart disease.

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