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Effect of Aerobic Interval Training Program in Reducing Abdominal Obesity in Patients with Metabolic Syndrome

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Abstract:
Abdominal obesity is the major and most significant component that indicates the presence of metabolic syndrome along with the other factors like hypertension, hypercholesterolemia and diabetes mellitus which has become the most throbbing health issue among the urban population in the last decade. This is a pre test and post test quasi experimental study design. A total of 20 patients of age group 25-40 years, both sexes were chosen based on the inclusion criteria and were subjected to aerobic interval training for a total period of 12 weeks. The only outcome measure was abdominal girth as it was the primary component of the metabolic syndrome which was measured before and after interval training program. The data was analyzed by student "t" testing. The results showed significant difference in the pre and post test values of abdominal girth measure for the subjects who underwent aerobic interval training. The study concluded that aerobic interval training was an effective strategy to reduce the abdominal girth measure among individuals with metabolic syndrome.

Key words : *Aerobic Interval Training, Abdominal obesity, Metabolic Syndrome*

1. Introduction

Metabolic syndrome is a disorder of energy utilization and storage, diagnosed by a co-occurrence of three out of five of the following medical conditions: abdominal (central) obesity, elevated blood pressure, elevated fasting plasma glucose, high serum triglycerides, and low High-Density Lipid cholesterol (HDL) levels. Metabolic syndrome increases the risk of developing cardiovascular disease, particularly heart failure, and diabetes *Alberti, KGMM; Zimmet (1999). The International Diabetes Federation consensus worldwide definition of the metabolic syndrome (2006)* is: Central obesity (defined as waist circumference with ethnicity-specific values) AND any two of the following: Raised triglycerides: > 150 mg/dL (1.7 mmol/L), or specific treatment for this lipid abnormality. Reduced HDL cholesterol: < 40 mg/dL (1.03 mmol/L) in males, < 50 mg/dL (1.29 mmol/L) in females, or specific treatment for this lipid abnormality. Raised blood pressure (BP): systolic BP > 130 or diastolic BP >85 mm Hg, or treatment of previously diagnosed hypertension. Raised fasting plasma glucose (FPG) : >100 mg/dL (5.6 mmol/L), or previously diagnosed type 2 diabetes. If FPG is >5.6 mmol/L or 100 mg/dL, an oral glucose tolerance test is strongly recommended, but is not necessary to define presence of the syndrome. Excess adipose tissue releases several products that apparently exacerbate these risk factors. They include Non Esterified Fatty Acids (NEFA), cytokines, PAI-1, and adipose nectin. A high plasma NEFA level overloads muscle and liver with lipid, which enhances insulin resistance. High CRP levels accompanying obesity may signify cytokine excess and a pro inflammatory state. An elevated PAI-1 contributes to a prothrombotic state, whereas low adiponectin levels that accompany obesity correlate with worsening of metabolic risk factors. The strong connection between obesity (especially abdominal obesity) and risk factors led ATP III to define the metabolic syndrome essentially as a clustering of metabolic complications of obesity. *Scott M. Grundy, MD, PhD; 2004*. Several lines of evidence suggest greater aerobic and cardiovascular adaptations after high-intensity exercise than with low and moderate levels in patients with coronary artery disease, The rationale for interval training is that it allows for rest periods that make it possible for patients with heart failure to complete short work periods at a higher intensity (which challenges the heart's pumping ability) than would be possible during continuous exercise. The purpose of this study was to determine the effects of aerobic interval training in reversing the abdominal obesity component of metabolic syndrome.

2. Methodology

This study is a, pretest and post test quasi experimental study design, conducted at the Department of Cardiac Rehabilitation/ Preventive Cardiology of K.G Hospital, Coimbatore, Tamil Nadu, India. Around (N=38) patients diagnosed by the clinical physician as having Metabolic Syndrome while presenting in the doctor's outpatient department were short listed, based on the inclusion criteria, which constituted of an age group (25 - 40 years), both sexes, any two factors of metabolic syndrome (Hypertension, Hypercholesterolemia, diabetes mellitus) along with abdominal obesity. The patients who related to the *ACSM*

2005 guidelines for exercise and prescription , that is (100-120 cms for men and 90-109 cms for women) were only taken into consideration , as this study focused only on the abdominal obesity risk component of Metabolic Syndrome.
Patients with complicated myocardial infarction, any loco motor disability, exacerbated Chronic Obstructive Pulmonary Disease (COPD), patients unable to understand the concept of exercise testing and subjects with neuromuscular abnormalities were excluded. Out of 38 subjects who were shortlisted initially (N=20) subjects were finalized and consented to the study. The base line measurement was taken using an inch tape at the umbilical level at maximal inspiration at 0 week. The Target Heart Rate (THR) was also calculated using Karvonen's formula for each individual subject on the treadmill using Bruce protocol. For a total duration of 12 weeks, the subjects worked at 75% of the HR_{max} for 30 minutes (work interval) at each session for 3 days a week using the interval training mode on the treadmill. The primary outcome measure that is the abdominal girth was measured at the end of the12^{th} week for all 20 subjects.

2.1. Aerobic Interval Training
The subjects were measured for their resting blood pressure and given a brief instruction and demo on the treadmill prior to commencement of the intervention. They walked at a normal speed for 5 minutes as a warm up at 50-55% of HR_{max} and increased the speed to attain 75% of HR_{max} as the target zone exercising. The subjects were instructed to walk at a ratio of 1:1 of work interval to rest interval on the treadmill. The rest interval was an active rest interval. Therefore they worked at 75% HR_{max} intensity as work interval for 5 minutes and slowed to 55 % HR_{max} as active rest interval for 5 minutes alternatively. The total work interval duration was 30 minutes and active rest interval duration was another 30 minutes interspersed alternatively. The total session time accounted for 60 minutes for an individual subject.

3. Results and Analysis
The pre and post test values were subjected to paired 't' testing . Table I and Figure I shows the results of the paired 't' test analysis of the intervention group.

	MEAN	MD	SD	't'
PRE TEST	106	2.19	3.66	(P<0.05) 10.1
POST TEST	97.4			

Table 1

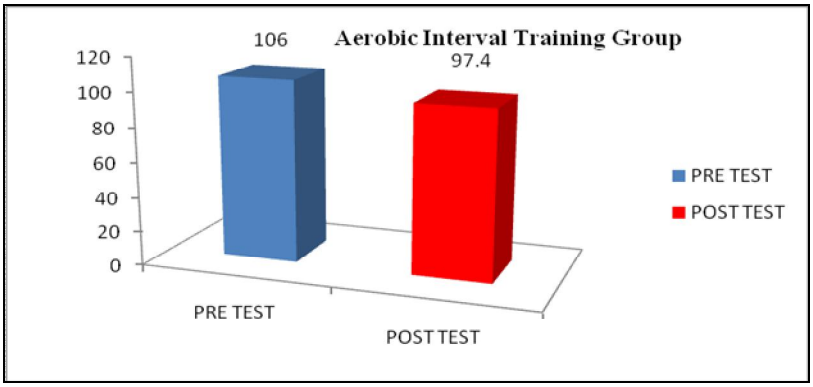

Figure 1

The above table and graph shows that there is significant reduction of the abdominal girth measurement after the aerobic interval training program denoted by a calculated 't' value of 10.1 which is greater than the tabulated 't' value at 5 % level of significance.

4. Discussion
This study was focused to determine the effects of AIT program in reversing or reducing abdominal girth which is a primary risk factor and component of metabolic syndrome. A total of 20 subjects were included and were trained on the treadmill for the period of 12 weeks using the interval training mode at 1:1 ratio. The study aimed at emphasizing that exercise intensity is an important factor for improving aerobic capacity and reversing the risk factor of the metabolic syndrome such as abdominal obesity in individuals with metabolic syndrome.
According to *Ulrik Wisløff 2008*, general agreement exists that we need better and more affordable prevention and treatmnt strategies to improve wide scale health outcome and to slow the current epidemic of overweight to prevent the epidemic of

metabolic syndrome from reaching global proportions and straining public health and the economy. Furthermore, weight reduction as complex nature, so the likelihood of a pharmacological solution is small. Infact, no available drug is ideal at the present time for most patients with metabolic syndrome. The present study suggests the exercise in general and AIT in particular is partly or fully able to reverse the metabolic syndrome, suggesting that this may be a promising treatment strategy.

Rennie . K.L .et.al 2005; suggests that those who are over weight , particularly, those who are 20 % more overweight and especially those who have abdominal obesity(big bellies, waist to hip ratio that exceed 1) are at much increased risk of developing the metabolic syndrome. Some evidence also indicated that physical inactivity is a risk factor for MS.

Askew EW, 1984; Strenuous submaximal exercise requiring 65 to 80 per cent of $VO2_{max}$ will utilize less fat (10 to 45 per cent of the energy expended). Exercise training is accompanied by metabolic adaptations that occur in skeletal muscle and adipose tissue and that facilitate a greater delivery and oxidation of fatty acids during exercise. The trained state is characterized by an increased flux of fatty acids through smaller pools of adipose tissue energy. This is reflected by smaller, more metabolically active adipose cells in smaller adipose tissue depots. Peak blood concentrations of free fatty acids and ketone bodies are lower during and following exercise in trained individuals, probably due to increased capacity of the skeletal musculature to oxidize these energy sources. Trained individuals oxidize more fat and less carbohydrate than untrained subjects when performing submaximal work of the same absolute intensity. This increased capacity to utilize energy from fat conserves crucial muscle and liver glycogen stores and can contribute to increased endurance. Further benefits of the enhanced lipid metabolism accompanying chronic aerobic exercise training are decreased cardiac risk factors. Exercise training results in lower blood cholesterol and triglycerides and increased high density lipoprotein cholesterol. High-fat diets are not recommended because of their association with atherosclerotic heart disease. Recent evidence suggests that low-fat high-carbohydrate diets may increase blood triglycerides and reduce high density lipoproteins. This suggests that the chronic ingestion of diets that are extreme in their composition of either fat or carbohydrate should be approached with caution in health-conscious athletes, as well as in sedentary individuals.

Based on the above considerations, a meaningful exercise prescription for metabolic syndrome should start with a strong base of cardio vascular exercise, but also make use of the more potent and synergistic interval and resistance modalities *Barbara Frey-Hewitt, M.S., Susan C. Garay, 1998* Walking, jogging and interval training all provide unique benefits with little time investment, for the less motivated and more obese, a simple daily walking program for 30 to 40 minutes daily would be a good start. However, for those who are motivated, want more substantial results are prone to become bed, exercise prescription should more varied. A mix of modalities would seem to be most beneficial.

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