Original Article

Cardiovascular and Electrocardiographic findings in Obese individuals at rest and using Exercise Stress Test

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Abstract

Introduction : Obesity is a common nutritional disorder and it is associated with increased mortality and predisposes to the development of various diseases. The acceptable BMI range is 20-25 Obesity is taken to start at a BMI of 30 and morbid obesity at and above 40.

Purpose : The purpose of this study is to see the cardiovascular findings, ECG changes and effort tolerance in obese individuals at rest and during TMT stress testing.

Material and Methods : The present cross sectional study included a total of 50 obese patients. A detailed history, clinical examination, requisite investigations, physical indices of built, nutrition and BMI are calculated and based upon BMI there grading of Obesity decided. In all studied patients TMT test done and interpretations of ECG, hemodynamic parameters, effort tolerance and fitness response of Obese individuals in exercise stress test documented.

Results: BMI data of studied patients showed 96 % patient have class 1 and 2 obesity while 4% patients had morbid obesity. This study also revealed various risk factors like Dyslipidemia, tobacco use, Diabetes Mellitus, alcohol consumption, family history of CAD etc. Commonly noticed abnormal cardiovascular findings in obese individuals at rest are Bradycardia, Tachycardia, Functional systolic murmurs and during treadmill stress testing (TMT) identified are Heart rate variation and fluctuation in Blood Pressure and appearance of new systolic murmur also heard.

ECG changes showed significant ST depression in about 18% of patients and T wave abnormalities are seen in 5% of studied patients. Exercise related Hypotensive response are more commonly noticed in patients who have history of Diabetes mellitus, Smoking, Alcoholism, Dyslipidemia, old coronary events and Left ventricular hypertrophy in resting ECG.

Conclusion :

There is strong evidence that IHD is common in obese individuals. The effort tolerance was found to be very poor in 20% of obese patients. Reduction of weight and control of risk factors like diabetes, cholesterol, alcohol and smoking may contribute to lower the incidence of cardiovascular diseases.

Key words : BMI, Obesity, TMT, Dyslipidemia, Diabetes mellitus, Effort Tolerance.

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INTRODUCTION

Obesity is a common nutritional disorder in affluent societies. It significance requires constant emphasis because it is associated with increased mortality and predisposes to the development of important diseases and diminishes the efficiency of those affected[1]. Weight of persons 20% above the ideal weight substantially increases the rate of morbidity and mortality. The incidence of obesity is proportional to the availability of food for excess consumption. Hence the incidence of obesity would be higher in affluent countries or amongst people belonging to higher economic strata in countries like India

The higher degree of health awareness may modify this statement. Obesity usually is defined as the presence of an abnormally large amount of adipose tissue. When the amount adipose tissue is very large the diagnosis is labeled "Morbid obesity". The recent recognition that the pattern of distribution of adipose tissue throughout the body affects metabolic consequences and may be more important factor than total adipose tissue mass thus a person with fat located predominantly in the abdominal region may be at greater risk of hypertension, heart diseases and diabetes mellitus than another individual with a greater total amount of adipose tissue that is located predominantly in gluteal region[2].

Classification of Weight Status and Obesity -

	BMI (kg/m²)	Obesity class
Underweight	<18.5	
Healthy weight	18.5-24.9	
Overweight	25.0-29.9	
Obesity	30.0-34.9	1
Obesity	*35.0-39.9*	*2*
Extreme Obesity	≥ 40	3

The most commonly anthropometric measure in obesity clinics and medical practice are weight and height. They have the advantages of wide availability of equipment, ease and accuracy of use general acceptability to patients in fact most patients define obesity on the basis of body weight. The basic problem with this measure is that body weight is strongly correlated with body height and for this reason, not a good measure of body fat[3]. Studies have shown that the body mass index (BMI) related closely to body fat while being quite independent of height although the calculation of BMI is more complex than that of relative weight, its interpretation possibly is more simple once BMI is calculated, therefore it can be related to a single set of easily memorized standards[4].

Simple measurement of weight does not give very useful information. If weight is adjusted to height and age and compared with desirable weight derived from longitudinal population. Studies it can give a very good idea about obesity. Individual with 20% above the ideal weight can be diagnosed as obese. Obesity exist when adipose tissue make up greater than "Normal" fraction of total body weight. In male subjects aged 18 years approximately 15 to 18% of body weight is fat.

"Body fat content greater than 28% of total body weight for men and greater than 30% for women is obesity". The problem with this definition is that body fat is difficult to measure in the clinical setting. The basic mechanism behind obesity is excess fat accumulation, because of imbalance between energy and expenditure. This can arise in different ways and obesity is clinical sign with several possible causes[5]. There is no aetiological classification of obesity but a number of factors are known to be associated with its development, like age, socio- economic status, heredity, endocrine factor energy balance etc. BMI is used to define nutritional status it is derived from formula = weight (kg.)/height (m²).

The acceptable (normal) range is 20-25 Obesity is taken to start at a BMI of 30 and morbid obesity at and above 40. Therefore, awareness of obesity consequences in relation to cardiovascular disorders and to identify strongest predictors from ECG and tread mill testing will be main objective of this study. The purpose of this study is to see the cardiovascular findings in obese individuals at rest and during tread mill stress testing and to see the electrocardiographic findings in obese individuals at rest and during tread mill stress testing and also to look for the effort tolerance of obese individuals using tread mill stress testing

MATERIAL AND METHOD

The present cross sectional study included a total of 50 obese patients attending the Cardiology outpatient department (OPD) of Superspeciality Hospital Netaji Subhash Chandra Bose Medical College (SSH, NSCBMCH), Jabalpur India. Patients who are having history of Acute coronary syndrome in the past or having baseline ECG changes are excluded from the study, presence of signs and symptoms of C.C.F., fresh changes in ECG, Hypertension, Various conduction blocks in ECG, Any congenital heart disease, suspected cases of ventricular aneurysm, myocarditis, pericarditis, pericardial effusion, chronic corpulmonale, severe anaemia (Hb < 7 gm%), Acute non cardiac illnesses or musculo-skeletal abnormalities are excluded from the study.

A total of 50 obese individuals were included in study. A proforma was prepared which included detailed history, clinical examination and requisite investigations. A detailed indices of built, nutrition, systemic examination and cardiovascular examinations performed, Height, Body weight and BMI of all patients are calculated and based upon BMI there grading of Obesity decided. Besides routine investigations specific investigations related with study like Serum Total Cholesterol , Serum Triglyceride, Serum HDL, Serum LDL, Serum VLDL, CPK MB, 12 lead ECG, 2 D Echocardiography and Exercise stress test were performed.
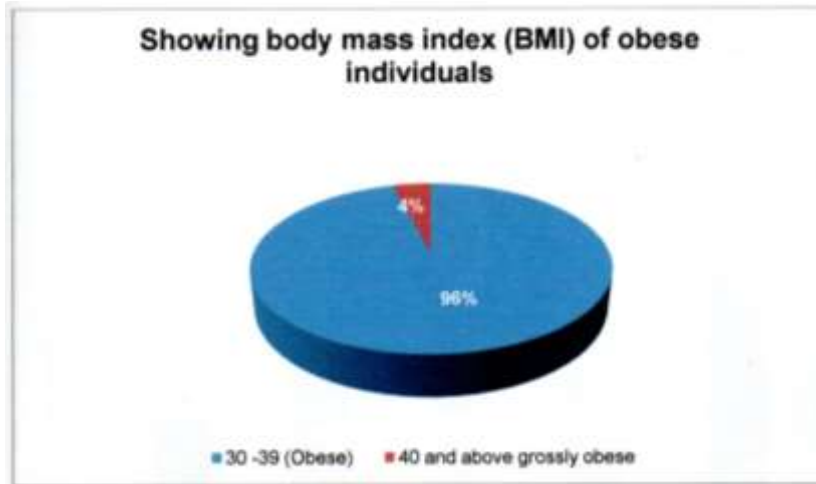
In Exercise stress test modified Bruce's protocol used and CMS monitoring lead system were used. Total exercise time, Maximal 02 consumption (MV02), achieved grade, achieved percentage Heart rate, performed METS , reason for terminating test, symptoms and signs during test and appearance of any new physical findings like S3, S4, Systolic murmur or rise and fall in Blood Pressure noted during exercise.

Interpretations of ECG response to Exercise like rate, Rhythm, Normal/ exercise induced arrhythmias, ST segment normal/ ischemic changes, conduction normal/exercise induced blocks are studied and documented, hemodynamic response to exercise changes in heart rate and Blood pressure noticed, R-

wave amplitude response in exercise ECG and Effort Tolerance and Fitness response in terms of Excellent / good / average / fair and poor documented
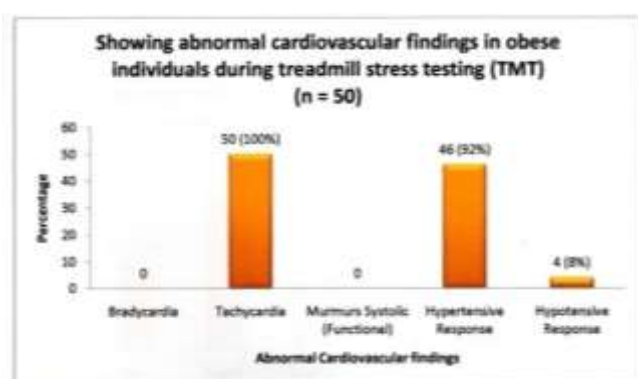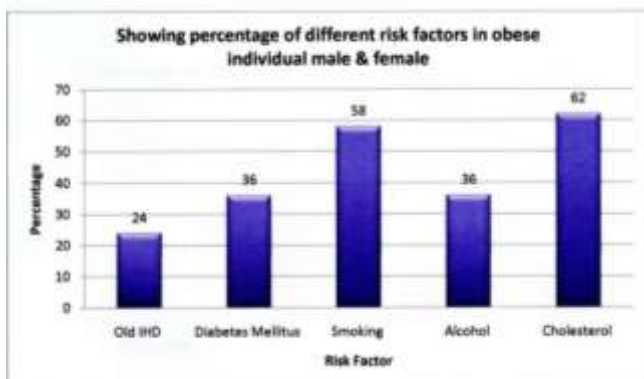
RESULTS

Between September 2022 and August 2023 total 50 obese patients attending the Cardiology OPD in superspeciality hospital, N.S.C.B. Medical College Hospital, Jabalpur (M.P.) were screened. In this study population about half of patients were of 40 to 50 years age group and in which two third are male and one third are female. BMI data of studied patients showed 96 % patient have class 1 and 2 obesity while 4% patients had morbid obesity.

Showing body mass index (BMI) of obese individuals

■ 30 -39 (Obese)   ■ 40 and above grossly obese

This study also revealed various risk factors like Dyslipidemia, Tobacco use, Diabetes Mellitus, alcohol consumption, family history of CAD etc. In this study we look for abnormal cardiovascular findings at rest and during treadmill stress testing (TMT). Commonly noticed abnormal cardiovascular findings in Obese individuals at rest are Bradycardia, Tachycardia, Functional systolic murmurs and slightly lower Blood pressure also noticed. Abnormal cardiovascular finding in obese individuals during treadmill stress testing (TMT) identified are Heart rate variation and fluctuation in Blood Pressure and appearance of new systolic murmur also heard.

Commonly noticed symptoms and signs during treadmill stress testing in obese individuals are chest discomfort, giddiness, syncopal attacks, leg cramps, breathing difficulties, arrhythmias, ST-T changes and abnormal Blood Pressure response also seen.

Showing percentage of different risk factors in obese individual male & female

Showing abnormal cardiovascular findings in obese individuals during treadmill stress testing (TMT) (n = 50)

In this study results of tread mill stress test and reasons for terminating the test are ischemic ST-T changes in 22%, achievement of 100% target heart rate in 4% and development of symptoms and signs in about 20% of studied patients.

Electrocardiographic findings in obese individuals at rest noticed are variation in Heart rate in 18% patients, abnormal rhythm in 10%, low voltage complex in ECG in 24% patients, evidence of old myocardial infarction in about 12% patients, ST-T changes in about 18% patients, left ventricular hypertrophy in 12% and T wave abnormalities present in 8% of patients.

Electrocardiographic changes documented during tread mill stress testing are increased Heart rate in all patients, atrial and ventricular ectopic also seen in almost all patients, significant ST depression seen in about 18% of patients and T wave abnormalities are seen in 5% of studied patients.

Exercise induced ST-T changes and T wave abnormalities and exercise related Hypotensive response are more commonly noticed in patients who have history of Diabetes mellitus, smoking, alcoholism, dyslipidemia, old Acute coronary syndrome and Left ventricular hypertrophy in resting ECG.
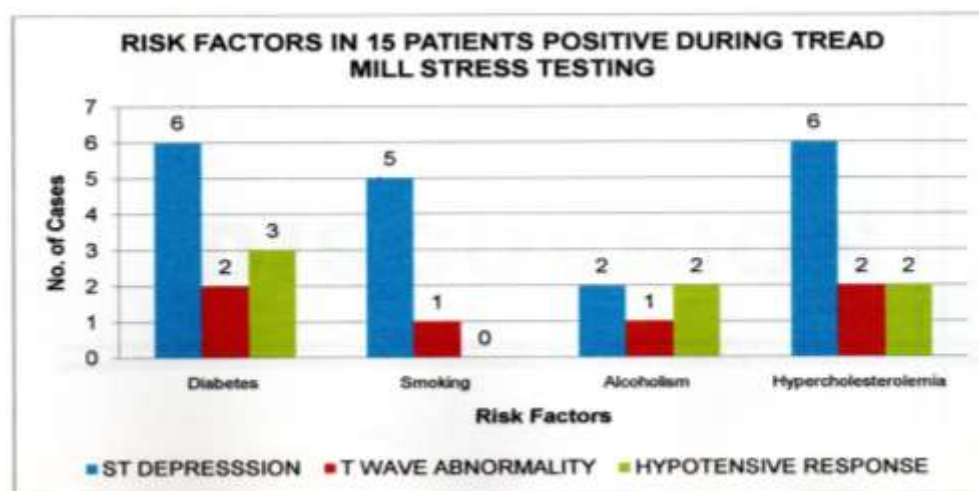
DISCUSSION

Obesity is an independent risk factor for cardiovascular disease[6]. This relationship between degree of obesity and the incidence of CVD has been proved by many studies. This relation was reexamined in male and female of Original Framingham Cohort, recent observation of disease occurrence over 26 years indicate that obesity is a significant independent predictor of CVD.

Obesity is directly related to an increased risk profile for atherogenesis ie, it has been associated with increased blood pressure, hypertlipidemia, glucose intolerance and hyperinsulimaenia[7]. Obesity increases the work done by heart which enlarges with rising body weight, cardiac output, stroke volume and blood volume all increases. Hypertension is also common. It is difficult to separate the contribution of obesity from that of other risk factors such as diabetes, hypertension, hyperlipidaemia, smoking, alcohol, physical inactivity[8].

Keeping the above facts in view a study of cardiovascular and ECG findings in obese at rest and using tread mill stress testing has been done in the Department of Cardiology Medical College, Hospital, Jabalpur. Though it was decided to select the cases from groups with other risk factors and without other risk factors, but in spite of our meticulous efforts we could not find any single obese individual having no other risk

Factor hence results of other studies assessing effort of risk factors other than obesity on incidence of heart disease were reviewed and compared with our study. In our study a total number of 50 obese individuals have been selected with criteria of body mass index (BMI) more than 30.

Out of total 50 cases, 34 (68%) obese were male and 16 (32%) were female. There were 41 (82%) obese of age between 31-50 years. One obese was 22 years old and rest of 8 (16%) were of more than 51 years. This data is in the favor of the fact that obesity usually occur in the middle age Preble et al 91953)[9,10] found the maximum incidence in the age group of 41-50 years. Patel (1966) found the maximum incidence in the age group of 31-40 years[11,12]. In the present study the incidence of IHD was total 25%. It is well known fact that IHD incidence increases with weight of individual in the presence of risk factors[13,14]. As the weight increases the incidence of ischemic heart disease also increases[15].

Ancel Keys et al (1972) says the relationship between the relative weight and of skin fold thickness to the 5 years incidence 632 cases of coronary heart disease was examined in man aged 40 to 59 years[16]. At entry to the study United States Railroad man 2439 men in Northern Europe and 6579 men in Southern Europe were studied of all men studied 22.3% had a body mass index (BMI) 27 or more at the entry and therefore were labeled as relatively heavy men. In this category coronary heart diseases was 29% of the Americans, 23.1% of Southern Europe[16,17].

In the present study the incidence of diabetes was 37% and incidence of IHD in this group 73%. Diabetes is a primary risk factor for incidence of increased atherosclerosis and IHD. From the Framingham study Gordon T. et al) in known diabetic, in both NIDDM and IDDM, there is at least two fold increase in incidence of coronary artery disease[18]. Hypercholesterolemia is also a well documented primary risk factor for coronary heart disease. When it is associated with other risk factors it accounts for higher incidence[19]. In present study value of serum cholesterol is found to be high in 62% of total obese individual.

In present study 29 obese individuals were chronic smokers. They all were giving the history of smoking for more than 10 years and 10-15 sticks per day. Out of the above 40% of chronic smokers, the effort tolerance was poor in all cases and the positive response for IHD was present in 6 cases. It is well known fact that smoking produces adverse effects on coronary vessels and if associated with other risk factor their incidence of coronary heart disease increases[20].The frequency of episodes of ischemia was 3 times greater and duration of ischemia 12 times longer in smokers than in non smokers. Barry J. et al (1989)[21.]

In this study tachycardia in 9 cases (19%), remaining 41 individuals had normal pulse rate. During treadmill test all obese had increased heart rate (normal response). Hypotensive response in 4 (8%) individuals. There was functional murmur present in 3 individual at rest.

Electrocardiographic Findings were corresponding with clinical cardiovascular findings in all obese individuals. In present study 41 (82%) obese had normal heart rate and tachycardia was in 9 (19%) individuals. Ventricular ectopic (VPC's) were present in 5 individuals. Left axis deviation (LAD) was present in 4 individuals. Left ventricular hypertrophy in 6(12%) cases. The findings of old typical myocardial infarction was present in 6 (12%) individuals. The finding of T-wave abnormality was present in 9(18%) individuals. ST Segment abnormality which was zero percent at rest in obese individuals became 23% during stress testing.

Out of 15 obese individuals who were positive for ischemic heart disease, 6(12%) had down sloping type of depression (reported as strongly positive) and 3 (6%) had horizontal. VPC's disappeared in 5 individuals possibly due to overdrive suppression of impulse. In 2 obese individual, T-wave which was inverted at rest became positive during stress test which was sign of ischemia and test was considered to be positive for IHD.

Franks Colliven et al (1986) has done statistical analysis of 1,029 electrocardiogram in obese subjects. The heart rate, PR-interval, QRS duration, QTc interval and voltage increase and QRS vector shifted to left with increasing obesity. These changes were independent of age, sex and blood pressure[22,23]. Bradycardia was present in 19% of patients but tachycardia in only 0.5%. The ST and T abnormalities were present in 11% correlating better with severity of obesity. The heart rate and QRS voltage increases with increasing obesity. Wilson et al (1991) determined the relationship of regional fat distribution and obesity to electrocardiographic parameters in healthy premenopausal women.[24]

They found that intra abdominal fat was significantly associated with prolongation of QTc interval and susceptibility of cardiac arrhythmia. In our study we found that QTc prolongation was not seen. An epidemiological study of urban population of Delhi was carried out in persons with history of obesity and hypertension and smoking. The obtained data form a sample of 13723 adults suggested that hypertension had strong association with obesity, diabetes, smoking and family history were also found to be associated with IHD[25].

In the tread mill stress test response in present study, we found that a total of 15(30%) obese individuals were positive for IHD. There was depression of ST segment more than 2 mm. In 6(12%) cases there was strongly positive response for IHD. In 3 (6%) obese individual, the ST segment depression was horizontal. Effort tolerance in all these individuals was impaired and poor. The point common in group which achieved THR was that they had only 1 additional risk factor i.e. family history. In 10, (20%), the reasons for terminating the test was development of symptoms and signs. The effort tolerance was impaired in 46(92%) which is common in obese individuals.

CONCLUSION

In the present study cardiovascular and ECG findings in obese individuals at rest and by using tread mill stress testing were studied and recorded. In our study 50 obese individuals were selected with body mass index (BMI) more than 30. 82% of obese individuals were in between 30- 50 years of age. Out of which 50 obese, 12 (24%) were positive for IHD, 18 (36%) diabetic, 23 (46%) were chronic smoker and 31 (62%) had hypercholesterolemia. The cardiovascular findings were tachycardia 9 (18%) and systolic

murmur 3 (6%). When these cardiovascular findings were compared with stress testing there was hypotensive response in 4 (8%).

The ischemic response: significant ST segment depression was found in 9 (18%). All these findings suggested that left ventricular function was abnormal and persons were prone to develop ischemic or infarction. In resting ECG the findings suggestive of left ventricular hypertrophy (LVH) was found in 6 (12%) and old myocardial infarction in 6 (12%). T wave abnormality in 9 (18%)..All bases persons were subjected for their serum cholesterol estimation and it was found to be significantly increased. There is strong evidence that IHD is common in obese individuals than persons having normal weight and height for that particular age, cholesterol may be an important common factor.

The effort tolerance was found to be very poor in 20% of obese individual in whom before producing ST changes during stress testing having sense of rotation, giddiness and heaviness or chest pain are also positive if they could have continued with exercise. This study helps us to rehabilitate and educated the cases of obesity. Reduction of weight and control of risk factors like diabetes, cholesterol, alcohol and smoking may contribute to lower the incidence of cardiovascular diseases.

REFERENCES

1. Ahmed H. kisebat MD et al: Health risk of obesity. Medical Cli of N. Am Vol.73. N0. 1 Jan. 1989.
2. Alan N. Peiris, MD; Mark S. Sothmann, PhD ; et al. : Adiposity, Fat Distribution, and cardiovascular Risk, Ann. Of Int. Med. 1989: 110:867-872.
3. Alexander JK Peterson KL : Cardiovascular effects of weight reduction. Circulation, 1977;45:310-8.
4. Ancel Keys, Christ Aravanis, ND et al: Coronary Heart Disease: overweight and obesity and risk Factors. Ann Of Int. Med. 77:15-27, 1972.
5. Ancel Kay et al (1972) : Coronary Heart Disease: Overweight and obesity as risk factors. Ann Of Int Med. 77:15-27, 1972.
6. Bellest S, Roman L. Nichos GJ : Correlation of the electrocardiographic exercise test and blood cholesterol. Am. J. Cardiol, 17:43, (1966).
7. Berkson DM, Stamper J and Jackson W: The precordial Electrocardiogram during and after strenuous exercise . Am J. Cardiol 17:43, (1966).
8. Larsson B, Svardsudd K, Welin L, Wilhelmsen L et al: Abdominal adipose tissue distribution , obesity and risk of cardiovasculardisease and death: 13 year follow up of participants in te study of men brn in 1913. Br. Med. J. Vol. 288;May 1984.
9. Brent Egan, Andrew Fitzpatrick M, et al : Importance of overweight in studies of left ventricular Hypertrophy and diastolic function ; in Mild systemic hypertension. Am J. Of Cardio Vol. 64, 752.
10. Bruce RA : Method of exercise testing. Am J. Card. 33;22:715,1975.
11. Bruce RA : Exercise testing for evaluation of ventricular function. N. Eng. J. Med. 296:671 (1977).
12. Bruce RA : Exercise electrocardiograpghy. In the heart (Hurst JB,) New York, MC Graw Hill. (1974).
13. Bruce RA, Donough JR:Stress testing in screening for cardiovascular disease. Bull Ny Acad. Med. 45;1228:1969.

14. Carl J Lavie , Celso Amodeo MD et al: Left atrial abnormalities indicating diastolic ventricular dysfunction in cardiopathy of obesity. Chest 92(6);1043:1987.

15. Carole A Warnes. BS MRCP, William C: Robert MD et al : The heart in Massive (More than 300 pounds or 136 kilograms) obesity : analysis of 12 patients studied at necropsy.

16. Chadha SL Ramchandra et al : Epidemiological study of coronary heart disease in urban population of Delhi Indian J. Med. Res. 1990 Dec.;92:424.

17. Chung EK : Exercise electrocardiography , practical approach. 1979.

18. Chung EK: Introductory remarks on exercise ECG 1-19.

19. Chung EK , Chung Lisa S : Preparation and precaution for exercise ECG test 34.35.

20. Chung EK : Indicating of exercise ECG test 83-93.

21. Chung EK : Contraindication of the exercise ECG test 95-109.

22. Chung EK : Protocola for exercise ECG test In Exercise electrocardiography. 111-121.

23. Chung EK : Interpretation of the exercise ECG test 156-219. Ed. Chung EK Baltimore, William and Wilkins(1979).

24. David S Gray MD: Diagnosis and prevalence of obesity. The medical Clinics at N. Am. Jan. 1989 Vol. 73(1).

25. Efrain Reisin , Edward D, Frohlilch et al: Cardiovascular changes after weight reduction of obesity hypertension. Ann. Of Int. Med. 1983;98:315-319.