DISSERTATION

on

SERUM INTERLEUKIN-6 LEVELS AND ITS CORRELATION WITH INSULIN RESISTANCE,SYTEMIC HYPERTENSION IN OBESITY

submitted in partial fulfillment of

requirements for

MD DEGREE EXAMINATION

BRANCH-I GENERAL MEDICINE

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INSTITUTE OF INTERNAL MEDICINE

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APRIL 2013

CERTIFICATE

This is to certify that the dissertation titled **"SERUM INTERLEUKIN-6 LEVELS AND ITS CORRELATION WITH INSULIN RESISTANCE,SYTEMIC HYPERTENSION IN OBESITY"** is a bona fide work done by **Dr. N. RAGAVAN**, Post Graduate Student, Institute of Internal Medicine, Madras Medical College, Chennai – 600003, in partial fulfillment of the university rules and regulations for the award of MD DEGREE in GENERAL MEDICINEBRANCH-I, under our guidance and supervision, during the academic period from April 2010 to April 2013.

Prof. A. RADHAKRISHNAN, MD,
Professor of Medicine,
Institute of Internal Medicine,
MMC and RGGGH,
Chennai – 600003.

Prof. N. RAGHU, MD,
Director and Professor,
Institute of Internal Medicine,
MMC and RGGGH,
Chennai – 600003.

Prof. V. KANAGASABAI, MD,
Dean,
MMC and RGGGH,
Chennai – 600003.

DECLARATION

I solemnly declare that the dissertation titled **"SERUM INTERLEUKIN-6 LEVELS AND ITS CORRELATION WITH INSULIN RESISTANCE,SYTEMIC HYPERTENSION IN OBESITY"** was done by me at Madras Medical College, Chennai – 600003, during the period May 2012 to October 2012 under the guidance and supervision of **Prof. A. RADHAKRISHNAN, MD**, to be submitted to The Tamil Nadu Dr. M.G.R. Medical University towards the partial fulfillment of requirements for the award of MD DEGREE in GENERAL MEDICINE BRANCH-I.

Place : Chennai

Date : 24/12/2012

Dr. N. RAGAVAN,
MD GENERAL MEDICINE,
Post Graduate Student,
Institute of Internal Medicine,
Madras Medical College,
Chennai – 600003.

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ABBREVATIONS

IL-6 – Interleukin-6

IL-1 – Interleukin-1

HT - Hypertension

TNF-α-Tumor necrosis factor-α

IR – Insulin resistance

HOMA-LR-Homeostatic model for assessment of insulin resistance

BMI- Body mass index

w/h- Waist hip ratio

FBS- Fasting blood sugar

WAT- White adipose tissue

BAT- Brown adipose tissue

LDL- Low density lipid

HDL- High density lipid

TGL- Triglycerides

PGE2- Prostaglandin E2

CONTENTS

INTRODUCTION

Obesity is a medical condition in which excess body fat gets accumulated to an extent that it may have an adverse effect on health, leading to reduced life expectancy and increased health problems.

The need for weight and fitness guideline, specific to Asian countries was stressed in a study by the world health organization's sub-committee setup, to look into obesity and metabolic syndrome in the Asia -Pacific region in 2000. Health ministry of India, in association with Diabetes foundation of India, All India institute of medical science, Indian Council of Medical research, National Institute of Nutrition and other 20 health organizations released a joint revised guidelines for obesity in India.

The guidelines estimate that the absolute mortality due to chronic heart diseases in India is 1.59 million annually in the year 2000, which may reach 2.58 million around 2020.

The current load of diabetes in the country is 41 million and is expected to rise by 170% in the next 20 years In 2050 India may become the global capital diabetes mellitus.

For every extra 10 kilogram, above the stipulated body weight [measured according to height], life expectancy a person reduces by three years. Obesity can be considered as the gateway for the development of metabolic syndrome in the affected individuals. In this modern world sedentary life style and diet habits in combination with stress increases the chances of acquiring obesity.

Insulin resistance, dyslipidemia and hypertension are the three major disease conditions related obesity and are being the factors which increases the morbidity and mortality in obese individuals.

In obesity excess visceral adipose tissue plays an important role in altering the homeostasis between the pro inflammatory and anti inflammatory cytokines which leads to series of biochemical reactions in body and thereby producing many disease states.

These reactions are mediated by various inflammatory cytokines that leads to the development of insulin resistance, alteration in the lipid profile and cardiovascular diseases. Among them, some of the important cytokines that are involved in the

pathogenesis of obesity related diseases are adiponectins, leptins, TNF-α, Interleukin-6 and reistins.

Interleukin -6 is an important cytokine which has pro inflammatory and anti inflammatory activity. In obesity the IL-6 that are secreted by the macrophages in the excess visceral adipose tissue predominantly act's as a pro inflammatory cytokine.

Increased levels of IL-6 and its pro- inflammatory activity leads to the development of insulin resistance and hypertension in obese individuals.

Adiponectin is an important cytokine produced by the adipose tissues has anti-inflammatory property, through which it plays a key role in increasing the insulin sensitivity. Also through its protective effect over the vascular endothelium, reduces risk of development of hypertension in obese persons.

In obesity the adiponectin levels are decreased and along with elevated IL-6 level alters the homeostasis between the pro and anti-inflammatory cytokines, ultimately increasing the risk for

development of insulin resistance and hypertension in these individuals.

In the present study obese individuals with and without hypertension, who fulfilled the criteria for the study was selected. Serum interleukin-6 levels were measured and compared with their insulin resistance status and hypertension.

AIMS AND OBJECTIVES

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1. To do serum Interleukin-6 in obese persons.

2.To find the correlation between serum Interleukin -6 levels with Insulin resistance and Hypertension in obesity.

REVIEW OF LITERATURE

Obesity has been considered as a medical disorder right from the ancient period in the evolution of human being.

The Greek were the first to recognize obesity as a medical disease. Hippocrates wrote that "corpulence is not only a disease itself, but the harbinger of others".

The Indian surgeon Sushrutha (6^{th} century BC) related obesity to diabetes and various disorders of cardiovascular system.

OBESITY AND INFLAMMATION

The concept of metabolic syndrome postulates that tissue resistance to insulin is the core mechanism underlying the co-occurrence of multiple metabolic risk factors i.e., central obesity, hyper insulinaemia, glucose tolerance and hypertension[1].

The adipose tissues of the body release many anti inflammatory and pro inflammatory cytokines into the body.

Adiponectin is an important anti-inflammatory cytokine which is synthesized from the adipocytes which increases the activity of insulin. In

liver it inhibits gluconeogeneis. In muscles it increases the glucose uptake.

In insulin resistance status plasma adiponectin levels are low from either obesity or lipodystrophy and adiponectin treatment improves insulin action and the metabolic disturbances associated with insulin resistance [2].

In obesity, due to the low levels of adiponectin these occurs an imbalance between the adiponectin and other pro inflammatory cytokines, which leads to series of metabolic consequences which leads to insulin resistance.

INTERLEUKIN-6 AND OBESITY

Numerous pro inflammatory cytokines are produced from the adipose tissue in obesity. Important among them are IL-1, IL-6, resistin, TNF-α, and

c-reactive protein.

Among these interleukin-6 (IL-6) is an important pro inflammatory cytokine which though various mechanism induce insulin resistance in patients with obesity.

Interleukin 6 (IL-6) originally denoted as a protein secreted by leucocytes, is now recognized to be produced by non-immune cells as well [3].

More than one third of the circulating IL-6 is produced from the adipose tissue [4].

The abdominal visceral obesity facilitates the pro inflammatory cytokines which are produced from the adipose tissue, a direct access to the liver through the portal vein.

INSULIN RESISTANCE AND IL-6

Various mechanisms have been postulated, by which IL-6 produces the insulin resistance status in peoples with obesity.

Insulin plays a vital role in glucose metabolism by its various effects such as increasing the uptake of glucose by the skeletal muscle and adipose tissue, promoting hepatic glycogen synthesis, inhibiting the gluconeogenesis by the liver and kidney.

Insulin mediates all the action though its interaction with its receptors and activating Tyrosine kinase, which is followed by auto phosphorylation and through which insulin receptor substrates activities are augmented.

IL-6 reduces the activity of insulin signaling molecule [5].

IL-6 induces the expression of suppressor of cytokine signaling 3 (SOCS-3) which then leads to the impairment of insulin action [6].

Insulin resistance may be considered as an early marker for the risk of development Type-II Diabetes mellitus in people who are obese.

Insulin resistance status if not intervened may procede to the next stage of pre diabetes in obese individuals.

At this stage, life style modification and weight reduction measures may attenuate the disease progression other ways these individuals may develop Type-II diabetes mellitus.

Adipose tissue IL-6 expression and the circulating IL-6 expression are increased in obese individuals are positively correlated with insulin resistance and the levels decrease following weight loss [7].

IL-6 has numerous other actions in the body apart from mediating insulin resistance.

When infection or trauma occurs to the body, T-cells and macrophages secrete IL-6 though which Immune response is stimulated and inflammation occurs.

IL-6 also has significant activity in skeletal muscle. When secreted by muscles called as myokines there, which levels are increased after exercise. IL-6 promotes the substrate delivery to the exercising muscle from extracellular substates [8].

This is one of the mechanism which says IL-6 also has anti-inflammatory role.

In blood vessels IL-6 exerts mainly a pro inflammatory effect. Smooth muscle cells of tunica media of many blood vessels secrete IL-6.

IL-6 is the most important mediator of fever in the body. It has the capability of crossing the blood brain barrier and reaches the hypothalamus where it initiates the synthesis of PGE_2[9].

This PGE_2 secreted in the hypothalamus mediates the alteration of body temperature.

IL-6 exerts its effect through its interaction with its two types of trans membrane glycoprotein receptors. One is GP 130/CD 130 receptor and the other one is R/GP 80/CD 126 receptor.

In bones osteoblasts are the main cells which secrete IL-6. The effect of IL-6 in bone is the stimulation of osteoclast formation.

IL-6 is an important mediator of acute phase protein synthesis. Regarding immune system it increases production of neutrophils, promotes growth of B cells and antagonizes regulatory T-cell action.

In obesity, the increased level of adipose tissue which secretes the inflammatory cytokines leads to the development of insulin resistant status.

INSULIN RESISTANCE-CAUSES

Apart from obesity, if other causes of insulin resistance are considered, the developmental origin of Insulin resistance is an important one.

A relationship between low birth weight and development of insulin resistance status has been established [10].

When there is maternal malnutrition or placental abnormalities it leads to malnutrition of the fetus and low birth weight.

Low birth weight compromises the development of various vital organs of the body which leads to organ malfunction, insulin resistance, abnormal vascular development and decreased nephron number etc.

Next important consideration in insulin resistance is the genetic cause.

Rare form of genetic mutuation have been identified in the glucokinase gene which are associated with insulin resistance and low birth weight [11].

When the insulin resistance is genetically determined, the fetus becomes resistant to insulin like growth factor, which leads to reduced fetal growth and low birth weight.

Maternal dietary habits also influences the fetal growth and over its future insulin response status.

Another important study is the relation between the breast feeding and future chances of getting obesity.

Breast feeding acts to protect against obesity, due to lower protein and total energy intake when compared to the bottle fed infants[12].

Mutuations in the insulin receptors may also lead to a state of Insulin resistance.

Dietary habits of a person also influence the sensitivity to insulin. A high fat diet, particularly foods containing saturated fat plays a key role in the development of insulin resistance.

Insulin resistance is positively correlated with quantity and quality of fat intake and it has been negatively correlated with proportion of the dietary fibre[13].

Sedentary life style is also an important contributing factor for the development of insulin resistance status.

It has been estimated in a study that each 500 Kcal/week increment in physical activity related to energy expenditure reduces the life time risk of developing type-2 diabetes by 6%[14].

At the molecular levels, superoxide dismutase activity abnormalities may also lead to insulin resistance.

In this condition the insulin resistance was found to be reversed by exposing the cells to inhibitors of electron transport chain inhibitors and mitochondrial uncouplers[15].

In women with polycystic ovarian disease have been found to be associated with insulin resistance particularly in overweight group.

Previous studies have showed that obesity and PCOS have a separate and synergistic relationship with insulin resistance[16].

Some of the possible risk factors for developing insulin resistance are hypertriglyceridaemia, hepatitis with infections, hypercortisolism and drugs like anti retrovirals, glucocorticoids etc.

Obesity is a major predisposition factors for various disease states such as Insulin Resistance, Diabetes and Hypertension.

OBESITY

Obesity can be defined as a state of increased adipose tissue mass in the body.

There is no direct method of measurement of obesity. Hence, it is measured by some indirect methods such as

Body mass index (BMI)

Skin fold thickness

Densitometry (underwater weighing)

Using CT or MRI and

Electrical impedance.

Commonly used criteria for obesity using BMI followed world wide is BMI>30 for obesity and BMI > 40 as Morbid obesity. But there are regional or ethnic variations.

In India the health ministry has revised the criteria for obesity as per the suggestion given by the WHO subcommittee report on obesity and metabolic syndromes in the Asia pacific region in 2000.

According to the survey India could become the global capital of diabetes around 2050. Hence, it became mandatory for the revision of obesity criteria.

According to the new revised criteria the following are considered.

BMI > 23/kgm^2 will be considered as overweight.

BMI > 25/kgm^2 will be considered as obese.

Waist circumference for

men > 90 cm

women > 88 cm

The above guideline has been jointly released by the Health Ministry, Diabetes foundation of India, Indian Council of Medical research, All India institute of medical science and national institute of nutrition.

Normal body weight is regulated by both endocrine and neuronal mediated mechanisms which maintain a equilibrium between energy intake and expenditure.

When forced overeating occurs the homeostatic mechanism begins to act following which increase in energy utilization and decrease in appetite occurs.

When forced deprivation of food occurs the homeostatic mechanism respond in a way to decrease the energy utilization and increase in appetite.

This adaptive mechanism in the body is mainly mediated by the leptin secreted by the adipose tissue. It crosses the blood brain harrier and reaches the hypothalamus through which it producing its action.

Appetite is generally influenced by three important factors such as hormones, neural and metabolic products over the hypothalamus.

Hormones included are insulin, cortisol and gut peptides. Neural influences are mediated by the vagal inputs. Metabolites including glucose and ketones can influence the appetite.

Among the factors which increase the appetite are neuropeptides, melanin concentrating hormone, orexin, agouti related peptide and endo cannabinnoid.

The factors which decrease the appetite are melanocyte stimulating hormone, cocaine and amphetamines, glucagon related peptide -1, and cholecystokinin.

ENERGY EXPENDITURE

Next to appetite, energy expenditure plays an important role in the homeostasis of maintaining the weight.

Energy expenditure occurs by the following methods.

Basal metabolic rate or resting state.

Energy utilized by metabolism and storage of food.

Exercise induced thermogenic process.

Thermogenesis by adaptive mechanism.

Among these mechanism basal metabolic rate plays a major contribution to energy expenditure. It is about 70%. Energy expenditure through exercise is about 5 to 10%.

Fat deposit in the body is of two types. Brown adipose tissue and white adipose tissue. Adaptive thermogenesis occurs through brown adipose tissue for energy expenditure.

Obesity also commonly runs in families. Many of the monozygotic twins reared at different places had same BMI.

Obesity specific mutant genus have been identified in humans[17]. They are

Leptin receptor gene.

Pro-opiomelanocortin gene.

Type 4 receptor of melanocyte receptor gene.

TrKB- a neutrophil receptor.

Even though the mutation in these specific genes makes a person susceptible, environmental factors have a key role in development of obesity, as evidenced by the fact that famine prevents obesity even in the most obese prone individual.

SYNDROMES WITH OBESITY

Human syndromes with defined inheritance are, prader-willi syndrome where deletion of IBQ 11-13 chromosome occurs and manifests as obesity, associated with mental retardation and hypogonadism.

In Bardet Biedl syndrome obesity is associated with mental retardation, retinitis pigmentosa, diabetes and cardiac malformations.

There are some other specific syndromes where people will present with obesity.

In Cushing's syndrome patient has obesity, hypertension and gluose intolerance. Here obesity may be due to local reactivation of cortisol in

fat by 11B-hydroxy steroid de-hydrogenase 1, an enzyme that converts inactive cortisone to cortisol.

Hypothyroidism, an uncommon cause of obesity can be easily ruled by measuring the levels of thyroid stimulating hormone.

Patients with insulinoma also present with obesity, which is mainly due to over eating which occurs to prevent hypoglycaemia.

Many intracranial pathology such as tumours, trauma & inflammation causes abnormal activation of hunger or satiety centre may also result in obesity. It can also cause decrease in growth hormone levels the one which has lipolytic activity, deficiency of this hormone may lead to obesity.

Adipose tissue is made up of adipose cell which has lipid storing function and a stromal/vascular compartment consisting of preadipocytes and macrophages.

In obesity, adipose mass increases which is also associated with an increased in macrophage population.

CYTOKINES IN OBESITY

These adipose tissue produces various cytokines and adiponectins.

The cytokines produced are

energy balance regulatory hormone leptin

Tumour necrosis factor α.

Interleukin-6

Factor - D (adipsin)

Plasminogen activator -1

The functions of adiponectins are, enhancing insulin sensitivity, lipid oxidation and vascular protective effect.

Resistin and IL-6 are the cytokines which produces insulin resistance status[18].

OBESITY AND HYPERTENSION

Next to Insulin resistance hypertension is the important consequence of obesity.

Hypertension has become one among the leading cause of mortality and morbidity in patients with obesity.

Blood pressure may be classified as

	Systolic, mm of Hg	*Diastolic mm of Hg*
Normal	<120	<80
Pre-hypertension	120-139	80-89
Stage-1 Hypertension	140-159	90-99
Stage-2 Hypertension	≥160	≥100
Isolated systolic hypertension	≥140	<90

In obesity various mechanisms have been postulated for the development of hypertension.

Inflammatory cytokines IL-6 elevation and reduction in anti-inflammatory mediator adiponectin are being the major cause in development of hypertension in obese persons.

Adiponectin is secreted from the adipose tissue. In obesity due to increase in visceral adiposity the plasma levels of adiponectins are markedly reduced[19].

ADIPONECTIN

Adiponectin has the following properties though which it exerts a strong anti hypertensive effects.

Enhanced endothelium dependent and non dependent vasodialation.

Suppression of atherosclerosis.

Suppression of vascular adhesion molecule scavenger receptors.

Reduces the levels of TNF-α and there by its inflammatory effects over endothelium.

Attenuation of growth factor effects on smooth muscle cells.

Enhanced Nitric oxide production

Stimulation of angiogenesis.

Reduction of neoinitimal thickening and proliferation of smooth muscle cells in mechanically injured arteries.

Inhibition of endothelial cell proliferation and migration.

Inhibition of hypertrophic myocardial signaling

HYPERTENSION AND IL-6

IL-6 secreted by the adipose tissue also play an role in the development of hypertension in obese individuals.

The association between hypertension and inflammation indicate that IL-6 plays a role in angiotensin-II mediated hypertension[20].

The renin-angiotensin-aldosterone system mediates its effect over the blood pressure through the vasocostrictor effect of angitensin-II and capability of aldosterone to retain sodium in the body.

There are three main stimulation for renin secretion.

In thick ascending loop of henle when the delivered sodium load is low.

When the afferent arteriole of the kidney sense the reduction in the stretch though is baroreceptor mechanism.

When the renin secreting cells are stimulated by the sympathetic neurons through β_1 adrenoceptors.

Once released into the circulation the renin cleaves the angiotensinogen into Angiotensin-I.

Angiotensin-I is then converted into angiotensin-II by angiotensin converting enzyme, which also catalyses the conversion of bradykenin to inactive peptide.

Angiotension II produces its effect mainly through the receptor suptypes AT_1 receptor and AT_2 receptor.

When AT_1 receptor is stimulated it produces strong pressure effect through sympathetic stimulation. AT1, receptor stimulation also leads to increased secretion of aldosterone by the Zona glomerulosa.

Aldosterone mainly exerts its action in the distant convoluted tubule by increasing the sodium reabsorbtion and thereby creating the pressure response in the blood vessels.

ENDOTHELINS AND IL-6

IL-6 also play a significant role in enhancing the formation of endothelial cell derived substances such an endothelin through which it mediates the hypertensive effect[21].

Endothelium are proteins which has vasoconstictor effect on blood vessels. They are produced mainly by the endothelium and also has an vascular homeostasis role.

Among the two types of endothelin receptors actions which are mediated through endothelin A type receptor contributes to the vasopressor effect.

NITRIC OXIDE SYNTHASE AND IL-6

IL-6 also increase the half life of caveolin-1 and facilitates it's binding to endothelial nitric oxide synthetase and thereby decreasing the production of nitric oxide production through which it mediates its hypertensive effect[22].

Nitric oxide (NO) is an important cell signaling molecule which has a powerful vasodialator effect.

Various methods are available for the calculation of insulin resistance. They are as follows:

Euglycaemic insulin clamp method.

Homoeostatic model assessment of insulin resistance (HOMA-IR)

Quantitative insulin check index (Quicki)

Fasting insulin / glucose ratio (FIGR)

Insulin sensitivity index

Triglyceride / High density lipid ratio (TG/HDL)

The specificity and sensitivity varies among these methods.

Euglycaemic clamp method is the gold standard for calculating insulin resistance.

In a comparative study, with the remaining methods, highest specificity (97.6%) and sensitivity (92.6%) for HOMA and QUIKI methods were found in predicting the insulin resistance[23].

LEPTINS AND OBESITY

Leptin is one of the important cytokine produced by the adipose tissue and plays a key role in regulating energy intake and expenditure.

The plasma levels of leptin are highly correlated with adipose tissue mass, their levels are increased in obese persons, decreased after losing weight[24].

Human leptin is produced by primarily produced by the adipocytes tissue of white adipose tissue (WAT). It has 167 amino acids. Small contribution is also from brown adipose tissue (BAT).

Main action of leptin is in the hypothalamus where it suppresses the appetite. This effect is done by counteracting the effects of neuropeptide and anandamide, also by promoting the synthesis of α-MSH.

It has been found that cognitive control of food intake occurring with low circulating levels of leptin is reversed by administration of leptin[25].

RESISTINS

Resistins also known as adipose tissue specific factor is another important inflammatory cytokine produced in obesity.

The role of Resistins in the development of obesity, and insulin resistance are inconclusive except for their raised levels in obesity[26].

Resitins play an established role in dyslipidaemia. It increases the production of LDL in liver. It also degrades the LDL receptors in the liver, by which it decrease the clearance of LDL.

Resistins accelerates the deposition of LDL in the arterial wall and thereby increasing the risk for cardiovascular disease. It also opposes the effect of statins, the drug mainly used for lipid lowering activity in cardio vascular diseases[27].

TUMOUR NECROSIS FACTOR-α

Tumor necrosis factor α (TNF-α) produced by the adipose tissue is implicated in the pathogenesis of metabolic syndrome[28].

It is also known as cachexins produced primarily by the activated macrophages and also by other cell types like CD^4 lymphocyte and NK cells.

Primary function of TNF-α is the regulation of immune cells, they also lake part in the systemic inflammation and in acute phase reaction.

In obesity, there is an increase production of TNF-α from the macrophages in the adipose tissue, and they play an important role in the development of insulin resistance in these individuals.

In liver TNF-α promotes the serine phosphorylation of insulin receptor substrate 1, and thereby impairing the insulin signaling which leads to a insulin resistance status.

MACROPHAGE AND MONOCYTE CHEMOATTRACTANT PROTEIN-1 (MCP-1)

Macrophage and monocyte chemoattractant protein-1 (MCP-1) is also an inflammatory cytokine produced by the adipose tissue.

This cytokine has both paracrine and endocrine functions. The main action of this cytokine is the impairment of insulin receptor phosphorylation and inhibition of insulin mediated glucose uptake by the adipose. cells[29]

PLASMINOGEN ACTIVATOR INHIBITOR-1 (PAI-1)

Plasminogen activator inhibitor-1 (PAI-1) is a member of serine protease inhibitor group that has an inhibitory effect on fibrinolytic system, thereby reducing intravascular thrombolysis by inactiviating urokinase and tissue plasminogen activation.

In obesity individuals, the visceral adipose tissue serves as a major source of PAI-1. Their elevation in this condition association has been positively correlated with insulin resistance and hypertriglyceridaemia[30].

OBESITY COMPLICATIONS

Obesity mediated complications involves many systems in the human body, increasing the risk of their morbidity and mortality.

Ischemic heart disease, myocardial infarction, congestive heart failure, high blood pressure, abnormal cholesterol levels, deep vein thrombosis

and pulmonary embolism are the cardiovascular complication that can be mediated or augmented by obesity.

Diabetes mellitus, polycystic ovarian disease, infertility, complications during pregnancy, menstural disorder, intra uterine fetal death and birth defects are the common endocrinal disorders associated with obesity.

Gouty arthritis, osteoarthritis, poor mobility and low back ache are some orthopedic conditions usually related to obesity.

Regarding central nervous system stroke, meralgiaparesthetica, dementia, carpal tunnel syndrome, multiple sclerosis, migraine are some of the conditions attributed to obesity.

Depression particularly in women and social stigmatizations are the common psychiatric conditions related to obesity.

Acanthosis nigricans, stretchmarks, cellulitis, hirsutism, intertrigo are the common dermatological problems in obesity.

Obstructive sleep apnea, obesity, hypoventilation syndrome, gastro eosophageal reflux disease, fatty liver, sexual dysfunction, hypogonadism are the other illness related to obesity.

LIPID PROFILE

In obesity the lipid profile of the individuals are also altered which also leads to many disorders.

The normal lipid profile is as follows, as per American Heart Association.

Serum cholesterol - Normal up to 200mgs/dl

Borderline up to 239 mg/dl

>240mg/dl elevated

HDL cholesterol - 30-60 mgs/dl

LDL cholesterol - 100-190 mg/dl

>190 mg/dl

Serum TGL - <150 mg/dl.

TGL value vary depending on diet, alcohol, metabolic state, exercise, elevation is considered only when repeated value are high.

Acylcoenzyme A diacyl glycerol acyltransferase - 1 (DGAT-1) acts as a key enzyme in the synthesis of TGL, which is the main storage form of excess caloric fat. It's over expression in obesity causes increases levels of TGL[31].

Based on medical conditions which cause morbidity and mortality in obese individuals, makes it as an important disease which should be treated.

The goal of therapy in treating obesity must be, treat to improve the obesity related co-morbid illness and reducing the risk of development of future co-morbid illness.

Lifestyle modification is the important initial step of treatment of obesity, consists of dietary intervention, physical activity and behavioural modification.

Regarding dietary intervention a very low fat diet <10 percent fat, vegetarian food, along with cessation of smoking and moderate exercise was helpful in reducing weight as well as improvement in coronary angiographic parameter[32].

Regarding physical activity when combined with dietary measures yields a good result.

The 2008 physical activity guidelines for American recommends that adults should engage 150 minutes in a week with moderate - intensity

activity or 75 minutes of vigorous activity performed in 10 mts episode distributed over a week.

Cognitive behavioral therapy haps to adhere to the reinforced dietary and physical activity. It consists of stress management, stimulus control and problem solving.

Pharmacotherapy for obesity include various classes such as centrally acting anorexiants (e.g.) Sibutramine, which acts as serotonin and noradrenalin reuptake inhibitor.

Peripherally acting drugs (e.g.) orlistat which is a potent, slowly reversible inhibitor of pancreatin, gastrin, corboxylester and phospholipaseA2.

Surgical intervention in treatment of obesity can be considered in case of morbid obesity (BMI > 40kg/m^2) or in those with moderate obesity (BMI >35 kgm^2) with serious medical conditions.

Restrictive surgeries which limit the amount of food that stomach can hold and slow the gastric emptying. Restrictive - malabsorbtive surgeries can be done for restriction and selected malabsorbtion.

Obesity having a definite role in insulin resistance and cardiovascular disease needs a thorough evaluation and treatment to lead a better life.

MATERIALS AND METHODS

MATERIALS AND METHODS:

The center of study is institute of internal medicine, madras medical college &Rajiv Gandhi government general hospital, Chennai -3

Study design : cross sectional study.

Venue : Rajiv Gandhi government general hospital, Chennai.

Collaborating departments:

Institute of Biochemistry, MMC &RGGGH, Chennai -3.

Duration : Study was conducted from June 2012 to November 2012.

About fifty obese patients who attended our hypertension outpatient department and general medical out Patient department with obesity related complaints such as weight gain, social stigma regarding obesity and obese hypertensive's who came for getting drugs were selected randomly. A complete history was taken including past history diabetes, hypertension, coronary artery disease, thyroid disorders and COPD. His/Her personal habits were enquired.

A complete physical examination was done with recording of vitals (temperature, pulse rate, and Blood pressure). A battery of blood investigations were done including renal function test, complete blood count, liver function test, urine analysis, HbA1c,Fasting blood sugar, and ECG were done. Based on the results fifty patients who fulfilled the inclusion criteria were selected. Fasting insulin was done insulin resistance was calculated.

Insulin resistance was calculated by Homeostatic model assessment of insulin resistance [HOMA-IR] method.Reference value=1

$$\text{HOMA-IR} = \frac{\text{Fasting blood glucose (mg/dl)} \times \text{Fasting plasma insulin}}{405}$$

Serum Interleukin-6 level was done by Genprobe Diaclone ELISA method for them. Up to a value of 2 is kept as normal.

INCLUSION CRITERIA

1. Age-20 to 35 years with BMI greater to 27 kg/m2 with and without hypertension.
2. Non diabetics.
3. Nonsmoker.
4. No pregnancy.

EXCLUSION CRITERIA

1. Hypothyroidism.

2. Renal disease.

3. Liver disorders.

STASTITICAL ANALYSIS PLAN

Data analysed using statistical package –SPSS Software.

CONSENT

All participants gave written informed consent.

ETHICAL COMMITTEE APPROVAL

Institutional Ethics Committee of Madras Medical College approved the study.

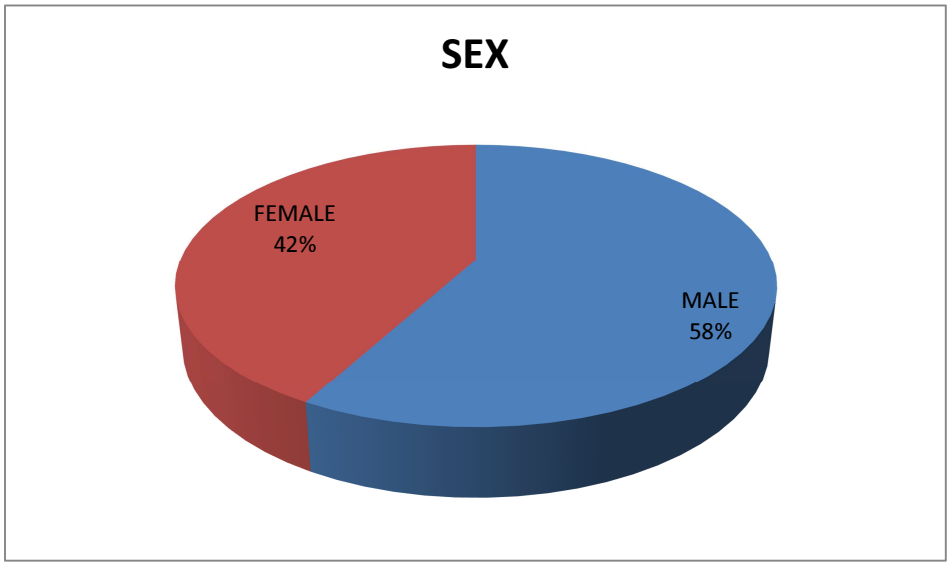
OBSERVATION AND RESULTS

GENDER DISTRIBUTION

Gender distribution of the 50 patients selected randomly for the study was 29 males and 21 females.

TABLE-1

SEX	NUMBER OF PATIENTS	PERCENTAGE
MALE	29	58%
FEMALE	21	42%

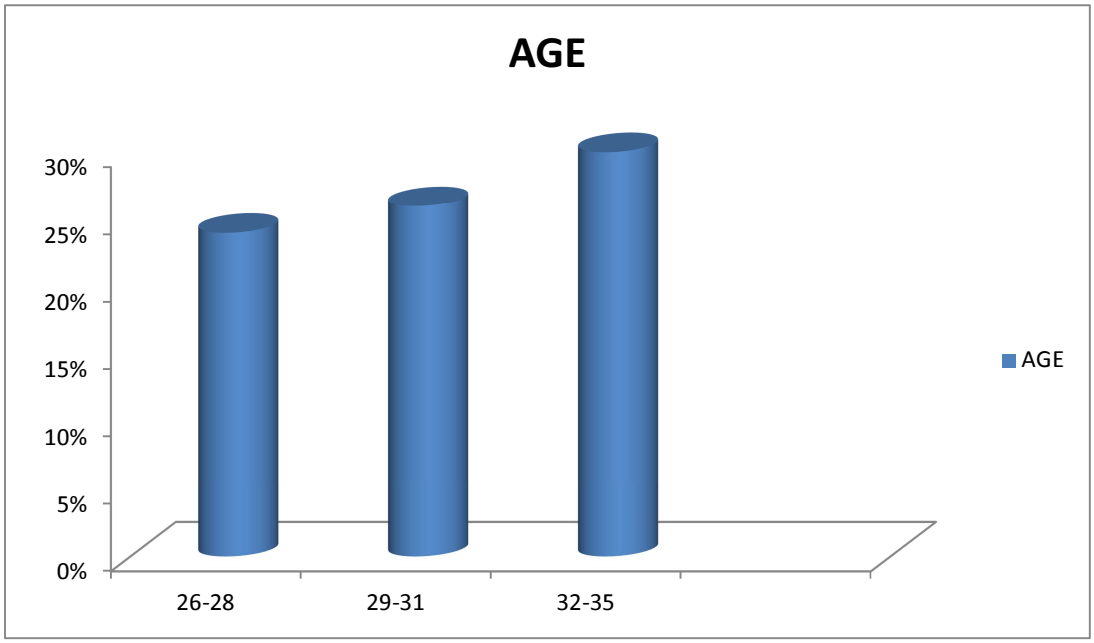


AGE DISTRIBUTION

The age of the patients selected for the study ranged from 25 years to 35Years.

TABLE-2

Age of the patient	No. of patients	Percentage
26-28 years	12	24%
29-31 years	13	26%
31-35 years	25	50%

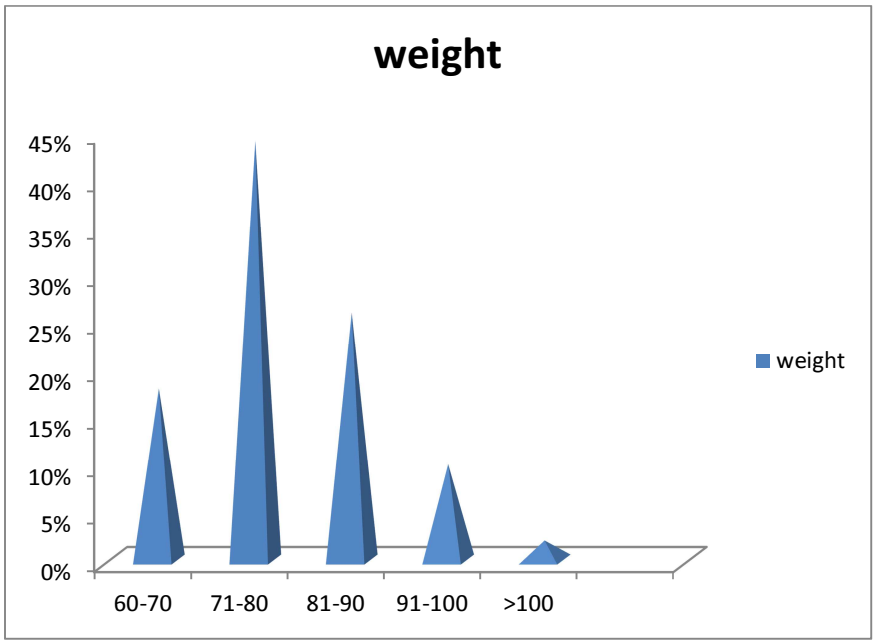


DISTRIBUTION OF THE WEIGHT OF THE PATIENTS

The weight of the 50 numbered study population ranged from 80 to 101 kilograms.

TABLE-3

Weight of the patients [kgms]	No. of patients	Percentage
60-70	9	18%
71-80	22	44%
81-90	13	26%
91-100	5	10%
More than 100	1	2%

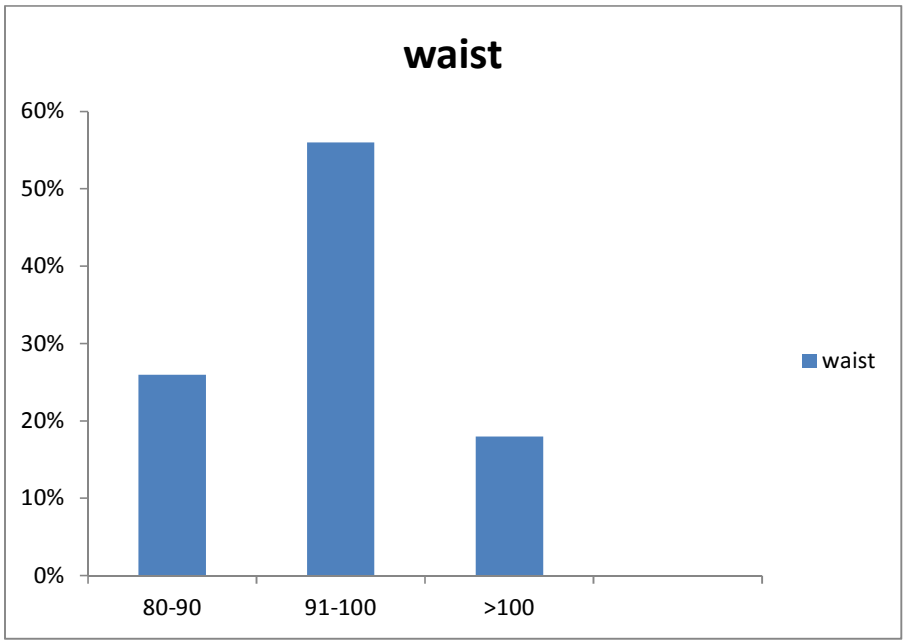


WAIST CIRCUMFERENCE

The waist circumference among the 50 numbered study population ranged from 80 to 101 cms.

Table shows the distribution waist circumference of the patients studied

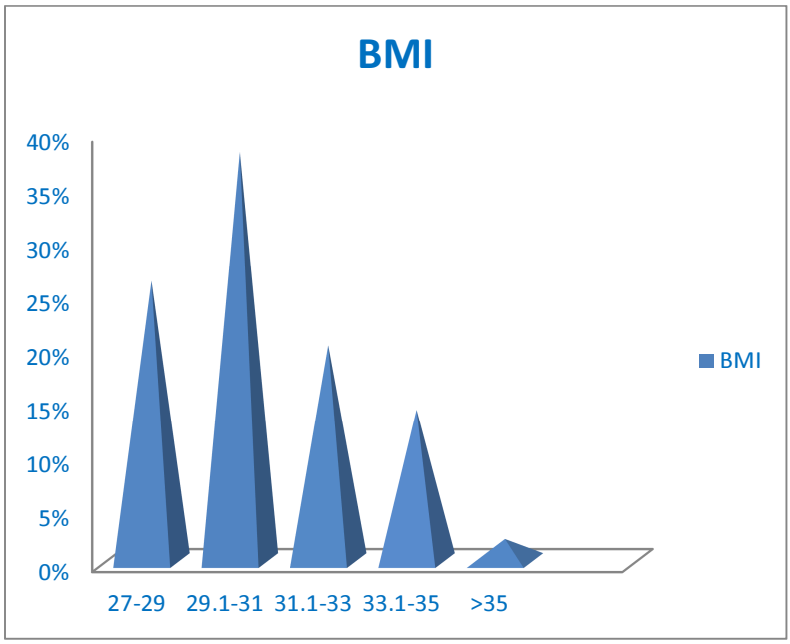
Waist	No.of patients	Percentage
80-90	13	26%
91-100	28	56%
>1oo	9	18%



BODY MASS INDEX DISTRIBUTION

Body mass distribution among the 50 numbered study group ranged from 29.0 to 35.2. **TABLE-5**

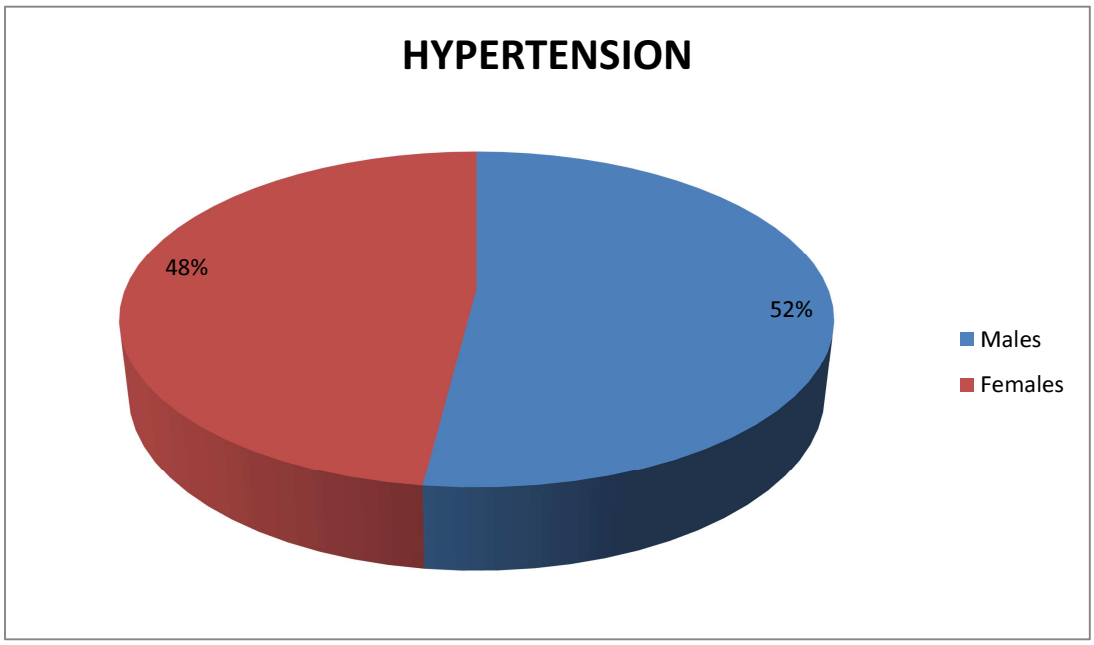
Body mass index	No.of Patients	Percentage
27.0 to 29.0	13	26%
29.1 to 31.0	19	38%
31.1 to 33.0	10	20%
33.1 to 35.0	7	14%
>35.0	1	2%



GENDER DISTRIBUTION OF HYPERTENSIVE PATIENTS

For the study group of 50 obese individuals,25 persons with obesity alone and another 25 with obesity and hypertension were selected. Gender distribution among the 25 numbered hypertensive obese patients is shown in the **Table-6.**

sex	Hypertension patients	Percentage
Male	13	52%
Female	12	48%

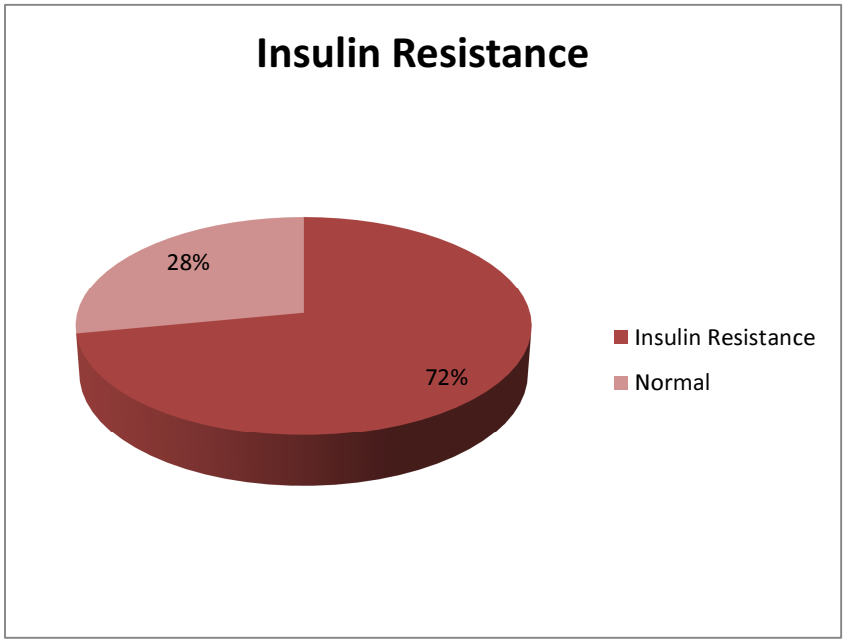


INSULIN RESISTANCE

Based on control values 36 patients among study population of 50 had insulin resitance.

Gender	No.of Patients	Insulin resistance	Percentage
Male	29	19	65.51%
Female	21	17	80.95%
Total	50	36	72%

DITRIBUTION OF INSULIN RESISTANCE



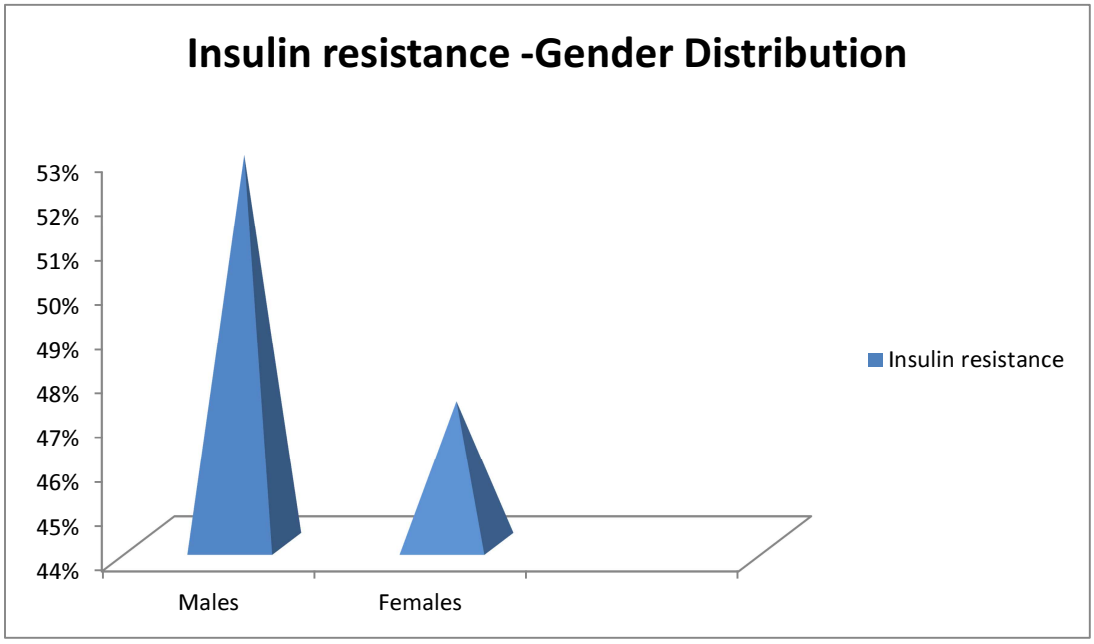
GENDER DISTRIBUTION OF INSULIN RESISTANCE

Among the study group 50 patients ,36 patients had insulin resistance.out of the 36 patients 19 were males and 17 were female patients.

TABLE-8

Gender	No.of Patients	Insulin resistance	Percentage
Male	29	19	65.51%
Female	21	17	80.95%

GENDER DISTRIBUTION OF INSULIN RESISTANCE



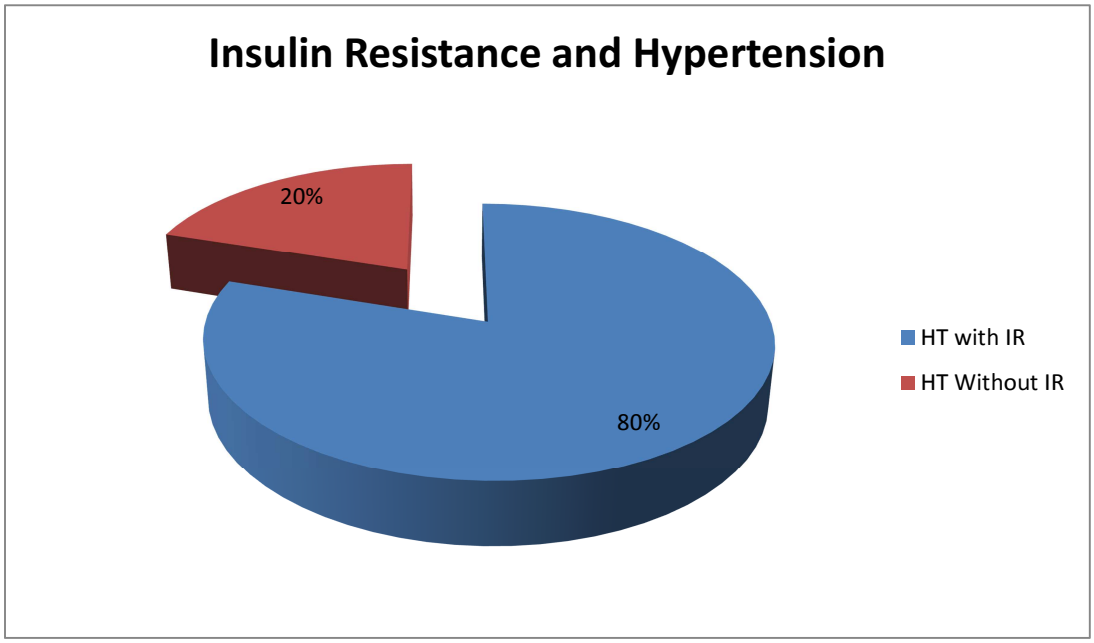
HYPERTENSION AND INSULIN RESISTANCE

In the study group 25 had both obesity and hypertension.Among these 25 patients had insulin resistance.

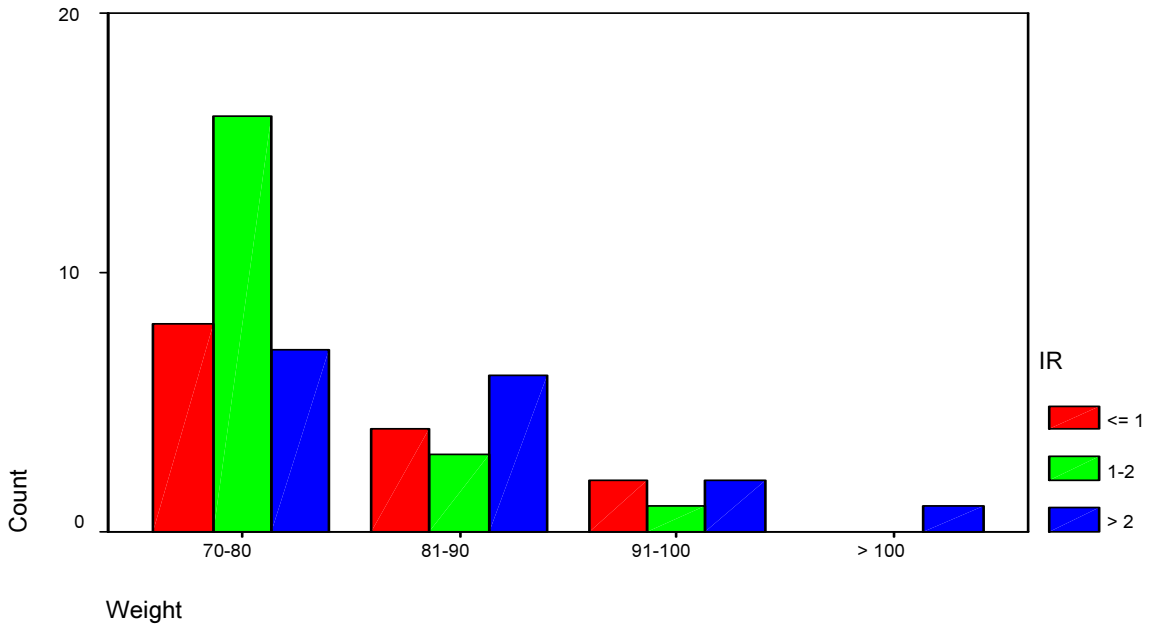
TABLE-9

No.of Hypertension patients	Hypertension with Insulin Resistance	Percentage
25	20	80%

DISTRIBUTION OF INSULIN RESISTANCE IN OBESE HYPERTENSIVES



Weight and Insulin resistance

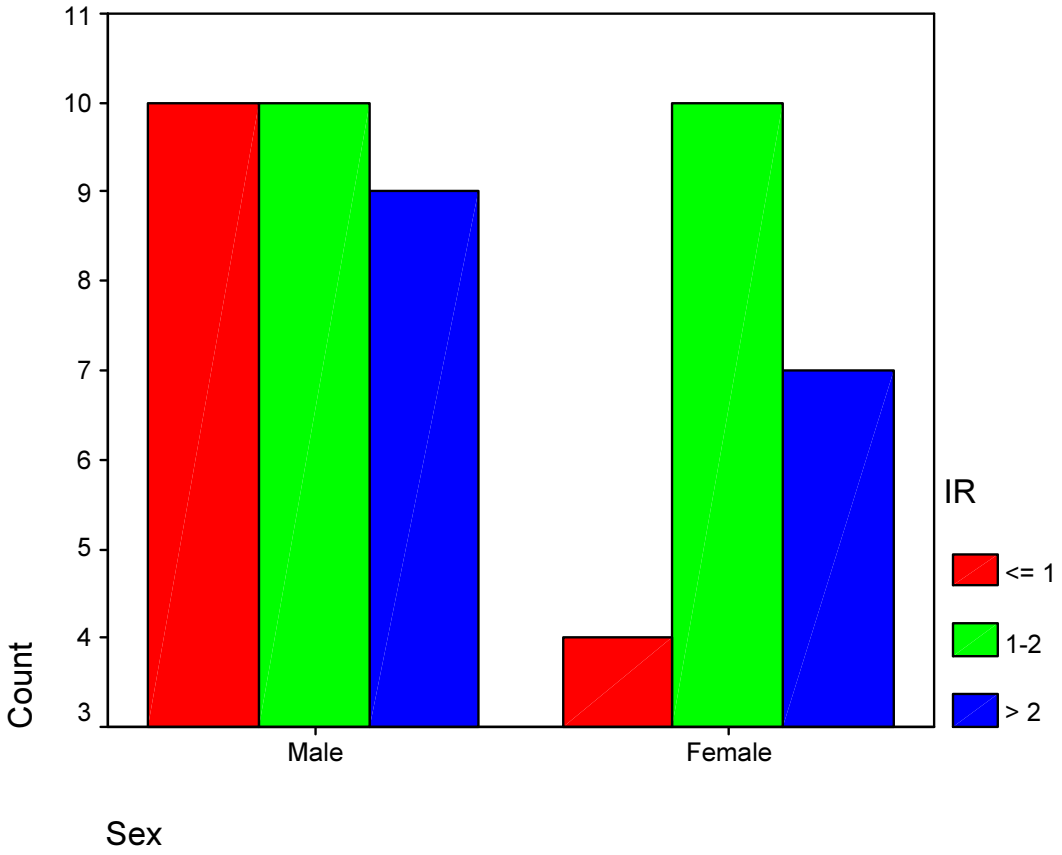


Chi square test

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.720(a)	6	.347
Likelihood Ratio	7.031	6	.318
Linear-by-Linear Association	.902	1	.342
N of Valid Cases	50		

P value = 0.347. NOT SIGNIFICANT.

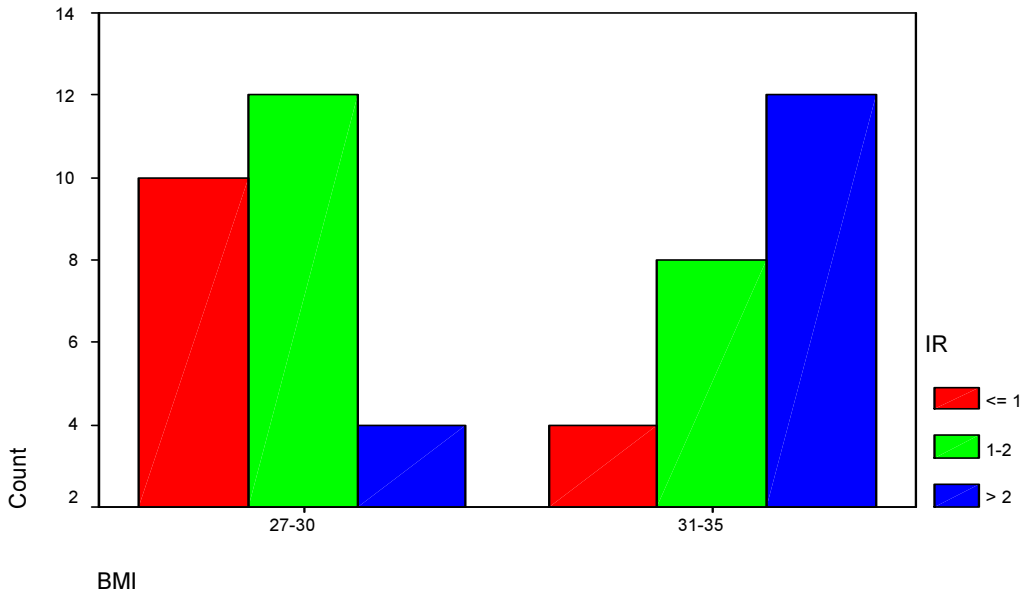
GENDER AND IR



	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.582(a)	2	.453
Likelihood Ratio	1.622	2	.444
Linear-by-Linear Association	.627	1	.428
N of Valid Cases	50		

P value =1.58.Not significant

BODY MASS INDEX AND INSULIN RESISTANCE



	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.303(a)	2	.026
Likelihood Ratio	7.568	2	.023
Linear-by-Linear Association	6.504	1	.011
N of Valid Cases	50		

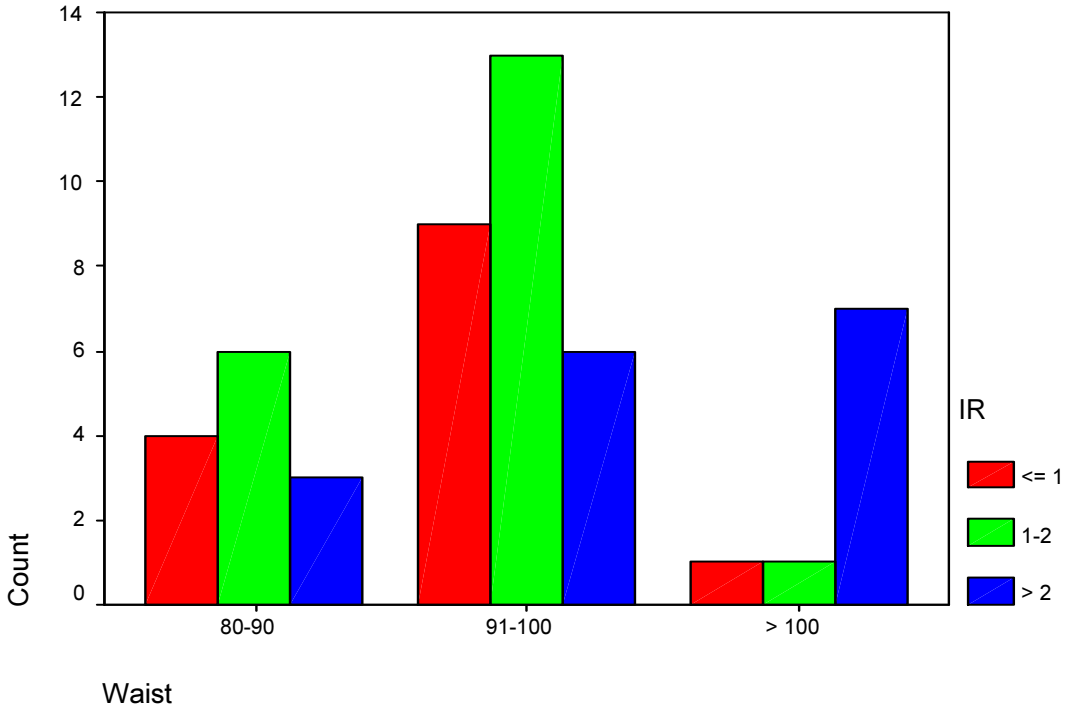
P value 0.026. significant

BMI and IR.

			IR			
			<= 1	1-2	> 2	Total
BMI	27-30	Count	10	12	4	26
		% within BMI	38.5%	46.2%	15.4%	100.0%
		% within IR	71.4%	60.0%	25.0%	52.0%
	31-35	Count	4	8	12	24
		% within BMI	16.7%	33.3%	50.0%	100.0%
		% within IR	28.6%	40.0%	75.0%	48.0%
Total		Count	14	20	16	50
		% within BMI	28.0%	40.0%	32.0%	100.0%
		% within IR	100.0%	100.0%	100.0%	100.0%

P value =o.026 .SIGNIFICANT

WAIST CIRCUMFERENCE AND INSULIN RESISTANCE



Chi square test

	value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.609(a)	4	.031
Likelihood Ratio	10.080	4	.039
Linear-by-Linear Association	3.873	1	.049
N of Valid Cases	5		

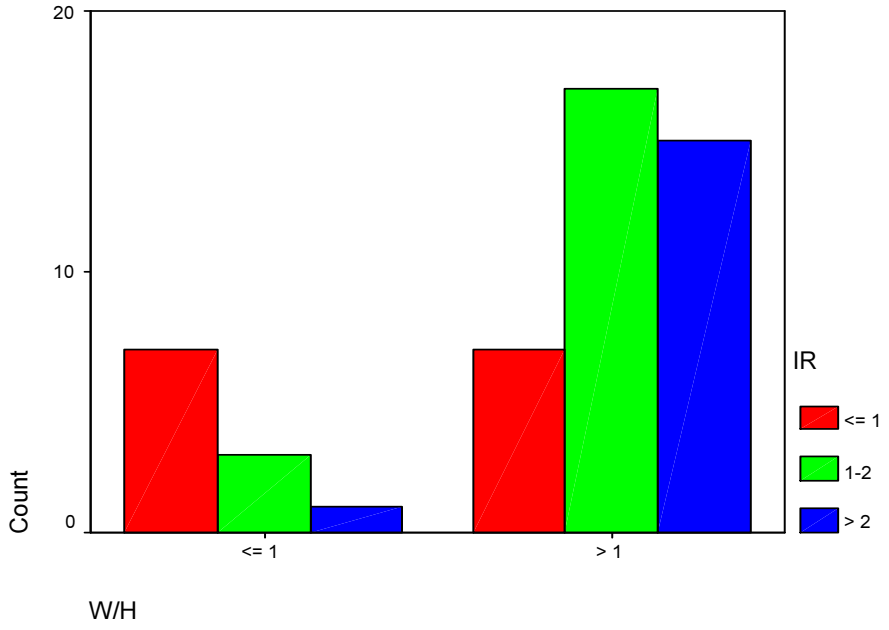
P value = 0.031 SIGNIFICANT

WAIST AND INSULIN RESISTANCE

.

			IR			
			<= 1	1-2	> 2	Total
Waist	80-90	Count	4	6	3	13
		% within Waist	30.8%	46.2%	23.1%	100.0%
		% within IR	28.6%	30.0%	18.8%	26.0%
	91-100	Count	9	13	6	28
		% within Waist	32.1%	46.4%	21.4%	100.0%
		% within IR	64.3%	65.0%	37.5%	56.0%
	> 100	Count	1	1	7	9
		% within Waist	11.1%	11.1%	77.8%	100.0%
		% within IR	7.1%	5.0%	43.8%	18.0%
Total		Count	14	20	16	50
		% within Waist	28.0%	40.0%	32.0%	100.0%
		% within IR	100.0%	100.0%	100.0%	100.0%

W/H RATIO AND INSULIN RESISTANCE



	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.280(a)	2	.010
Likelihood Ratio	8.893	2	.012
Linear-by-Linear Association	7.916	1	.005
N of Valid Cases	50		

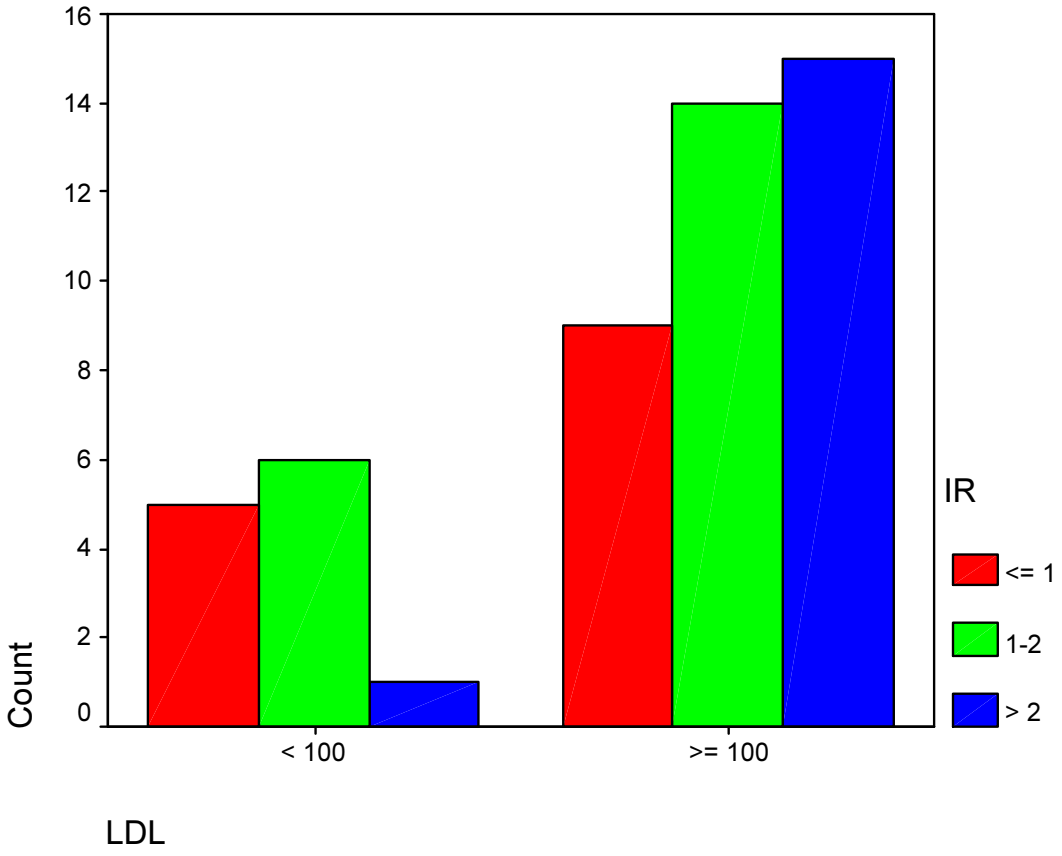
P value=0.0410.SIGNIFICANT

			IR			Total
			<= 1	1-2	> 2	
W/H	<= 1	Count	7	3	1	11
		% within W/H	63.6%	27.3%	9.1%	100.0%
		% within IR	50.0%	15.0%	6.3%	22.0%
	> 1	Count	7	17	15	39
		% within W/H	17.9%	43.6%	38.5%	100.0%
		% within IR	50.0%	85.0%	93.8%	78.0%
Total		Count	14	20	16	50
		% within W/H	28.0%	40.0%	32.0%	100.0%
		% within IR	100.0%	100.0%	100.0%	100.0%

	W/H	N	Mean	Std. Deviation	Std. Error Mean
IL6	<= 1	11	3.182	.7319	.2207
	> 1	39	4.879	1.8192	.2913

	W/H	N	Mean	Std. Deviation	Std. Error Mean
IIL6	<= 1	11	3.182	.7319	.2207
	> 1	39	4.879	1.8192	.2913

LDL AND IL-6



	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.212(a)	2	.122
Likelihood Ratio	4.943	2	.084
Linear-by-Linear Association	3.604	1	.058
N of Valid Cases	50		

P value =0.012. NOT SIGNIFICANT

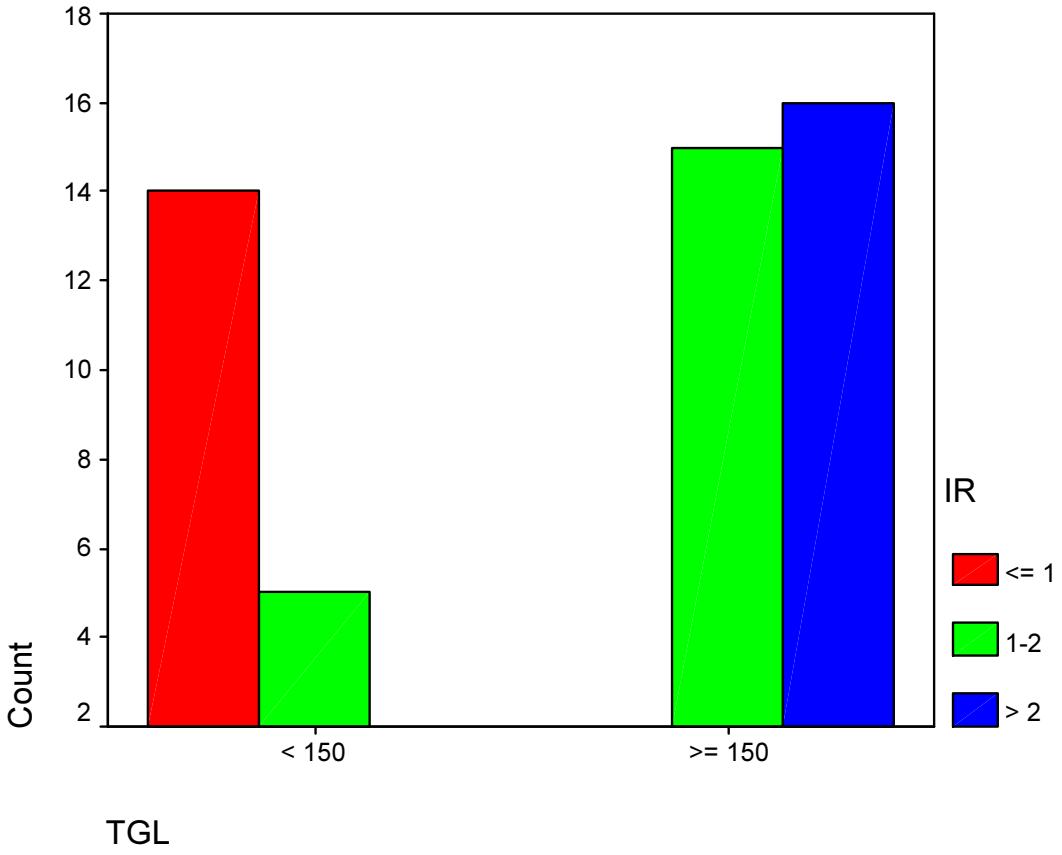
			IR			Total
			<= 1	1-2	> 2	
LLDL	< 100	Count	5	6	1	12
		% within LDL	41.7%	50.0%	8.3%	100.0%
		% within IR	35.7%	30.0%	6.3%	24.0%
	>= 100	Count	9	14	15	38
		% within LDL	23.7%	36.8%	39.5%	100.0%
		% within IR	64.3%	70.0%	93.8%	76.0%
Total		Count	14	20	16	50
		% within LDL	28.0%	40.0%	32.0%	100.0%
		% within IR	100.0%	100.0%	100.0%	100.0%

LDL AND IL-6

	LDL	N	Mean	Std. Deviation	Std. Error Mean
IL6	< 100	12	3.850	1.4152	.4085
	>= 100	38	4.713	1.8529	.3006

P value -0.14. Not Significant

TGL AND IR



	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	34.083(a)	2	.000
Likelihood Ratio	43.913	2	.000
Linear-by-Linear Association	30.287	1	.000
N of Valid Cases	50		

P value =0.00.SIGNIFICANT

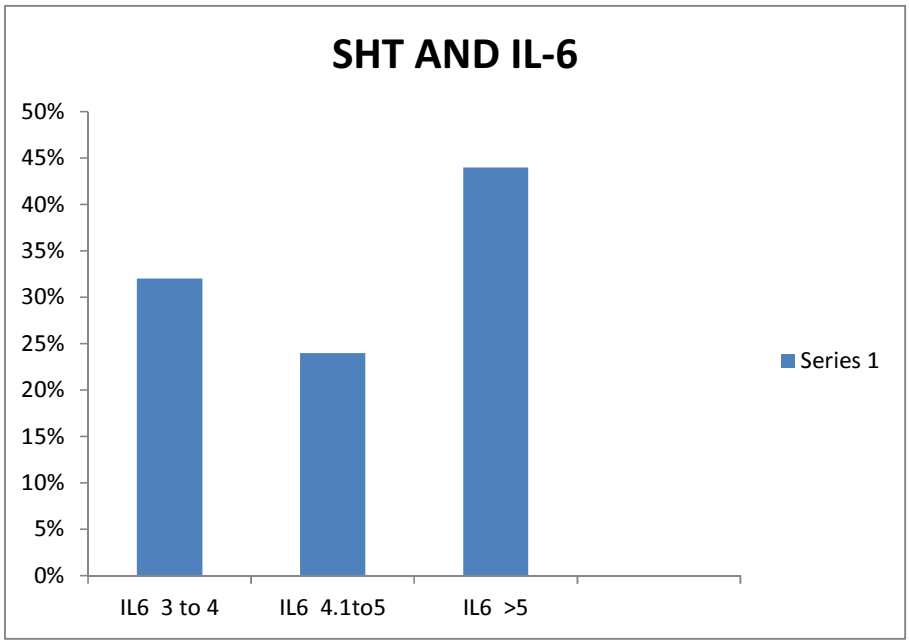
			IR			Total
			<= 1	1-2	> 2	
TGL	< 150	Count	14	5	0	19
		% within TGL	73.7%	26.3%	.0%	100.0%
		% within IR	100.0%	25.0%	.0%	38.0%
	>= 150	Count	0	15	16	31
		% within TGL	.0%	48.4%	51.6%	100.0%
		% within IR	.0%	75.0%	100.0%	62.0%
Total		Count	14	20	16	50
		% within TGL	28.0%	40.0%	32.0%	100.0%
		% within IR	100.0%	100.0%	100.0%	100.0%

TGL AND IL-6

	TGL	N	Mean	Std. Deviation	Std. Error Mean
IL6	< 150	19	2.974	.5772	.1324
	>= 150	31	5.445	1.6114	.2894

P value=0.00.SIGNIFICANT

SYSTEMIC HYPERTENSION AND IL-6



SHT AND IR

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.193(a)	2	.203
Likelihood Ratio	3.238	2	.198
Linear-by-Linear Association	.131	1	.717
N of Valid Cases	50		

P value=0.20.Not significant

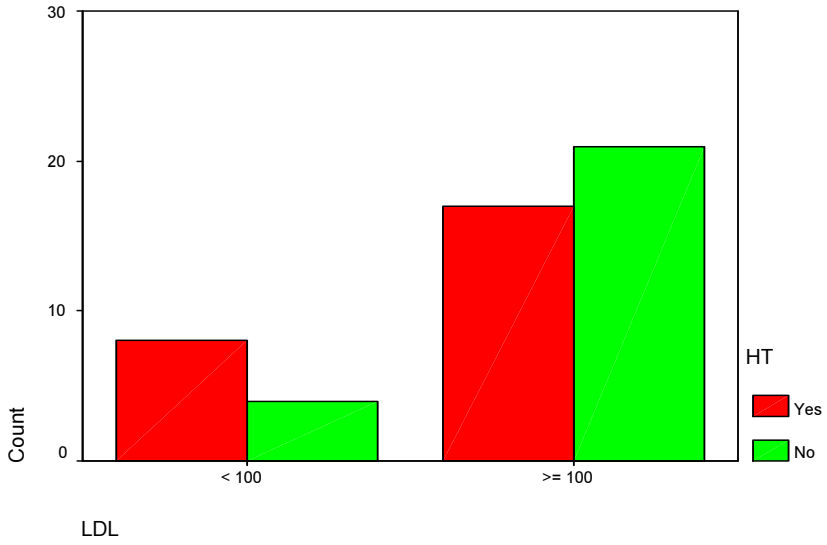
			IR			Total
			<= 1	1-2	> 2	
HT	Yes	Count	5	13	7	25
		% within HT	20.0%	52.0%	28.0%	100.0%
		% within IR	35.7%	65.0%	43.8%	50.0%
	No	Count	9	7	9	25
		% within HT	36.0%	28.0%	36.0%	100.0%
		% within IR	64.3%	35.0%	56.3%	50.0%
Total		Count	14	20	16	50
		% within HT	28.0%	40.0%	32.0%	100.0%
		% within IR	100.0%	100.0%	100.0%	100.0%

HT AND IL-6

	HHT	N	Mean	Std. Deviation	Std. Error Mean
IIL6	Yes	25	5.216	1.8694	.3739
	No	25	3.796	1.3960	.2792

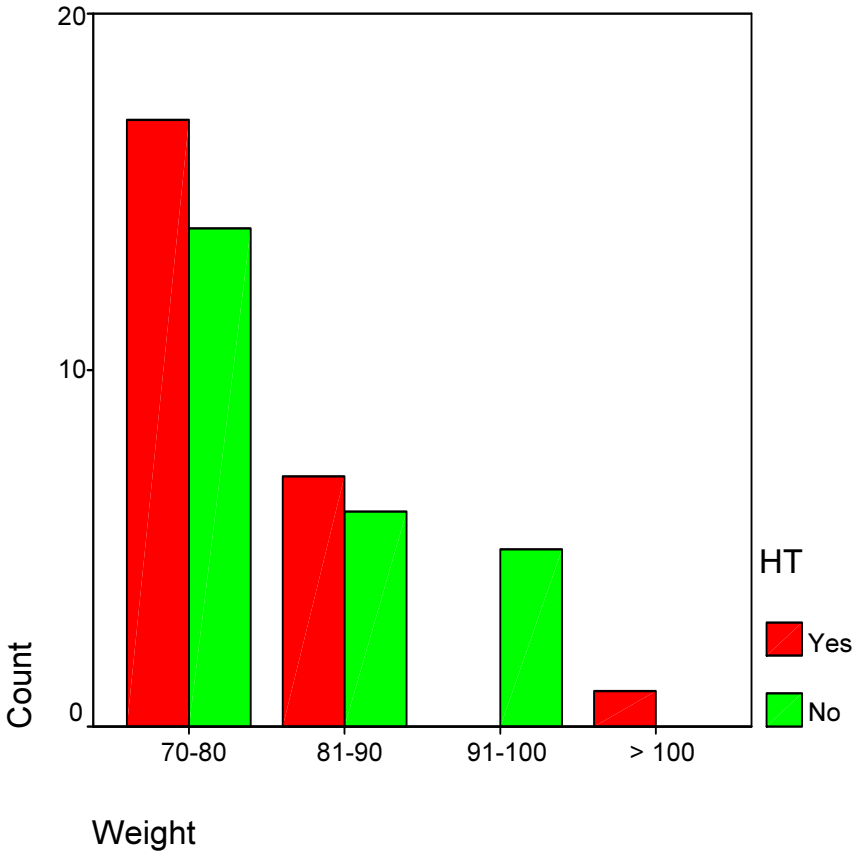
P value=0.004. SIGNIFICANT

LDL AND HT



	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.754(b)	1	.185		
Continuity Correction(a)	.987	1	.321		
Likelihood Ratio	1.781	1	.182		
Fisher's Exact Test				.321	.160
Linear-by-Linear Association	1.719	1	.190		
N of Valid Cases	50				

P value =0.160. Not significant



	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	6.367(a)	3	.095
Likelihood Ratio	8.686	3	.034
Linear-by-Linear Association	1.239	1	.266
N of Valid Cases	50		

P value= .095. Not significant

Descriptives of weight

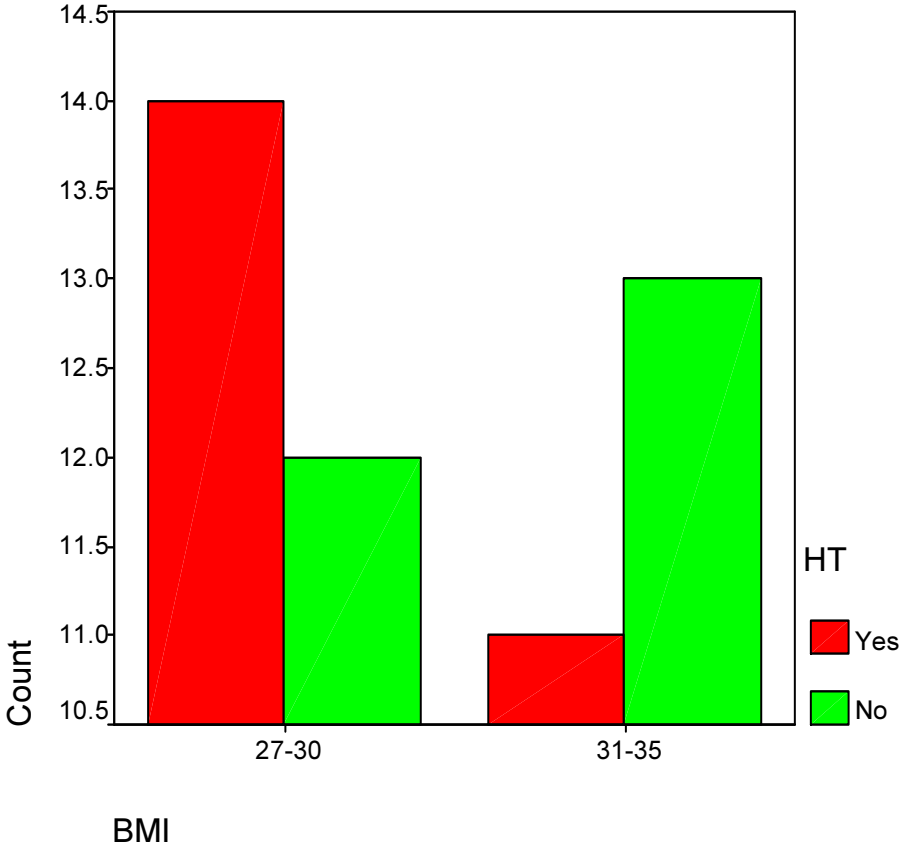
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
80-90	13	4.062	1.3562	.3761	3.242	4.881
91-100	28	4.239	1.5763	.2979	3.628	4.851
> 100	9	5.978	2.3086	.7695	4.203	7.752
Total	50	4.506	1.7834	.2522	3.999	5.013

Descriptives of IL-6

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	24.055	2	12.028	4.289	.019
Within Groups	131.793	47	2.804		
Total	155.848	49			

P value =.019.Significant

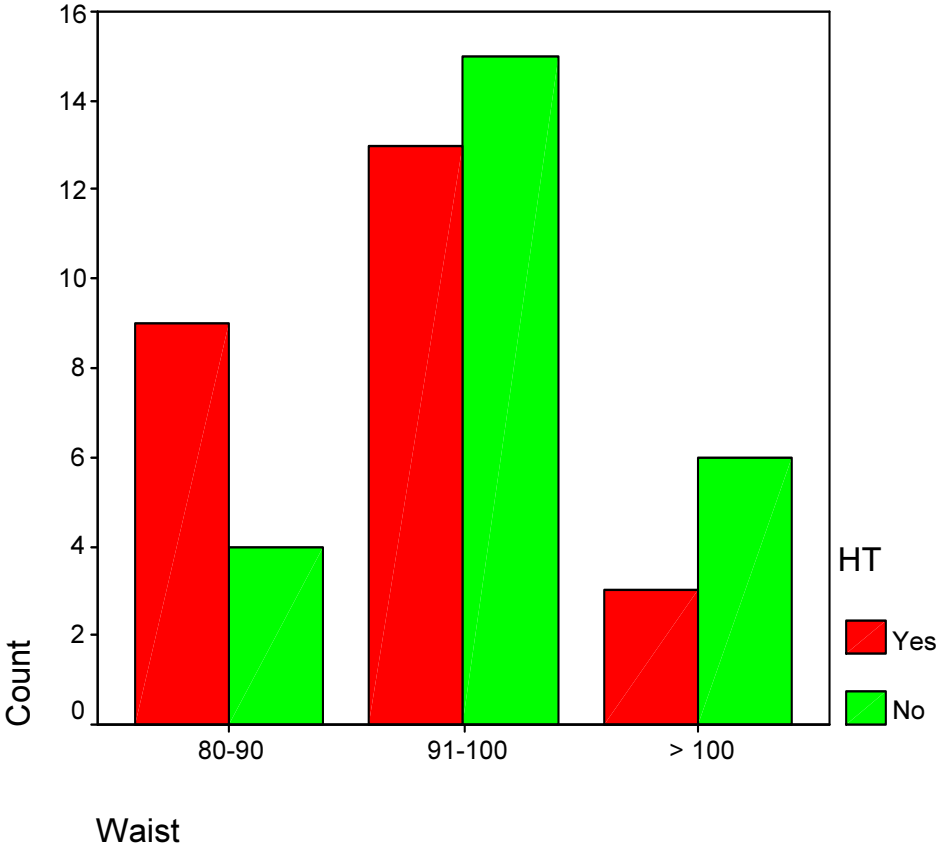
BMI AND HT



	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.321(b)	1	.571		
Continuity Correction(a)	.080	1	.777		
Likelihood Ratio	.321	1	.571		
Fisher's Exact Test				.778	.389
Linear-by-Linear Association	.314	1	.575		
N of Valid Cases	50				

P value =.58. Not significant

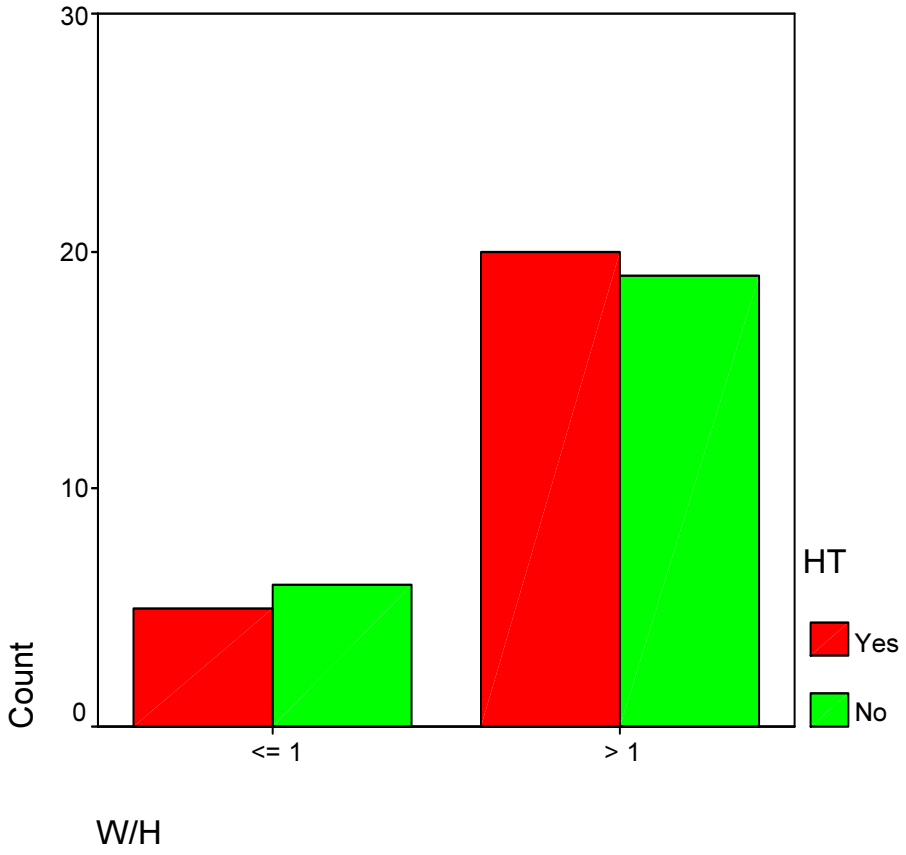
WAIST AND HT



	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.066(a)	2	.216
Likelihood Ratio	3.136	2	.208
Linear-by-Linear Association	2.893	1	.089
N of Valid Cases	50		

P value= .21. Not significant.

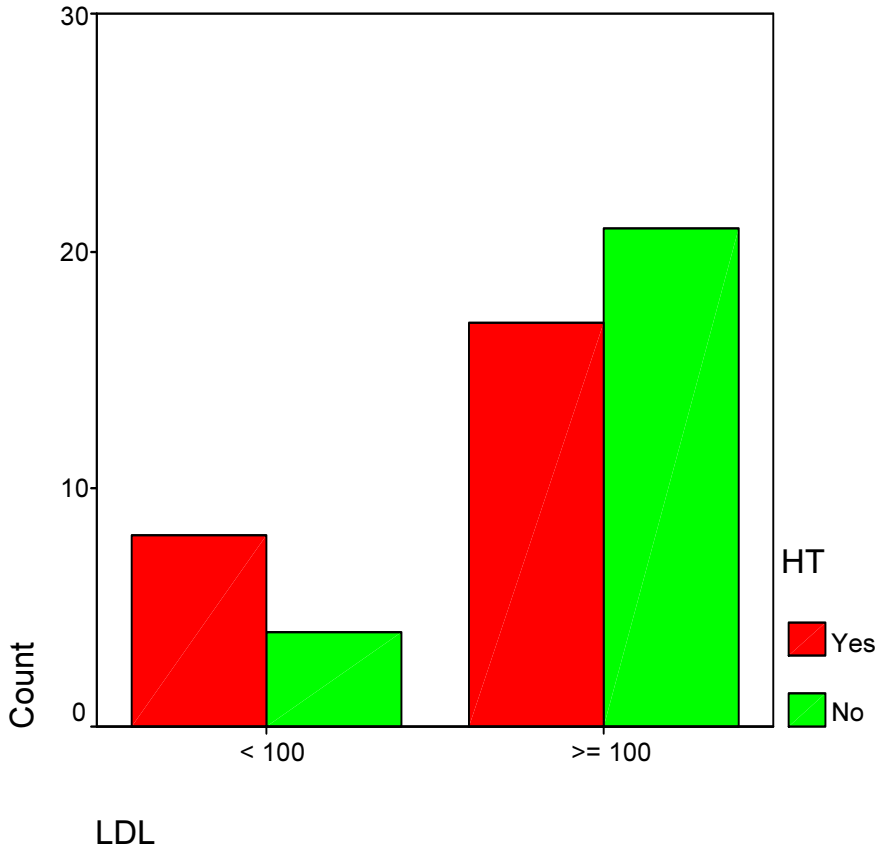
W/H RATIO AND HT



	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.117(b)	1	.733		
Continuity Correction(a)	.000	1	1.000		
Likelihood Ratio	.117	1	.733		
Fisher's Exact Test				1.000	.500
Linear-by-Linear Association	.114	1	.735		
N of Valid Cases	50				

P value =.50. not significant

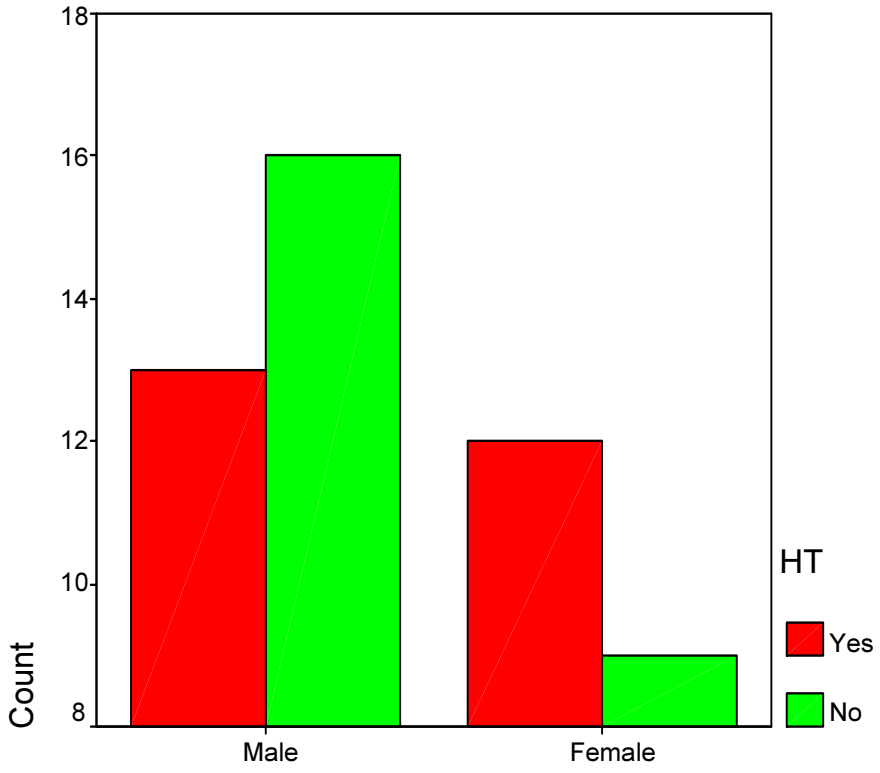
TGL AND HT



	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.754(b)	1	.185		
Continuity Correction(a)	.987	1	.321		
Likelihood Ratio	1.781	1	.182		
Fisher's Exact Test				.321	.160
Linear-by-Linear Association	1.719	1	.190		
N of Valid Cases	50				

P Value=.18. NOT SIGNIFICANT

GENDER AND HT



	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.739(b)	1	.390		
Continuity Correction(a)	.328	1	.567		
Likelihood Ratio	.741	1	.389		
Fisher's Exact Test				.567	.284
Linear-by-Linear Association	.724	1	.395		
N of Valid Cases	50				

P value =.39.Not Sisnificant

IR AND IL-6

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	102.375	2	51.187	44.991	.000
Within Groups	53.473	47	1.138		
Total	155.848	49			

P Value=0.00 SIGNIFICANT

Multiple comparisons :- Dependable variation of IL-6

(I) IR	(J) IR	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
<= 1	1-2	-1.406(*)	.3717	.001	-2.306	-.507
	> 2	-3.640(*)	.3904	.000	-4.585	-2.695
1-2	<= 1	1.406(*)	.3717	.001	.507	2.306
	> 2	-2.234(*)	.3578	.000	-3.100	-1.368
> 2	<= 1	3.640(*)	.3904	.000	2.695	4.585
	1-2	2.234(*)	.3578	.000	1.368	3.100

Multiple comparisons:- waist circumference

(I) Waist	(J) Waist	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
80-90	91-100	-.178	.5620	.946	-1.538	1.182
	> 100	-1.916(*)	.7261	.030	-3.674	-.159
91-100	80-90	.178	.5620	.946	-1.182	1.538
	> 100	-1.738(*)	.6416	.025	-3.291	-.186
> 100	80-90	1.916(*)	.7261	.030	.159	3.674
	91-100	1.738(*)	.6416	.025	.186	3.291

Homogeneous Subsets-IL-6

IR	N	Subset for alpha = .05		
		1	2	3
<= 1	14	2.779		
1-2	20		4.185	
> 2	16			6.419
Sig.		1.000	1.000	1.000

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
80-90	13	4.062	1.3562	.3761	3.242	4.881
91-100	28	4.239	1.5763	.2979	3.628	4.851
> 100	9	5.978	2.3086	.7695	4.203	7.752
Total	50	4.506	1.7834	.2522	3.999	5.013

DISCUSSION

DISCUSSION

In obesity the excess adipose tissue particularly from the viscera secretes a number of pro-inflammatory mediators. These mediators are main causative factors for the development of metabolic syndrome obese individuals.

In this context we evaluated the correlation between Insulin resistance and systemic hypertension with serum IL-6 level of obese individuals. In our study we found that there is significant correlation for Insulin resistance with serum IL-6.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	102.375	2	51.187	44.991	.000
Within Groups	53.473	47	1.138		
Total	155.848	49			

P Value=0.00 SIGNIFICANT

. Fernandez-real etal [33] study reported that among the cytokine which are secreted from adipose tissues IL-6 play a key role in causing IR obese persons. Our study showed positive correlation body mass index and insulin resistance. In previous studies done by Garca- Estevez et al also had similar results[34]. In their study the increase in insulin resistance was noted when BMI increases above 27.The p value for BMI and IR was .26 which is a significant one.

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.303(a)	2	.026
Likelihood Ratio	7.568	2	.023
Linear-by-Linear Association	6.504	1	.011
N of Valid Cases	50		

P value =.026.

Waist circumference and insulin resistance also showed a positive correlation in our study. In previous study by

Pouliot MC etal showed that waist circumference can be kept as best measure for abdominal visceral adipose tissue deposition[35]. Our study had a p value of .031 which is significant.

In our study we also found a significant correlation between W/H ratio and IR. It had a significant p value of .10

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.280(a)	2	.010
Likelihood Ratio	8.893	2	.012
Linear-by-Linear Association	7.916	1	.005
N of Valid Cases	50		

W/H ratio also had positive correlation with IL6 in our study it had a p value of .04. In obesity while considering insulin resistance both waist levels w/h ratio have a significant correlation

While comparing TGL levels with IR and IL-6 we found a positive association for TGL levels with them.

Previous study by Qulec et al showed that serum TGL levels and BMI were positively correlated to IR. In our study also we found a similar result while comparing BMI, TGL levels with insulin resistance status in obese individuals.[36].

IR and TGL comparison had p value=.00 which is very significant.TGL and IL-6 had a P value =.00 which is very significant

	TTGL	N	Mean	Std. Deviation	Std. Error Mean
IIL6	< 150	19	2.974	.5772	.1324
	>= 150	31	5.445	1.6114	.2894

IR and TGL comparison had p value=.00 which is very significant.LDL had no positive association with IR as its p value was not significant. LDL also had no correlation with HT. Waist and weight had no positive correlation with HT as their p values were not significant.

In our study we included 25 obese individuals who also had systemic hypertension and were on treatment. These patients had a positive correlation for insulin resistance. The P value for

comparison of hypertension and IR was .02 which is significant. In previous study regarding HT and IL-6 comparison by Bautista et al in 2005 showed a positive correlation.[37]

	HHT	N	Mean	Std. Deviation	Std. Error Mean
IIL6	Yyes	25	5.216	1.8694	.3739
	Nno	25	3.796	1.3960	.2792

P value =.04.

The mean for IL-6 the patients who had hypertension was 5, while mean for non hypertensive obese was 3. The P value is .04. This inference of positive association of HT and IL-6 was similar to the previous study.

CONCLUSION

CONCLUSION

1In obese non diabetic individuals evaluation of serum IL-6 may be heipful in assessment of insulin resistance.

2.In obese hypertensives evaluation of serumIL-6 shows additive association for inflammatory cause.

3 serum TGL levels are elevated in both obese hypertensives and obese with insulin resistance status Further studies are needed for confirmation.

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PROFORMA

SERUM INTERLEUKIN-6 LEVELS AND ITS CORRELATION WITH INSULIN RESISTANCE AND SYTEMIC HYPERTENSION IN OBESITY

Name : Age : Sex :

Address :

Occupation

Symptoms :

Polyuria
Polydipsia
Chest pain
Palpitation
Giddiness
Breathlessness

Past history:

Diabetes mellitus:
Duration:
Treatment: OHA/Insulin
Compliance of treatment:
Associated complications (if any)

Hypertension -duration
-treatment history

Coronary artery disease

Other co morbid illnesses

Thyroid disorders

Personal history:

Smoking

Alcoholism

General examination:

Anthropometry:

Height (in cm): Weight(in kg): Waist: Hip:

Waist/Hip ratio: Body mass index:

PULSE:

BLOOD PRESSURE: Right upper limb: Left upper limb:

SYSTEMIC EXAMINATION:

CARDIO VASCULAR SYSTEM:

RESPIRATORY SYSTEM:

ABDOMEN:

CENTRAL NERVOUS SYSTEM:

FUNDUS EXAMINATION

Complete Hemogram			Renal function test		
TC		cells/mm^3	Glucose (F)		mg/dl
DC			Glucose (PP)		mg/dl
ESR		mm/hr	Urea		mg/dl
Hb		g/dl	Creatinine		mg/dl
PCV		%	Na+		mEq/l
Platelets		lakhs/mm^3	K+		mEq/l
RBCs		million/mm^3	Urinanalysis		
Lipid profile			Albumin		
Total cholesterol		mg/dl	Sugar		
LDL		mg/dl	Deposits		
HDL		mg/dl	Microalbumin		
Triglycerides		mg/dl	Culture		

LFT

DB		mg/dl
IB		mg/dl
AST		IU
ALT		IU
ALP		IU
TP		mg/dl
ALB		mg/dl
GLO		mg/dl

X-ray chest

Fasting blood sugar

HbA1c

Fasting Plasma Insulin

Serum Interleukin-6.

Insulin resistance was calculated using HOMA-IR method.

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI -3

Telephone No : 044 25305301
Fax : 044 25363970

CERTIFICATE OF APPROVAL

To
Dr. N. Ragavan
PG in MD General Medicine
Madras Medical College, Chennai -3

Dear Dr. N. Ragavan

The Institutional Ethics committee of Madras Medical College, reviewed and discussed your application for approval of the proposal entitled "Serum interleukin-6 levels and its correlation with insulin resistance and systemic hypertension in obesity" No.23062012.

The following members of Ethics Committee were present in the meeting held on 19.06.2012 conducted at Madras Medical College, Chennai -3.

1.	Dr. S.K. Rajan. M.D.,FRCP.,DSc	-- Chairperson
2.	Prof. K. Ramadevi MD Prof of Biochemistry, MMC, Ch-3	-- Member
3.	Prof. R. Nandhini MD Director, Inst. of Pharmacology ,MMC, Ch-3	-- Member
4.	Prof. C. Rajendiran, MD Director , Inst. of Internal Medicine, MMC, Ch-3	-- Member
5.	Prof. S. Deivanayagam MS Prof of Surgery, MMC, Ch-3	-- Member
6.	Prof. A. Radhakrishnan MD Prof of Internal Medicine, MMC, Ch-3	-- Member

We approve the proposal to be conducted in its presented form.

Sd/ Chairman & Other Members

The Institutional Ethics Committee expects to be informed about the progress of the study, and SAE occurring in the course of the study, any changes in the protocol and patients information / informed consent and asks to be provided a copy of the final report.

Member Secretary, Ethics Committee

MASTER CHART

ID	AGE	Sex	Height	Wt	BMI	Waist	Hip	W/H	LDL	TGL	HbA1c	Fasting Insulin	FBS	HT	IR	IL6
1	28	M	165	76	27.9	106	87	1.22	114	156	5.4	5.5	86	N	1.17	3.1
2	32	M	150	70	31.1	96	80	1.2	130	176	4.9	9.6	90	N	2.13	4
3	34	F	155	67	27.9	90	72	1.25	102	180	5	12	84	N	2.49	4.6
4	30	M	162	78	29.7	82	96	0.85	98	114	4.3	4.5	80	N	0.89	2.6
5	35	F	154	80	33.7	98	89	1.1	140	198	5.1	13.2	96	N	3.13	5.2
6	28	M	172	96	32.4	95	109	0.87	112	134	5.4	5.1	84	N	1.06	2.8
7	34	M	164	92	34.2	103	94	1.1	140	182	4.9	14.5	82	N	2.94	4.8
8	26	M	159	83	32.8	93	102	0.91	124	132	5.4	4.9	90	N	1.09	3.4
9	27	M	163	75	28.2	94	90	1.04	118	128	4.6	3.5	90	N	0.78	2.2
10	30	F	157	79	32	96	83	1.16	134	158	4.2	7.6	84	N	1.58	3.8
11	32	M	168	77	27.3	97	92	1.05	132	169	4.7	8.2	97	Y	1.96	4
12	34	F	158	80	32	87	83	1.05	142	170	5.4	9.5	82	Y	1.92	4.3
13	29	F	154	72	30.4	92	84	1.1	118	182	5.1	12.1	92	Y	2.75	6.4
14	33	M	168	83	29.4	98	94	1.04	87	206	4.9	15.2	80	Y	3	7.3
15	30	M	159	79	31.2	94	83	1.13	138	167	4.6	7.4	83	Y	1.52	4.4
16	35	F	163	84	31.6	87	99	0.88	114	132	5.3	3.9	85	Y	0.82	2.5

ID	AGE	Sex	Height	Wt	BMI	Waist	Hip	W/H	LDL	TGL	HbA1c	Fasting Insulin	FBS	HT	IR	IL6
17	28	M	172	102	34.5	108	94	1.15	156	195	5.5	19.2	94	Y	4.46	8.9
18	34	M	165	86	31.6	96	87	1.1	94	112	4.7	5.5	80	Y	1.09	4.1
19	29	F	157	70	28.4	89	86	1.03	132	153	5.2	8.8	78	Y	1.69	4.6
20	31	M	162	78	29.7	97	92	1.05	98	161	4.7	7.9	80	Y	1.56	4.4
21	29	F	154	69	29.1	87	92	0.95	87	94	5.3	4.8	92	Y	1.09	3.5
22	35	M	166	84	30.5	97	83	1.17	137	188	4.8	18.2	77	Y	3.46	8.2
23	33	F	158	74	29.6	88	85	1.04	117	137	4.5	5.3	89	Y	1.16	3.8
24	31	F	153	69	29.5	87	85	1.02	88	169	5.6	6.7	98	Y	1.62	4.3
25	27	M	169	82	28.7	94	92	1.02	102	113	5.1	4.7	79	N	0.92	2.9
26	32	F	155	69	28.7	89	88	1.01	98	113	5.2	3.9	81	N	0.78	2.1
27	34	M	164	78	29	101	92	1.1	114	122	4.7	4.2	85	N	0.88	2.4
28	29	M	172	94	31.8	98	108	0.91	128	139	5.6	4.8	83	N	0.98	3
29	34	M	168	97	34.4	102	92	1.11	138	167	5.1	12.2	96	N	2.89	5.1
30	32	M	157	73	29.6	94	89	1.06	92	160	5.5	7.2	84	N	1.49	3.3
31	27	M	162	88	33.5	109	98	1.11	147	168	5.6	16.5	90	N	3.67	6.2
32	32	F	152	69	29.9	97	84	1.15	132	152	4.9	7.4	89	N	1.63	3.6
33	27	F	149	64	28.8	92	104	0.88	128	147	5	3.9	85	N	0.82	2.4
34	32	M	178	94	29.7	98	97	1.01	118	138	4.7	4.8	82	N	0.97	2.9

ID	AGE	Sex	Height	Wt	BMI	Waist	Hip	W/H	LDL	TGL	HbA1c	Fasting Insulin	FBS	HT	IR	IL6
35	26	F	154	72	30.4	92	84	1.1	124	194	5.6	13.8	92	N	3.13	6.6
36	29	F	163	72	27.1	89	106	0.84	138	174	4.8	12	82	N	2.43	5
37	33	F	157	88	35.7	96	86	1.12	112	157	5.3	7.1	90	N	1.58	3.5
38	31	M	169	90	31.5	98	94	1.04	96	132	4.6	3.8	87	N	0.82	2.5
39	34	M	159	87	34.4	104	90	1.16	139	195	5.6	19.2	84	N	3.98	6.9
40	35	M	160	72	28.1	89	98	0.91	94	122	4.6	3.9	81	Y	0.78	3.1
41	32	F	155	82	34.1	106	95	1.12	168	172	5.5	13.7	89	Y	3.01	8
42	28	F	157	73	29.6	89	84	1.06	158	179	4.3	12.3	88	Y	2.67	7.1
43	34	M	164	77	28.6	93	100	0.93	86	93	5.4	4.3	78	Y	0.83	3.7
44	32	M	172	90	30.4	102	93	1.1	110	158	4.9	15.9	82	Y	3.22	8.4
45	30	F	161	80	30.9	92	89	1.03	146	128	4.6	4.2	80	Y	0.83	3.6
46	28	F	156	68	27.9	84	82	1.02	98	155	5.3	8.9	82	Y	1.8	5.3
47	33	M	169	85	29.8	94	103	0.91	110	123	5.6	3.4	87	Y	0.73	3
48	29	M	159	74	29.3	98	93	1.05	147	162	4.9	7.8	94	Y	1.81	5.9
49	32	F	157	72	29.2	93	87	1.07	134	159	5.3	8.9	87	Y	1.91	6.2
50	28	M	160	79	30.9	99	95	1.04	129	153	5.6	8.5	81	Y	1.7	5.4