PREVALANCE AND KAP STUDY OF METABOLIC SYNDROME IN TYPE 2 DIABETIC PATIENTS

DISSERTATION

Submitted in Partial Fulfilment of the Requirement for

The Award of the Degree of

MASTER'S PROGRAMME IN

CLINICAL NUTRITION AND DIETETICS

BY

LAKSHMI MEHTA A

(Register No: SM19MCN007)

DEPARTMENT OF CLINICAL NUTRITION AND DIETETICS

ST. TERESA'S COLLEGE (AUTONOMOUS)

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APRIL 2021

External Examiner **Internal Examiner**

DECLARATION

I hereby declare that the thesis entitled **PREVALANCE AND KAP STUDY OF METABOLIC SYNDROME IN TYPE 2 DIABETIC PATIENTS** submitted in partial fulfilment of the requirement for the award of the Degree of Master's Programme in Clinical Nutrition and Dietetics is a record of original research work done by me under the supervision and guidance of **Ms. Rajani LR** Assistant Professor, Department of Clinical Nutrition and Dietetics, Women's Study Centre, St. Teresa's College(Autonomous), Ernakulam and that the thesis has not previously formed on the basis for the award of any degree work has not been submitted in part or full or any other degree/diploma/ fellowship or the similar titles to any candidate of any other University.

Place: Ernakulam **LAKSHMI MEHTA A**

Date:

CERTIFICATE

I hereby certify that the dissertation entitled **PREVALANCE AND KAP STUDY OF METABOLIC SYNDROME IN TYPE 2 DIABETIC PATIENTS** submitted in partial fulfilment of the requirement for the award of the Degree of Master's in Clinical Nutrition and Dietetics is a record of original research work do by Ms LAKSHMI MEHTA during the period of her study under my guidance and supervision.

Signature of HOD

Signature of Research Guide

Ms Rajani LR

Assistant Professor

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LAKSHMI MEHTA

ABSTRACT

ABSTRACT

Metabolic syndrome is a constellation of interrelated factors that increase the risk for Heart disease, Diabetes, Stroke. The NCEP ATP III criteria was used in this study for the diagnosis of Metabolic syndrome in Type 2 Diabetic patients. A total of 50 subjects having Type 2 Diabetes between the age group 30-60 years were selected from Silverline Hospital, Ernakulam District. The objectives of the study were to assess the KAP of patients, to find out the incidence of Metabolic syndrome in Type 2 Diabetics, to estimate the nutritional status of the subjects. Using the NCEP ATP III guidelines it was found that 27 subject had Metabolic syndrome. The KAP analysis shows that the patients had sufficient knowledge about Type 2 diabetes but were not aware of the term Metabolic syndrome. The patients had a positive attitude towards lifestyle modification for the management but their practices indicate a lack of effort. The dietary assessment indicates that the subjects had a moderate calorie consumption, a high fat intake, a moderate protein intake and a low fibre intake. It was discovered from the study that risk of Metabolic syndrome and Type 2 diabetes increases with age and that Metabolic syndrome was prevalent among patients having Diabetes between 1-10 years. Pearson correlation was found between Calorie intake and Fasting blood sugar, Fat intake and Serum Triglyceride levels, Calorie intake and Body Mass Index, Fat intake and Body Mass Index, Body Mass Index and Serum Triglyceride. A booklet containing information on Type 2 Diabetes and Metabolic syndrome was distributed to the patients. The study interpreted that there is an increased need for awareness about Type 2 Diabetes and Metabolic syndrome to help people understand the treatment regimen better.

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INTRODUCTION

1. INTRODUCTION

One in six people with Diabetes in the world is from India. The numbers place the country among the top 10 countries for people with Diabetes, coming in at Number 2 with an estimated 77 million Diabetics (IDF Diabetes Atlas, 2019).

Diabetes, being a lifestyle disorder with multidimensional causative factors, definitely needs a multidimensional approach. One such causative factor for Diabetes is Metabolic Syndrome.

Metabolic syndrome is a group of interconnected factors namely lipid abnormalities, high blood pressure, diabetes or pre-diabetes that are seen in an individual. It is a complex web of metabolic factors that have a 2-fold risk of cardio vascular diseases and a 5-fold risk of Diabetes (Lee Lana et al., 2012).

"Gerald Reaven introduced the concept of insulin resistance as a common etiologic factor for the group of metabolic disturbances and disorders he collectively called Syndrome X. In addition to hypertension, Reaven's definition included impaired glucose tolerance (IGT), hyperinsulinemia, high levels of very-low-density lipoprotein (VLDL) triglycerides (TGs), and low levels of high-density lipoprotein (HDL) cholesterol. Central adiposity was added subsequently as a clinical feature of MetS by Norman Kaplan, and current definitions of MetS now include the following key characteristics: hyperinsulinemia or insulin resistance, dyslipidemia, hypertension, and obesity, with a particular emphasis on central adiposity" (Sanders et al., 2012).

"The most commonly observed collection of metabolic risk factors has several different names: syndrome X, insulin resistance syndrome, pre-diabetes, metabolic syndrome,

dysmetabolic syndrome, cardiometabolic syndrome, dyslipidemic hypertension, hypertriglyceridemic waist, and deadly quartet" (Grundy S.M, 2006).

"The metabolic syndrome is a simple clinical tool to identify people with a particular set of risk factors who are at higher long-term risk for both ASCVD and type 2 diabetes. Affected individuals deserve *1*) lifestyle intervention (weight loss, increased physical activity, and a healthy diet) and *2*) more detailed, short-term risk assessment (e.g., Framingham scoring). On the basis of the latter, risk-reducing drugs may be required for treatment of individual risk factors" (Grundy S.M, 2006).

"MetS started as a concept rather than a diagnosis. The metabolic syndrome has its origins in 1920 when Kylin, a Swedish physician, demonstrated the association of high blood pressure (hypertension), high blood glucose (hyperglycemia), and gout. Later in 1947, Vague described that the visceral obesity was commonly associated with the metabolic abnormalities found in CVD and T2DM. Following this, in 1965, an abstract was presented at the European Association for the Study of Diabetes annual meeting by Avogaro and Crepaldi which again described a syndrome which comprised hypertension, hyperglycemia, and obesity. The field moved forward significantly following the 1988 Banting Lecture given by Reaven. He described "a cluster of risk factors for diabetes and cardiovascular disease" and named it "Syndrome X". His main contribution was an introduction of the concept of the insulin resistance. However, he surprisingly missed obesity or visceral obesity from the definition which was later added as a crucial abnormality. In 1989, Kaplan renamed the syndrome "The Deadly Quartet" for the combination of upper body obesity, glucose intolerance, hypertriglyceridemia, and hypertension and however, in 1992, it was again renamed "The Insulin Resistance Syndrome" (Kaur J, 2014).

Metabolic syndrome is a cluster of conditions including hyperglycemia or insulin resistance, obesity and dyslipidaemia. It is important because it helps to classify patients who are at risk of developing atherosclerotic CVD and type 2 Diabetes, the relationship between the components of Metabolic syndrome help for the better understanding of the pathophysiology of its link with increased risk of CVD. It also helps in epidemiological and clinical studies of pharmacological, lifestyle and preventive treatment approaches (Huang L P, 2009).

"Diabetes is a major lifestyle disorder, the prevalence of which is increasing globally. Asian countries contribute to more than 60% of the world's diabetic population as the prevalence of diabetes is increasing in these countries" (Ramachandran et al., 2012).
"Worldwide prevalence of MetS ranges from <10% to as much as 84%, depending on the region, urban or rural environment, composition (sex, age, race, and ethnicity) of the population studied, and the definition of the syndrome used. In general, the IDF estimates that one-quarter of the world's adult population has the MetS. Higher socioeconomic status, sedentary lifestyle, and high body mass index (BMI) were significantly associated with MetS. Cameron et al. have concluded that the differences in genetic background, diet, levels of physical activity, smoking, family history of diabetes, and education all influence the prevalence of the MetS and its components. The observed prevalence of the MetS in National Health and Nutrition Examination Survey (NHANES) was 5% among the subjects of normal weight, 22% among the overweight, and 60% among the obese" (Kaur J, 2014).

Dhananjay yadav et al., in the year 2013 examined the Prevalence of Metabolic Syndrome in Type 2 Diabetes Mellitus using NCEP ATP III, WHO and IDF definitions and its agreement in Gwalior Chambal region of central India. This study involved 700

Type 2 Diabetic subjects from the urban areas of Gwalior Chambal region. Subjects were of the age group 28-87 years. The prevalence of Metabolic syndrome was 45.8%, 57.7% and 28 % according to NCEP ATP III, IDF and WHO definitions. The prevalence was found to be higher in women using all the definitions. IDF definition had the highest prevalence.

SIGNIFICANCE

Diabetes Mellitus, Type 2 is on rise in India. Metabolic syndrome is a leading cause for Type 2 Diabetes and people are not aware about this. If people are able to find out if they have Metabolic syndrome or not and if manage it by lifestyle modification, they can delay the onset of Diabetes and also prevent its complications. The main aim of choosing this topic was to find out the Knowledge, Attitude and Practices of people with regards to Metabolic syndrome and its relation with Diabetes Mellitus and also to find out the prevalence of Metabolic syndrome in Type 2 Diabetic patients. Based on these the following objectives were formulated.

OBJECTIVES

- To check the prevalence of Metabolic Syndrome in Type 2 Diabetic patients.
- To assess the knowledge of patients about Type 2 Diabetes and Metabolic Syndrome.
- To analyse the attitude of patients about Metabolic syndrome and Type 2 Diabetes and to evaluate their practices to prevent the development of complications.
- To estimate the Nutritional status of Type 2 Diabetic patients.
- An intervention programme to create awareness about Metabolic syndrome and Type 2 Diabetes Mellitus.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

The Review of Literature pertaining to the study **PREVALANCE AND KAP STUDY OF METABOLIC SYNDROME IN TYPE 2 DIABETIC PATIENTS** is presented under the following headings,

2.1 Definition of Metabolic syndrome

2.2 Prevalence of Metabolic syndrome

2.3 Risk factors of Metabolic syndrome

2.4 Diagnosis criteria

2.5 Prevention and Treatment

2.6 Nutritional Intervention to prevent Metabolic syndrome.

2.1 Definition of Metabolic Syndrome

"The metabolic syndrome (MetS) refers to the clustering of various metabolic risk factors that include abdominal obesity, dyslipidaemia, hypertension, and hyperglycaemia. It is now well known that it is associated with an increased risk of cardiovascular disease (CVD) and of type 2 diabetes. The increasing prevalence of the MetS, associated with the substantial progression of obesity and diabetes, is therefore an important public health concern" (Levesque J et al.,2008).

"The 'metabolic syndrome' is a clustering of risk factors which predispose an individual to cardiovascular morbidity and mortality. There is general consensus regarding the main components of the syndrome (glucose intolerance, obesity, raised blood pressure and dyslipidaemia [elevated triglycerides, low levels of high-density lipoprotein cholesterol]) but different definitions require different cut points and have

different mandatory inclusion criteria. Although insulin resistance is considered a major pathological influence, only the World Health Organization (WHO) and European Group for the study of Insulin Resistance (EGIR) definitions include it amongst the diagnostic criteria and only the International Diabetes Federation (IDF) definition has waist circumference as a mandatory component" (Day, 2007).

"The metabolic syndrome is a clustering of hyperglycemia/insulin resistance, obesity and dyslipidemia. It is important for several reasons. First, it identifies patients who are at high risk of developing atherosclerotic CVD and type 2 diabetes (T2D). Second, by considering the relationships between the components of metabolic syndrome, we may be able to better understand the pathophysiology that links them with each other and with the increased risk of CVD. Third, it facilitates epidemiological and clinical studies of pharmacological, lifestyle and preventive treatment approaches" (Huang Paul, 2009).

"The combination of metabolic disturbances now known as the metabolic syndrome (MetS) was first described by Kylin in the 1920's as the clustering of hypertension, hyperglycaemia and gout. Two decades later, Vague noted that upper body adiposity (android or male type obesity) was the type most often associated with the metabolic abnormalities seen with diabetes and cardiovascular disease (CVD). During the 1988 Banting Lecture, Reaven used the term 'Syndrome X' and firmly established the clinical importance of this syndrome, although obesity was not included. In 1989, Kaplan renamed it 'The Deadly Quartet' and others then coined the term 'The Insulin Resistance Syndrome. "It is now agreed that the well-established term 'metabolic syndrome' remains the most useful and widely accepted description of this cluster of

metabolically related cardiovascular risk factors which also predict a high risk of developing diabetes" (Alberti K G, 2006).

According to Marjani et al., work published in 2011, "Metabolic syndrome (MetS) is a major public-health problem worldwide. It increases the risk of developing type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD) by 5- and 2- fold, respectively. Many studies have shown that patients with metabolic syndrome are at greater risk of stroke (2-4 fold), myocardial infarction (3-4 fold) and mortality (2-fold) compared to those without the syndrome." "The metabolic syndrome is a syndrome associated with many physiological changes including insulin resistance and hyperinsulinemia, visceral adiposity, increased estrogen levels, increased inflammatory cytokines such as interleukin (IL)-6, and tumor necrosis factor (TNF)-α, as well as altered levels of circulating adipokines. These factors may contribute to the development of hypertension, dyslipidemia, and hyperglycemia, as well as cancer" (Gallagher E J et al, 2013).

2.2 Prevalence of Metabolic Syndrome

D.S Prasad et al., in the year 2012 estimated the Prevalence and risk factors for Metabolic Syndrome in Asian Indians. 1178 adults between the age of 20-80 years were selected for the study. "They followed a unified definition of the metabolic syndrome by joint interim statement of five major scientific organizations – the International Diabetes Federation, the National Heart, Lung, and Blood Institute, the American Heart Association, the World Heart Federation, the International Atherosclerosis Society, and the International Association of the Study of Obesity. Individuals who meet at least three of five clinical criteria of abdominal obesity, hypertriglyceridemia, low HDL, hypertension, and hyperglycemia are diagnosed as having the condition; presence of

these criteria is mandatory. A very high prevalence rate of metabolic syndrome was reported in this community. In this study, metabolic syndrome rates are significantly higher among females with 52.2% (n = 307) than in males at 34.2% (n = 202)."

Dhananjay yadav et al., in the year 2013 examined the Prevalence of Metabolic Syndrome in Type 2 Diabetes Mellitus using NCEP ATP III, WHO and IDF definitions and its agreement in Gwalior Chambal region of central India. This study involved 700 Type 2 Diabetic subjects from the urban areas of Gwalior Chambal region. Subjects were of the age group 28-87 years. The prevalence of Metabolic syndrome was 45.8%, 57.7% and 28 % according to NCEP ATP III, IDF and WHO definitions. The prevalence was found to be higher in women using all the definitions. IDF definition had the highest prevalence.

The study named Prevalence of Metabolic syndrome and its components among Type 2 Diabetic patients, using NCEP ATP III and IDF Criteria was conducted in a Tertiary Hospital, Northwest, Ethiopia, including a total of 159 participants; 119 (59.7%) of which were females. The overall prevalence of MetS based on NCEP-ATPIII and IDF criteria was 66.7% and 53.5%, respectively. The frequencies of MetS components were the highest for elevated TG (56.6%) and elevated blood pressure (55.4%) using NCEP-ATPIII, and in the IDF criteria it was central obesity (61.0%), elevated TG (62.3%). The prevalence of MetS and its components were found to be higher in females using both the criteria (Biadgo B et al., 2018).

Khan Yasmee et al, in a study found out the prevalence of Metabolic syndrome in Northern India in the year 2018. Out of the 420 patients (232 males and 188 females) selected randomly, 172 subjects (61 males and 111 females) were found to have Metabolic syndrome using the National Cholesterol Education Program Adult

Treatment Panel III criteria. The prevalence of MeTS was 40.9% (26.2% of total males and 59% of total females). Among the 172 subjects, a higher proportion of females had Metabolic syndrome than males. (64.5% vs. 35.4%).

A cross sectional study on The Prevalence and determinants of Metabolic syndrome among the rural adult population of Puducherry, India was conducted by Venugopal V et al., in the year 2019. "The study was carried out at 13 villages comprising of 8400 households under the service area of Primary Health Centre (PHC) situated at Thirubhuvanai, Puducherry. A cross-sectional study was undertaken on a representative sample of 489 adults of age 30 years and above over the period of 18 months. Metabolic syndrome was defined according to the International Diabetes Federation (IDF) criteria." The prevalence of Metabolic syndrome was 39.7% among the study participants out of which 40.7% were females and 38.5% were males.

A cross sectional study on Metabolic syndrome knowledge among adults with cardio metabolic risk factors found out that: "Patients revealed poor knowledge about MetS, indicating the urgent needs of MetS education in current practice. Education level and lipid management were significant predictors of MetS knowledge, indicating the need to develop educational strategies for this at-risk population. A total of 252 patients were invited, and 204 agreed to participate, with a response rate of 80.95%. The mean MSKS score was 36.7, out of the 100 total score. About two-thirds of the participants (67.2%) obtained a MSKS score of less than 50. In the current study, more than half-of the participants had MetS. However, they could only correctly answer 10.5% of the items on MetS definition and diagnosis. Without an adequate understanding of the definition and diagnosis, patients could not be aware of the presence of MetS, or their increased risks for developing DM or CVD" (Wang Qun et al., 2019).

Mahtab Niroomand et al., in the year 2016 conducted A cross sectional study on the Diabetic Knowledge, Attitude and Practice (KAP) study among Iranian in patients with Type 2 Diabetes. “Two hundred type-2 diabetic patients with the mean age of 60.17 years were evaluated (106 males and 94 female). The mean diabetes duration was 13.06 years. The levels of patients' good knowledge, attitude, and practice were 61.41%, 50.44% and 52.23%, respectively. Age, treatment methods, DM duration, and existence of diabetic retinopathy had significant correlations with KAP level. The results of this study showed that recent educational programs in Iran improved KAP level. Patients' KAP increases as their condition worsens/progresses. Hence education should be considered as a priority for newly diagnosed patients and those with lower KAP levels before occurrence of diabetes complications.”

The Knowledge, attitude and practices toward health behaviour and cardiovascular disease risk factors among the patients of metabolic syndrome in a teaching hospital in India was assessed by Verma A et al., in the year 2019. “It was a cross-sectional study conducted from April 2017 to March 2018 in a teaching hospital of Udaipur, Rajasthan. It involved 402 patients of MS diagnosed using National Cholesterol Education Program – Adult Treatment Panel III criteria. Only 30% of the participants had good knowledge about risk factors CVD. Most of the participants had good attitude toward the CVD risk reduction but poor practices. Only 9% of the patients were practicing lifestyle measures to reduce the risk of CVD. Good lifestyle practices were found to be significantly higher among the younger participants (under 40 years) as compared to older age patients. Knowledge and attitude were also better among younger patients; however, no significant association was found. Male participants had better knowledge and practices than the females and the difference was statistically significant.”

Makbul A et al., in the year 2018 analysed The Association Between Parents History of Type 2 Diabetes with Metabolic Syndrome Component and Insulin Resistance in Non-Diabetic Young Adult Male. This was “a cross sectional study comparing the metabolic profile, risk of metabolic syndrome and insulin resistance in non-diabetic male adolescents (17-24 years old) whose one or both parents were with type-2 diabetes. metabolic abnormalities were more prevalent in subjects whose parents were with history of type-2 diabetes, especially their waist circumference, fasting plasma glucose, triglyceride, fasting insulin. The early multiple metabolic defect can be detected in non-diabetes adolescents with parental history of type-2 diabetes. Cluster of metabolic syndrome component in these subject become a powerful determinant factor for insulin resistance.”

“Worldwide prevalence of MetS ranges from <10% to as much as 84%, depending on the region, urban or rural environment, composition (sex, age, race, and ethnicity) of the population studied, and the definition of the syndrome used. In general, the IDF estimates that one-quarter of the world’s adult population has the MetS. Higher socioeconomic status, sedentary lifestyle, and high body mass index (BMI) were significantly associated with MetS.” Cameron et al (2018). have concluded that “the differences in genetic background, diet, levels of physical activity, smoking, family history of diabetes, and education all influence the prevalence of the MetS and its components. The observed prevalence of the MetS in National Health and Nutrition Examination Survey (NHANES) was 5% among the subjects of normal weight, 22% among the overweight, and 60% among the obese” (Kaur J, 2014).

2.3 Risk Factors for Metabolic Syndrome

Metabolic syndrome is defined as an amalgamation of interrelated physiological, biochemical, clinical, and metabolic factors that directly increases the danger of Type 2 Diabetes Mellitus, Cardiovascular diseases, and all-cause mortality (Kaur J, 2014).

Risk factors in metabolic syndrome predict the progression of diabetic nephropathy in patients with type 2 diabetes was evaluated by Chuang et al., in the year 2019. “This retrospective observational cohort study lasted approximately five years. They defined metabolic syndrome using the criteria of the National Cholesterol Education Program Adult Treatment Panel III with the Asian definition of obesity. The progression of DKD was demonstrated by either the progression of albuminuria or worsening renal function. Progression of albuminuria was defined by the transition from normoalbuminuria (<30 mg/g) to microalbuminuria (30-300 mg/g) or from micro- to macroalbuminuria (>300 mg/g). Worsening renal function was defined by a reduction of eGFR to 50% of the baseline or the doubling of serum creatinine. This study consisted of 935 type 2 diabetic patients with a mean age of 64.62 years. We found progression of albuminuria in 172 patients (18.4%) and worsened renal function in 41 patients (4.4%).”

“The metabolic syndrome is a simple clinical tool to identify people with a particular set of risk factors who are at higher long-term risk for both ASCVD and type 2 diabetes. Affected individuals deserve *1*) lifestyle intervention (weight loss, increased physical activity, and a healthy diet) and *2*) more detailed, short-term risk assessment (e.g., Framingham scoring). On the basis of the latter, risk-reducing drugs may be required for treatment of individual risk factors” (Costa F, 2006).

Grundy S.M in the year 2006 in his article: Does Metabolic syndrome exist? has stated "Many recent reports document that the metabolic syndrome raises the risk for both ASCVD and type 2 diabetes. Average relative risks are increased about twofold for ASCVD and fivefold for type 2 diabetes compared with those for individuals without the metabolic syndrome. This higher relative risk translates into a high lifetime risk for both ASCVD and diabetes**."**

Roshanak Monzavi et al., in the year 2004 estimated the Improvement in Risk Factors for Metabolic Syndrome and Insulin Resistance in Overweight Youth Who Are Treated with Lifestyle Intervention. "Overweight youth who were between 8 and 16 years of age participated in a 12-week, family-centered, lifestyle intervention program. Anthropometric and metabolic measures were assessed before the program in all participants (n = 109) and after the program in a subset of the participants (n = 43). At baseline, 49.5% of youth had multiple risk factors associated with the metabolic syndrome, based on a modified definition of the National Cholesterol Education Program, and 10% had impaired fasting glucose and/or impaired glucose tolerance. Measures of insulin resistance correlated significantly with the risk factors of the metabolic syndrome. Forty-three youth had pre- and post-intervention evaluations that showed statistically significant improvements in body mass index, systolic blood pressure, lipids (total, low-density lipoprotein cholesterol, and triglycerides), postprandial glucose, and leptin levels. They concluded that A 12-week lifestyle program may have a positive effect on reducing risk factors for the metabolic syndrome and insulin resistance in overweight youth."

"A cluster of risk factors for cardiovascular disease and type 2 diabetes mellitus, which occur together more often than by chance alone, have become known as the metabolic

syndrome. The risk factors include raised blood pressure, dyslipidemia (raised triglycerides and lowered high-density lipoprotein cholesterol), raised fasting glucose, and central obesity" (KG Alberti, 2009). "Diabetes is a major lifestyle disorder, the prevalence of which is increasing globally. Asian countries contribute to more than 60% of the world's diabetic population as the prevalence of diabetes is increasing in these countries" (Ramachandran et al., 2012).

The worldwide increase in overweight and obesity has given rise to a histrionic increase of type 2 diabetes and is estimated to lead to an increase in cardiovascular disease (CVD) as well. Obesity and the consequent clustering of insulin resistance–related CVD risk factors lead to a high risk for diabetes and CVD (Dekker M, 2005).

Data from national health agencies report that "CVD is twice as likely to develop in those individuals with metabolic syndrome and that type 2 diabetes is five times as likely to develop. Metabolic syndrome increases risk for non-alcoholic fatty liver disease, hyperuricaemia and obstructive sleep apnoea. Almost 50% of women with polycystic ovary syndrome have metabolic syndrome" (National Heart, Lung, and Blood Institute, 2012).

"The metabolic syndrome is a multiplex risk factor for atherosclerotic cardiovascular disease and type 2 diabetes. It is composed of atherogenic dyslipidemia, elevated blood pressure, insulin resistance and elevated glucose, a pro-thrombotic state, and a pro-inflammatory state" (Grundy SM, 2006).

The American Heart Association defines “Metabolic syndrome is a group of risk factors that raises risk of heart disease, diabetes, stroke, and other health problems. It is diagnosed when any three of the following five risk factors are present:

• High blood glucose (sugar)

• Low levels of HDL (“good”) cholesterol in the blood

• High levels of triglycerides in the blood

• Large waist circumference or “apple-shaped” body

• High blood pressure

Metabolic syndrome is a serious health condition” (AHA).

2.4.1 Over Weight, Obesity & Increased Waist Circumference and BMI:

“The “obesity epidemic” is principally driven by an increased consumption of cheap, calorie-dense food and reduced physical activity. Adipose tissue is a heterogeneous mix of adipocytes, stromal preadipocytes, immune cells, and endothelium, and it can respond rapidly and dynamically to alterations in nutrient excess through adipocytes hypertrophy and hyperplasia. With obesity and progressive adipocytes enlargement, the blood supply to adipocytes may be reduced with consequent hypoxia. Hypoxia has been proposed to be an inciting etiology of necrosis and macrophage infiltration into adipose tissue that leads to an overproduction of biologically active metabolites known as adipocytokines which includes glycerol, free fatty acids (FFA), proinflammatory mediators (tumor necrosis factor alpha (TNFα) and interleukin-6 (IL-6)), plasminogen activator inhibitor-1 (PAI-1), and C-reactive protein (CRP). This results in a localized inflammation in adipose tissue that propagates an overall systemic inflammation associated with the development of obesity related comorbidities. Adipocytokines integrate the endocrine, autocrine, and paracrine signals to mediate the multiple processes including insulin sensitivity, oxidant stress, energy metabolism, blood

coagulation, and inflammatory responses which are thought to accelerate atherosclerosis, plaque rupture, and atherothrombosis. This shows that the adipose tissue is not only specialized in the storage and mobilization of lipids but it is also a remarkable endocrine organ releasing the numerous cytokines" (Kaur J, 2014).

2.4.2 Adiponectin:

"Several studies published over the last decade reported that adipokines play an important role in glucose and lipid metabolisms, and in the development of cardiovascular and metabolic complications of obesity. Adiponectin has anti-inflammatory, anti-atherogenic and insulin-sensitizing properties. Adiponectin protects against atherogenesis by modulating the cross-link between endothelial cells and platelets, by stimulating NO production, and by inhibiting the vascular endothelial growth factor (VEGF)" (Orlando A et al., 2019).

"Adiponectin is inversely associated with CVD risk factors such as blood pressure, low density lipoprotein cholesterol (LDL-C), and TGs. Moreover, Pischon et al., in the year 2004 have shown adiponectin to be a strong inverse independent risk factor for CVD. Further, Fumeron et al., in the year 2004 concluded that hypoadiponectinemia is associated with insulin resistance, hyperinsulinemia, and the possibility of developing T2DM, independent of fat mass. The anti-inflammatory molecule, adiponectin, is negatively associated with the body weight, WC, TGs, fasting insulin, insulin resistance (HOMA-Homeostasis Model Assessment, BMI, and blood pressure, whereas a positive association exists between adiponectin and HDL-C. Its expressions and secretions are reduced by TNFα, possibly through a stimulated production of IL-6, which also inhibits adiponectin secretion. Adiponectin is seen to be "protective," not only in its inverse relationship with the features of MetS but also through its antagonism of TNFα action."

2.4.3 Free Fatty Acids:

"Upper body subcutaneous adipocytes generate a majority of circulating FFA while an intra-abdominal fat content has been positively correlated with the splanchnic FFA levels which may contribute to the liver fat accumulation commonly found in abdominal obesity. Further, an acute exposure of skeletal muscle to the elevated levels of FFA induces insulin resistance by inhibiting the insulin-mediated glucose uptake, while, a chronic exposure of the pancreas to the elevated FFA impairs a pancreatic β-cell function. FFAs increase fibrinogen and PAI-1 production" (Kaur J, 2014).

2.4.4 Insulin Resistance:

Eckel et al., in the year 2005 examined that "insulin resistance is enhanced by excess adipose tissue, in particular abdominal adiposity. Excess adipose tissue releases nonesterified fatty acids (NEFA). A high NEFA level overloads muscle and liver with lipid and enhances insulin resistance. Free fatty acids are also produced through the lipolysis of lipoproteins by the action of lipoprotein lipase, the stimulation of which is influenced by insulin. Insulin also inhibits lipolysis in adipose tissue. When insulin resistance develops, increased lipolysis in adipose tissue produces more fatty acids, further inhibiting the antilipolytic effect of insulin and creates additional lipolysis."

2.4.5 Hypertension:

The amplified cardiovascular risk caused by MS in hypertensive subjects could in part be facilitated through preclinical end-organ damage (Mulè et al., 2005).

The reason of hypertension in Metabolic Syndrome is multifactorial and probably includes all of the elements of the syndrome, which includes: obesity, insulin resistance, and dyslipidemia. Obesity might be the most important factor, but, the other

components of the syndrome also play an important role in crafting and mediating the changes that eventually result in hypertension (Morse et al., 2005).

2.4.6 Leptin:

"It is an adipokine involved in the regulation of satiety and energy intake. Levels of leptin in the plasma increase during the development of obesity and decline during the weight loss. Leptin receptors are located mostly in the hypothalamus and the brain stem and signals through these receptors controls satiety, energy expenditure, and neuroendocrine function. Most overweight and obese individuals have an elevated level of leptin that do not suppress appetite, or in other words, leptin resistance. Leptin resistance is thought to be a fundamental pathology in obesity" (Kaur J, 2014).

2.4.7 Menopause:

Jouyandeh, Z et al., in the year 2013 suggest that Postmenopausal status in a woman is associated with an increased danger of metabolic syndrome. Therefore, in order to prevent cardiovascular disease, it is essential to estimate metabolic syndrome and its components from the time of the menopause.

2.4.8 Smoking and Alcohol:

Nakanishi et al., in 2005 Reported that smoking and physical inactivity have been recognized as important changeable risk factors for Metabolic Syndrome and its consequences. It has been shown by various studies that smoking is considered to be a major risk factor for CVD and Type 2 DM and it is also related with metabolic abnormalities and it increases the risk of Metabolic Syndrome. People who smocked tobacco had a 1.07–1.66-fold increased risk of developing Metabolic Syndrome than those who did not smoke.

2.4.9 Dietary Habits:

A study by Aljada et al., in 2004 has shown that “a high dietary fat intake is associated with an oxidative stress and an activation of the proinflammatory transcription factor, that is, nuclear factor kappa-beta (NFB). In contrast, a diet rich in fruits and fibres has no inflammation-inducing capacity compared with a high-fat diet even if it has the same calories content.”

Wennberg, M.et al., in the year 2016 opined that “irregular eating of meals at age 16 years was associated with higher prevalence of the metabolic syndrome at age 43 years, but this was explained by concurrent unhealthy lifestyle at age 16 years. Poor breakfast at age 16 years was the only meal associated with the metabolic syndrome at age 43 years, independent of other meals, BMI (kg/m2) and lifestyle at age 16 years. Irregular eating of meals in adolescence predicted the metabolic syndrome in adulthood, but not independently of BMI and lifestyle in adolescence. Poor breakfast in adolescence was the only specific meal associated with future metabolic syndrome, even after adjustments. Breakfast eating should be encouraged in adolescence.”

2.4.10 Dyslipidaemia

“Dyslipidaemia is characterised by a spectrum of qualitative lipid abnormalities reflecting perturbations in the structure, metabolism, and biological activities of both atherogenic lipoproteins and antiatherogenic HDL-C which includes an elevation of lipoproteins containing apolipoprotein B (apoB), elevated TGs, increased levels of small particles of LDL, and low levels of HDL-C. Insulin resistance leads to an atherogenic dyslipidemia in several ways. First, insulin normally suppresses lipolysis in adipocytes, so an impaired insulin signalling increases lipolysis, resulting in increased FFA levels. In the liver, FFAs serve as a substrate for the synthesis of TGs.

FFAs also stabilize the production of apoB, the major lipoprotein of very low density lipoprotein (VLDL) particles, resulting in a more VLDL production. Second, insulin normally degrades apoB through PI3K-dependent pathways, so an insulin resistance directly increases VLDL production. Third, insulin regulates the activity of lipoprotein lipase, the rate-limiting and major mediator of VLDL clearance. Thus, hypertriglyceridemia in insulin resistance is the result of both an increase in VLDL production and a decrease in VLDL clearance" (Kaur J, 2014).

2.4 Diagnosis Criteria

"Metabolic syndrome was defined as the presence of 3 or more of the following 5 categories: 1) elevated blood pressure (average systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥ 85 mmHg) or current blood pressure medication use; 2) low HDL-cholesterol level (< 40 mg/dL); 3) elevated serum TG level (≥ 150 mg/ dL) or current anti-dyslipidemic medication use; 4) elevated fasting blood glucose level (≥ 100 mg/dL) or current anti-diabetic medication use; and 5) abdominal obesity (waist circumference ≥ 90 cm)" (Ahn et al., 2017).

2.4.1 WORLD HEALTH ORGANISATION (WHO):

"The World Health Organization (WHO) first developed its definition in 1998 (Alberti and Zimmet, 1998). Because insulin resistance was felt to be central to the pathophysiology of metabolic syndrome, evidence for insulin resistance is an absolute requirement in the WHO definition. This could be impaired fasting glucose [IFG, defined as a fasting glucose level above a predetermined cut off, commonly 100 milligrams per decilitre (mg/dl)] or impaired glucose tolerance (IGT, defined as a glucose level above a predetermined cut-off, commonly 140 mg/dl, for 120 minutes after ingestion of 75 grams of glucose load during an oral glucose tolerance test).

Alternatively, other measures could serve as evidence of insulin resistance, such as an elevated homeostatic model assessment of insulin resistance (HOMA-IR) value, which is proportional to the product of the fasting insulin and fasting glucose level. Finally, euglycemic hyperinsulinemia clamp studies could be used as evidence of insulin resistance. In addition to this absolute requirement for insulin resistance, two additional criteria have to be met. These include obesity, dyslipidemia, hypertension and microalbuminuria. The WHO definition was the first to tie together the key components of insulin resistance, obesity, dyslipidemia and hypertension. The definition mandates that insulin resistance be present; without it, even if all the other criteria were met, the patient would not have metabolic syndrome. The WHO definition also allows patients with T2D to be diagnosed with metabolic syndrome if they meet the other criteria. Because some of the measurements are not performed routinely, for example, euglycemic clamp studies, this definition is not easily applied clinically and does not lend itself as well to large epidemiologic studies, where rapid and simple assessment is important." (Huang L P, 2009).

2.4.2 THE NATIONAL CHOLESTEROL EDUCATION PROGRAM ADULT TREATMENT PANEL III (NCEP ATP III):

"In 2001, the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) devised a definition for the metabolic syndrome (National Cholesterol Education Program, 2002), which was updated by the American Heart Association and the National Heart Lung and Blood Institute in 2005 (Grundy et al., 2005).

According to the NCEP ATP III definition, metabolic syndrome is present if three or more of the following five criteria are met:

- Waist circumference over 40 inches (men) or 35 inches (women),
- Blood pressure over 130/85 mmHg,

- Fasting triglyceride (TG) level over 150 mg/dl,
- Fasting high-density lipoprotein (HDL)
- Fasting blood sugar over 100 mg/dl.

The NCEP ATP III definition is one of the most widely used criteria of metabolic syndrome. It incorporates the key features of hyperglycemia/insulin resistance, visceral obesity, atherogenic dyslipidemia and hypertension. It uses measurements and laboratory results that are readily available to physicians, facilitating its clinical and epidemiological application. It is also simple and easy to remember. Importantly, it does not require that any specific criterion be met; only that at least three of five criteria are met. Thus, the definition does not build in any preconceived notion of the underlying cause of metabolic syndrome, whether it is insulin resistance or obesity." (Huang L P, 2009).

2.4.3 INTERNATIONAL DIABETES FEDERATION (IDF):

"The International Diabetes Federation (IDF) has proposed a new definition of the metabolic syndrome that emphasizes central adiposity as determined by ethnic group–specific thresholds of waist circumference. According to the IDF definition, someone has the metabolic syndrome if he or she has central adiposity plus two or more of the following four factors : *1*) raised concentration of triglycerides: ≥150 mg/dl (1.7 mmol/l) or specific treatment for this lipid abnormality; *2*) reduced concentration of HDL cholesterol: <40 mg/dl (1.03 mmol/l) in men and <50 mg/dl (1.29 mmol/l) in women or specific treatment for this lipid abnormality; *3*) raised blood pressure: systolic blood pressure ≥130 mmHg or diastolic blood pressure ≥85 mmHg or treatment of previously diagnosed hypertension; and *4*) raised fasting plasma glucose

concentration ≥100 mg/dl (5.6 mmol/l) or previously diagnosed type 2 diabetes" (Ford E.S., 2005).

2.4.4 THE EUROPEAN GROUP OF INSULIN RESISTANCE (EGIR):

"In 1999, the European Group for the Study of Insulin Resistance (EGIR) proposed a modification to the WHO definition (Balkau and Charles, 1999). Like the WHO, the EGIR felt that insulin resistance is central to the pathophysiology of the metabolic syndrome, so it also requires it for the definition. In this case, insulin resistance is defined by a fasting plasma insulin value that is greater than the 75th percentile. The use of elevated fasting insulin alone as a reflection of insulin resistance simplifies the definition, but it also means that patients with T2D cannot be diagnosed as having metabolic syndrome, since fasting insulin may not be a useful measure of insulin resistance in such patients. Also, similar to the WHO definition, the EGIR definition requires two additional criteria, which can be selected from obesity, hypertension and dyslipidemia. The obesity criteria were simplified to waist circumference, whereas the WHO definition used a choice of waist-to-hip ratio or body-mass index. Microalbuminuria was eliminated as a diagnostic criterion" (Huang L P, 2009).

2.4.5 AMERICAN HEART ASSOCIATION:

"Metabolic syndrome is a group of risk factors that raises risk of heart disease, diabetes, stroke, and other health problems. It is diagnosed when any three of the following five risk factors are present:

- High blood glucose (sugar)
- Low levels of HDL ("good") cholesterol in the blood
- High levels of triglycerides in the blood
- Large waist circumference or "apple-shaped" body

- High blood pressure
- Metabolic syndrome is a serious health condition.

The **criteria** to identify this syndrome are by the presence of three or more of these risk factors:

- Central obesity. This is measured by waist circumference: More than 40 inches for men and More than 35 inches for women.
- Fasting blood triglycerides are 150 mg/dL or more or taking medicine for high triglycerides.
- Low HDL cholesterol levels or taking medicine for low HDL cholesterol: Men — Less than 40 mg/dL Women — Less than 50 mg/dL
- Elevated blood pressure of 130/85 mm Hg or higher or taking medicine for high blood pressure.
- Fasting glucose (blood sugar) of 100 mg/dL or more or taking medicine for high blood glucose."

Source: heart.org (AHA).

Table No 1. Diagnostic Criteria for Metabolic Syndrome:

	IDF (Obesity+ ≥2)	**AHA (≥3)**	**NCEP ATP III (≥3)**	**WHO(Insulin resistance /Diabetes+ ≥2)**	**EGIR (hyperinsulinemia+≥**
Obesity	BMI >30 Kg/m² or specific gender and ethnicity	Waist circumference male >102 cm in,	Waist circumference male >102 cm in, females >88 cm	Waist/hip ratio >0.9 in males and 0.85 in females	Waist Circumference for males ≥94cm,females≥80cm

	IDF (Obesity+ ≥2)	**AHA (≥3)**	**NCEP ATP III (≥3)**	**WHO(Insulin resistance /Diabetes+ ≥2)**	**EGIR (hyperinsulinemia+≥**
	waist circumference cut-off	females >88 cm		or BMI>30kg/m²	
Elevated triglycerides level	TG≥150 mg/dL or treatment of this lipid abnormality	Fasting TG≥ 150mg/dL or treatment	TG≥150mg/dL or treatment of this lipid abnormality	TG≥150mg/dL	TG≥177mg/dL
Decreased HDL	HDL <40mg/dL in males and 30mg/dL in females or specific treatment for this lipid abnormality	HDL <40mg/dL in males and 50mg/dL in females or treatment	HDL <40mg/dL in males and 50mg/dL in females or treatment for this lipid abnormality	HDL <35mg/dL in males and <39mg/dL in females	HDL <39mg/dL in females

	IDF (Obesity+ ≥2)	**AHA (≥3)**	**NCEP ATP III (≥3)**	**WHO(Insulin resistance /Diabetes+ ≥2)**	**EGIR (hyperinsulinemia+≥**
Hypertension	SBP≥130 or DBP≥85mm Hg or treatment of previously diagnosed hypertension	BP>130/85mm Hg or taking medication	SBP≥130 or DBP ≥85mm Hg or taking medication for hypertension	≥140/90 mm Hg	≥140mm Hg or taking medication for hypertension
Hyperglycaemia	Fasting plasma glucose >100mg/dL or previously diagnosed type 2 diabetes	Fasting glucose >100mg/dL or taking medicine	Fasting glucose >100mg/dL or taking medicine	Insulin résistance required	Insulin resistance required (plasma insulin>75th percentile
Other				Urine albumin ≥20µg/min or Albumin creatinine ratio ≥30mg/g	

2.5 Prevention and Treatment

Pitsavos et al., in 2006 found that: “Even though exercise is considered a cornerstone in the treatment of diabetes, a condition that is strongly related to metabolic syndrome, only a few studies have investigated its relationship with cardiovascular disease risk in diabetic persons. In a sample of 492 diabetic men and women from the National Health and Nutrition Examination Survey, followed-up for 2 years, Ford and DeStefano found that inactivity in non-leisure time was significantly associated with higher rates of coronary death. Data from an average 8.2-year, prospective, follow-up of 8,715 men in a preventive medicine clinic in the USA demonstrated a higher risk of all-cause mortality for unfit compared to fit persons, within each of three glycemic status levels.”

Tanasescu et al., in the year 2003 conducted a study to examine the relationship of physical activity with risk of cardiovascular disease (CVD) and mortality among men with type 2 diabetes. They found that “of the 3058 men who reported a diagnosis of diabetes at age 30 years or older in the Health Professionals' Follow-up Study (HPFS), we excluded 255 who reported a physical impairment. In the remaining 2803 men, physical activity was assessed every 2 years; 266 new cases of CVD and 355 deaths of all causes were identified during 14 years of follow-up. Relative risks of CVD and death were estimated from Cox proportional hazards analysis with adjustment for potential confounders. Walking was associated with reduced risk of total mortality. They concluded that: Physical activity was associated with reduced risk of CVD, cardiovascular death, and total mortality in men with type 2 diabetes. Walking and walking pace were associated with reduced total mortality."

J Tuomilehto et al., in the year 2001 assessed the Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. “522 middle-

aged, overweight subjects (172 men and 350 women; mean age, 55 years; mean body-mass index [weight in kilograms divided by the square of the height in meters], 31) with impaired glucose tolerance to either the intervention group or the control group. Each subject in the intervention group received individualized counselling aimed at reducing weight, total intake of fat, and intake of saturated fat and increasing intake of fiber and physical activity. An oral glucose-tolerance test was performed annually; the diagnosis of diabetes was confirmed by a second test. The mean duration of follow-up was 3.2 years. The cumulative incidence of diabetes after four years was 11 percent (95 percent confidence interval, 6 to 15 percent) in the intervention group and 23 percent (95 percent confidence interval, 17 to 29 percent) in the control group. During the trial, the risk of diabetes was reduced by 58 percent in the intervention group. The reduction in the incidence of diabetes was directly associated with changes in lifestyle."

The Impact of lifestyle habits on the prevalence of the metabolic syndrome among Greek adults from the ATTICA study was assessed by Panagiotakos et al., in the year 2006. They evaluated the "effect of leisure time physical activity (PA) and the Mediterranean diet (MD) on the prevalence of the MS. The ATTICA study is a health and nutritional survey. On the basis of a multistage, random sampling, 1128 men and 1154 women (>18 years old) without any evidence of cardiovascular disease or diabetes mellitus were enrolled from the greater Athens area during 2001 to 2002. The MS was defined according to the National Cholesterol Education Program (NCEP) Adult Treatment Panel (ATP) III criteria. PA was determined from a detailed questionnaire and graded according to the kcal/min expanded. MD was assessed through a validated nutrient questionnaire. The overall prevalence of the MS was 453 of 2282 subjects (19.8%). Of these subjects, 284 (25.2%) were men and 169 (14.6%) were women. ATTICA Study investigators demonstrated that the adoption of the Mediterranean diet

by physically active people was associated with greater reduction in the odds of having the syndrome than diet or exercise alone, after adjusting for several potential confounders. Thus, the combination of beneficial health factors in terms of nutrition and exercise explained at least a part of the reduction in the prevalence of the metabolic syndrome."

2.6 Nutritional Intervention to Prevent Metabolic Syndrome

"Among other reasons, sedentary life and the easy access to inexpensive foods contribute to the explanation of why MetS is currently so prevalent. Its treatment aims to decrease the risks of CVD and T2DM. The first and most important step is the implementation of a new lifestyle with changes in diet and physical activity, as well as the acquisition of healthier habits. Weight loss and lifestyle changes may improve individual MetS components. Behavioural interventions make it easier for individuals to incorporate and maintain these changes in their daily routines" (Hoyas et al., 2019).

"Severe obesity increases the prevalence of the metabolic syndrome, and moderate acute weight loss with a very low-calorie diet in obese subjects with the metabolic syndrome leads to significant metabolic benefits. Weight reduction was the main goal of most intervention study. It is associated with significant improvements in all parameters of Metabolic Syndrome. Even moderate weight loss (around 7%) resulted in substantial reductions in blood pressure, and glucose, triglyceride, and total cholesterol concentrations Out of 185 individuals, 125 (68%) met the NCEP definition of the MS. A moderate decrease in weight (6.5%) induced by a very low calorie diet (VLCD) resulted in substantial reductions of systolic (11.1 mmHg) and diastolic (5.8 mmHg) blood pressure (BP), glucose (17 mg/dl), triglycerides (94 mg/dl) and total

cholesterol (37 mg/dl) at 4 weeks. These improvements were sustained at the end of active weight loss (average 16.7 weeks; total weight loss 15.1%), with further significant reductions in BP and triglycerides. Weight loss was related to the changes in each criterion of the metabolic syndrome" (Case et al., 2002).

"The most effective intervention for metabolic intervention is caloric restriction. Nutrition change to support a 7–10% weight loss is an appropriate goal for people with prediabetes, unless additional weight loss is desired for other purposes. The contributions of different nutrients to success in the reduction have to be seen in the context of the general eating plan of the patient. There is no perfect combination of macronutrients useful for all individuals. Compliance with a healthier lifestyle and dietary intake are more important than a particular dietary pattern. This represents an advantage for patients confronting MetS. As there is no "one-size-fits-all" pattern, individuals can advance with any healthy plan that is easy for them to follow. It also opens the door to adaptations of dietary recommendations based on metabolic goals, socioeconomic factors, food availability, and personal and cultural preferences. Irrespective of the macronutrient balance in the diet, total energy intake should be appropriate to accomplish the weight management goals" (Hoyas et al., 2019).

METHODOLOGY

3. METHODOLOGY

The study entitled "**PREVALANCE AND KAP STUDY OF METABOLIC SYNDROME IN TYPE 2 DIABETIC PATIENTS"** was conducted at Silverline Hospital, Kadavantara, Kochi. The methodology pertaining the study is carried out using following step:

3.1 Selection of Area

3.2 Selection of Sample

3.3 Selection of Tools

3.4 Pilot study

3.5 Conduct of the Study

3.6 Development of an Education tool to create General Awareness among the Public

3.7 Data entry, analysis and Interpretation

3.1 Selection of Area

The area selected for the study was Ernakulam city. The prevalence of Non communicable disease like Diabetes is very high in such Urban areas. Kerala which seems to have entered into the fourth stage of the epidemiological transition is now facing a huge threat due to alarmingly rising trends of Non communicable diseases (NCD) (PS Rakesh., 2018). The people in the city are very conscious of what they eat, so this area was selected to assess their Knowledge, Attitude and Practice. Silverline is a boutique hospital, located in Ernakulam, Kerala, offering a high quality medical care in India in the areas of Diabetes, Thyroid disorders, Obesity and Weight loss surgery. It is one of the reputed Diabetes hospitals in Kerala, so this hospital for chosen for the study.

3.2 Selection of Subjects

For the study a total of 50 adult Men and Women (28 men and 22 women) having Type 2 Diabetes Mellitus of the age group 30-60 years were selected using stratified sampling technique. The study participants selected were outpatients.

Inclusion criteria: Type 2 Diabetics

Men and women aged 35-55 years.

Exclusion criteria: Pregnant women with GDM.

Lactating women.

Paediatric population.

Patients with other co morbidities like liver or renal disease.

Patients with a history of surgery.

3.3 Selection of Tools

3.3.1 An interview schedule was planned and structured to assess the Knowledge, Attitude and Practice of the patients regarding Type 2 Diabetes and Metabolic syndrome. The questions were self-structured, simple and close ended. A google form was created and the questions were asked during the interview.

3.3.2 An interview schedule was planned and structured to collect information from the subjects. Demographic data like name, sex, age, marital status, religion, nutritional assessment (anthropometric assessment, biochemical assessment and dietary assessment) were collected using a questionnaire.

Risk factors such as diabetes mellitus, hypertension, obesity, physical activity and smoking, hereditary pattern and eating pattern were collected by self-structured

questions in the interview schedule and incidence of Metabolic syndrome was analysed using NCEP ATP III (2006) Guidelines.

The National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) Criteria was used to assess the incidence of Metabolic syndrome in the subjects. "In 2001, the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) introduced alternative clinical criteria for defining the metabolic syndrome. In so doing, the purpose of ATP III was to identify people at higher long-term risk for ASCVD who deserved clinical lifestyle intervention to reduce risk. The ATP III criteria thus required no single factor for diagnosis, but instead made the presence of 3 of 5 factors the basis for establishing the diagnosis; these were abdominal obesity (also highly correlated with insulin resistance), elevated triglycerides, reduced HDL-C, elevated blood pressure, and elevated fasting glucose (IFG or type 2 diabetes mellitus). ATP III criteria are simple to use in a clinical setting and have the advantage of avoiding emphasis on a single cause" (Grundy SM, 2005).

According to the third report of The National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III), adult to be diagnosed with metabolic syndrome must have three or more of the following:

- Waist circumference >102cm (40.2in) in men and >88cm (35.6 in) in women.
- Serum triglyceride ≥ 150 mg/dL
- Blood pressure ≥ 130/85 mm Hg
- HDL cholesterol <40 mg/ dL in men and < 50 mg/ dL in women.
- Fasting Plasma Glucose > 6.1 m mol/ L (≥110 mg/dL)

A) Anthropometric measurement

Weight and Height Measurements

- Weight of the participants was measured using digital weighing scale. Weight was taken without shoes & minimal cloth.
- "Height or stature is defined as the measurement of an individual from head to foot, taking into consideration the standard landmarks" (Kanchan T et al, 2020). Height is assessed using a stadiometer without shoes and recorded to the nearest 0.5 centimetre.

BMI Measurements

BMI of each respondent was calculated by dividing weight (in kilograms) with height (in meter2). The ratio of Weight in Kg / Height in m^2 is referred to as Body Mass Index (BMI). "BMI, formerly called the Quenelles index, is a measure for indicating nutritional status in adults" (WHO). In the case of adults, the following classification suggested for Asians (WHO, 2004):

BMI = Weight (kg) / Height (m^2)

Table 2: BMI Classification (WHO)

BMI CLASSIFICATION	
< 18.5 kg/m^2	Underweight
18.5 to 22.9 kg/m^2	Normal weight
23 to 24.9 kg/m^2	Over weight
25 to 29.9 kg/m^2	Pre obese
30 to 34.9 kg/m^2	Grade 1 obesity
35 to 39.9 kg/m^2	Grade 2 obesity
≥40 kg/m^2	Grade 3 obesity

Waist Circumference Measurements:

"Waist circumference was taken around the navel using a non-stretchable tape. It is the most practical tool a clinician can use to evaluate a patient's abdominal fat". (Srilakshmi B., 2014).

Anthropometric measurements were noted with the assistance of a trained nurse.

Blood Pressure:

Blood pressure is the pressure, measured in millimetres of mercury, within the major arterial system of the body. It is conventionally separated into systolic and diastolic determinations. Systolic pressure is the maximum blood pressure during contraction of the ventricles; diastolic pressure is the minimum pressure recorded just prior to the next contraction.

"The blood pressure is usually written as the systolic pressure over the diastolic pressure (e.g., 120/80 mm Hg). The minimum acceptable blood pressure is determined by adequate perfusion of the vital organs without symptoms of hypotension. This is usually more than 90 mm Hg systolic and 60 mm Hg diastolic, although there can be great variation between patients" (Brzezinski A.,1990).

B) Biochemical Parameters:

Biochemical assessment means checking various blood parameters in a person's blood. Biochemical parameters used for present study included serum triglyceride level, HDL cholesterol and fasting plasma glucose.

Biochemical details and Blood pressure of each patient were collected from the medical records of Silverline Hospital.

C) Dietary Assessment:

Dietary assessment was done using 24 Hour Recall method and food frequency questionnaire.

24-Hour Recall:

"During a 24-hour recall, respondents (i.e. adults, children and their parents or caretakers) are asked, by a nutritionist or dietitian who has been trained in interviewing techniques, to recall and report all foods and beverages consumed over the preceding 24 hours. The 24-hour period starts with the first thing eaten by the respondent in the morning until the last food item consumed before he/she got up the next morning. Thus, the method assesses the actual intake of individuals" (Food and Agricultural Organisation of United Nations).

The 24-hour recall was collected during the interview schedule and noted down in the printed form.

Food Frequency Questionnaire:

"FFQs assesses the frequency with which foods and/or food groups are eaten over a certain time period. The questionnaire includes a food list (usually close-ended) and a frequency category section, and can be self- or interviewer administered" (Food and Agricultural Organisation of United Nations).

The food frequency questionnaire was collected during the interview schedule and noted down in the printed form.

Pilot Study

Pilot study was conducted to find out the relevance of the study. 10 patients were included for the pilot study. The data analysed revealed that 7 out of 10 patients had Metabolic Syndrome.

The patients had some knowledge about Diabetes Mellitus and had poor knowledge about Metabolic Syndrome. When explained in brief about Metabolic syndrome, they were able to relate to the further questions asked. The patients had positive attitude towards many aspects of healthy lifestyle, but when asked about practices, they failed to follow a few guidelines which would help them manage Diabetes. The average consumption of Energy was 1407 Kcal, Carbohydrate was 184.6 grams, Protein was 45.9 grams, Fat was 47.4 grams, and Fibre was 22 grams.

It was found that there is incidence of Metabolic syndrome in Type 2 Diabetic patients. Although the patients had the knowledge to manage Diabetes, their practices did not reveal the same. The calorie consumption was found to be less, however, the fat consumption was higher and a low fibre consumption was found.

3.4 Conduct of Study

An informed consent was obtained prior to data collection. Two google form questionnaire were made and data were collected using the Interview schedule method. Dietary data (24-hour recall and food frequency questionnaire) were collected in the printed form. Data collected includes:

Socio demographic data,

ABCD assessment,

Knowledge, Attitude and Practice regarding Metabolic syndrome and Type 2 Diabetes.

3.5 Development of an Education Tool to Create General Awareness Among the Public

A booklet with information on Diabetes and Metabolic syndrome was developed to impart knowledge about Diabetes and Metabolic syndrome and distributed to all the patients visiting Silverline Hospital.

3.6 Data Analysis and Interpretation

The dietary assessment was done using the App Ntutive. Data were collected, tabulated and analysed using IBM SPSS Software 21.

RESULT AND DISCUSSION

4. RESULT AND DISCUSSION

The data collected regarding the study entitled **PREVALANCE AND KAP STUDY OF METABOLIC SYNDROME IN TYPE 2 DIABETIC PATIENTS** was tabulated and discussed under the following heading:

4.1 Prevalence of Metabolic Syndrome in Type 2 Diabetic Patients

- 4.1.1 Demographic Profile
- 4.1.2 Hereditary Pattern
- 4.1.3 Diabetic Profile
- 4.1.4 Assessment of Nutritional Profile:
  - 4.1.4.1 Anthropometric Assessment
  - 4.1.4.2 Biochemical Assessment
  - 4.1.4.3 Dietary Assessment

4.2 Knowledge, Attitude and Practice Analysis

4.3 Testing of Hypothesis

4.1 Prevalence of Metabolic Syndrome in Type 2 Diabetic Patients

4.1.1 Demographic Profile:

Table 3. Demographic profile of Type 2 Diabetes Patients

Characteristics		Total	Percentage
Age	30-40 years	6	12
	41-50 years	16	32
	51-60 years	28	56
Gender	Male	28	56
	Female	22	44
Type of family	Nuclear	36	72
	Joint	14	28
Marital Status	Married	44	88
	Single	4	8
	Widow	2	4
Religion	Hindu	26	52
	Muslim	3	6
	Christian	21	42

Figure 1. Age distribution of selected subjects

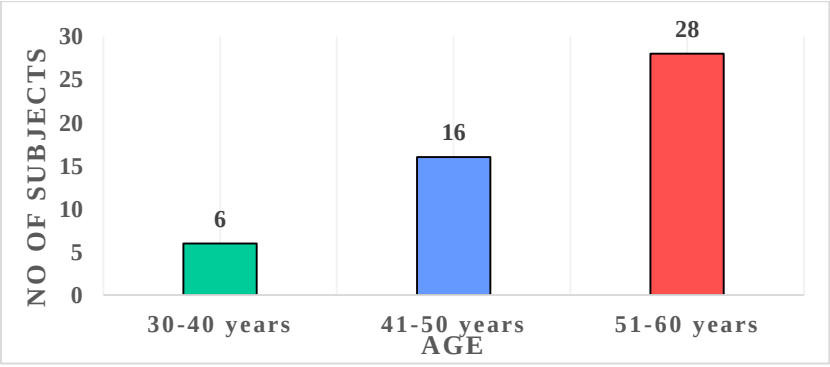
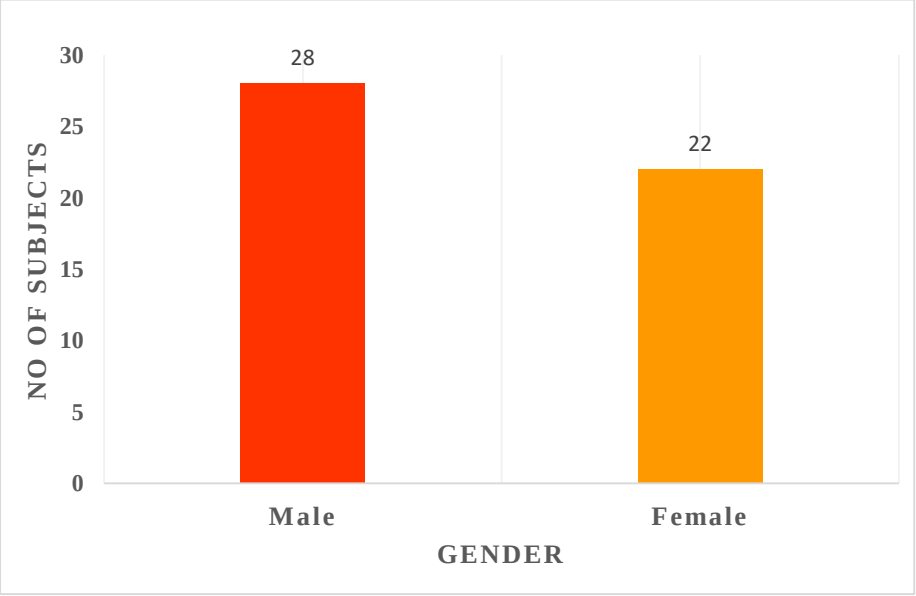


Table 3 and Figure 1 shows the age distribution of the selected Type 2 Diabetes patients. People of age group 30-60 years were chosen for the study and a total of 50 participants were included in the study. The age was categorized into three ranges: 30-40 years, 41-50 years and 51-60 years. Among the 50 subjects, twenty-eight were in the age group 51-60 years, sixteen were in the age group 41-50 years and only six were within the age group of 30-40 years. It is therefore clear that majority of the elderly population visited the hospital for their Diabetes treatment. Since majority of the elderly population visited the hospital, a higher incidence of Metabolic syndrome was found in these people.

“Diabetes in the elderly is a common condition that requires the most careful of clinical application. The complexity of issues surrounding a patient over the age of 50 with diabetes, especially the very elderly and frail, require a healthcare professional to have a sound understanding of different scenarios encountered” (Adam et al., 2015).

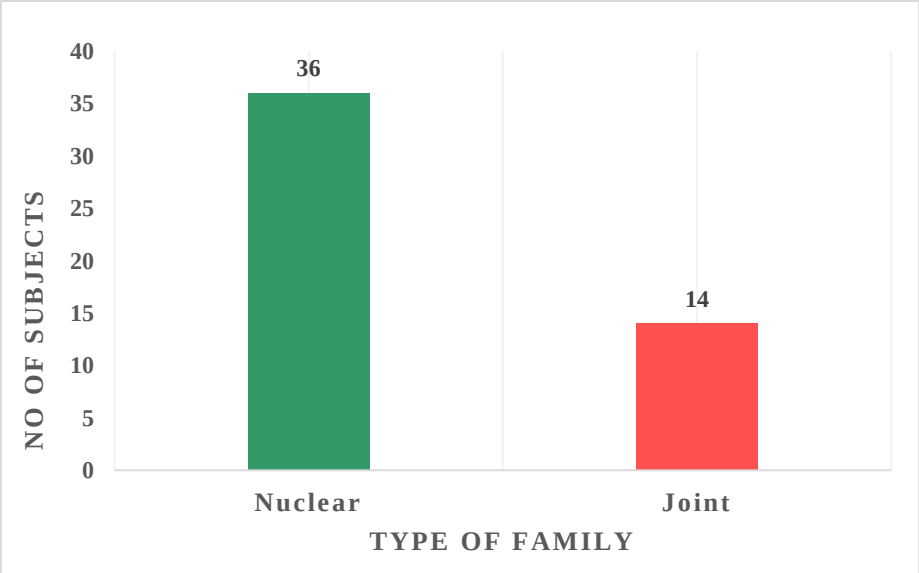
Figure 2. Gender distribution of selected subjects



From the Table 3 and Figure 2, it can be interpreted that out of the fifty patients; twenty-eight were men and twenty-two were women. It was identified that a higher proportion of men visited the hospital for their diabetes treatment than women.

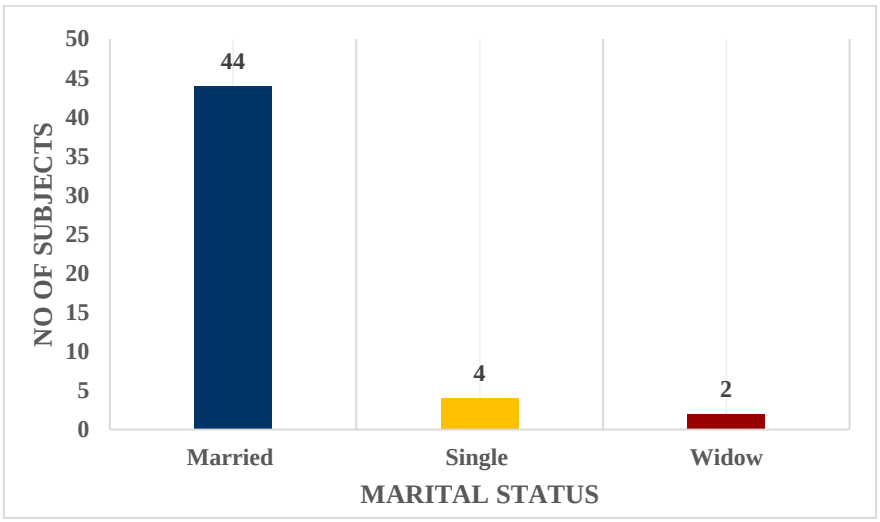
“Type II diabetes showed a pronounced female excess in the first half of the last century but is now equally prevalent among men and women in most populations, with some evidence of male preponderance in early middle age. Men seem more susceptible than women to the consequences of indolence and obesity, possibly due to differences in insulin sensitivity and regional fat deposition” (Gale E et al., 2011).

Figure 3. Family type of selected subjects



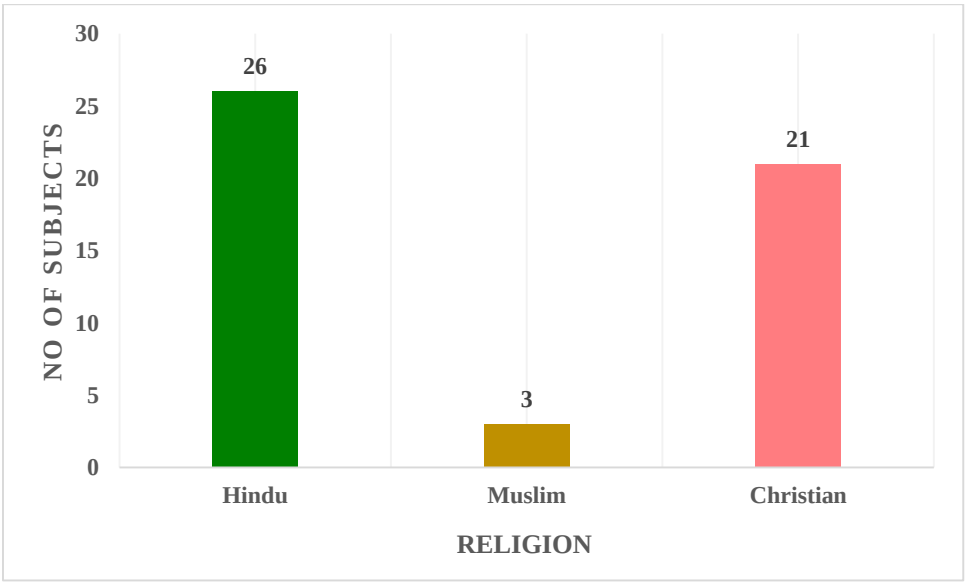
From Table 3 and Figure 3 it is interpreted that among the fifty patients interviewed, majority of them (thirty-six) live in a nuclear family, and only a small number of the subjects (fourteen) lived in joint family.

Figure 4. Marital Status of selected subjects



From Table 3 and Figure 4, it is understood that among the fifty patients, forty-four were married, four were single and two were widow.

Figure 5. Classification of selected subjects by Religion



From the Table 3 and Figure 5 it was found that among fifty patients, twenty-six (52%) were Hindus, three (6%) were Muslim and twenty-one (42%) were Christians.

4.1.2 Hereditary Pattern

Table 4. Hereditary Pattern of selected subjects

Conditions	Yes	No
Diabetes	39	11
Hypertension	11	39
Obesity	13	37
Heart Diseases	12	38

Figure 6 Hereditary Pattern of selected subjects

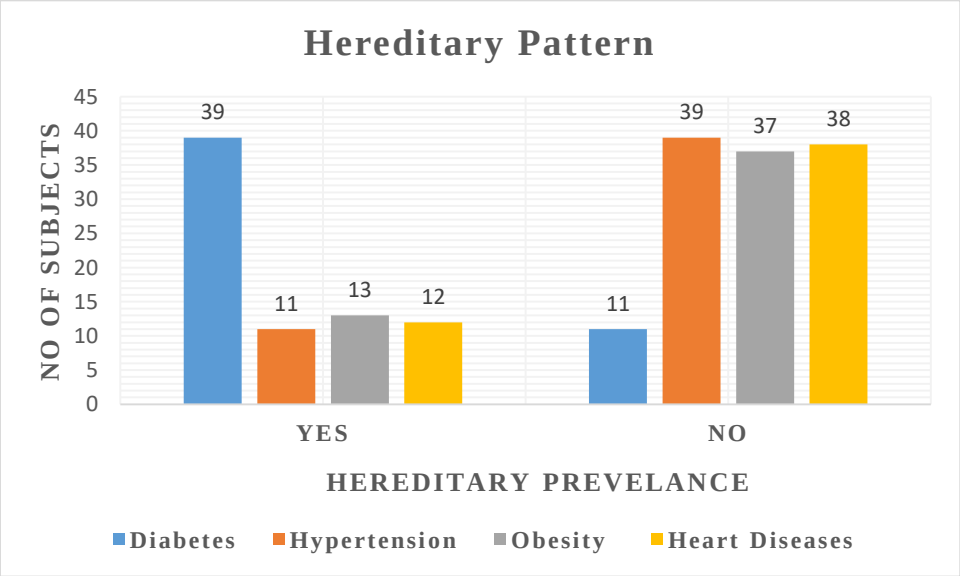


Table 4 and Figure 6 shows the Hereditary pattern of some metabolic conditions. Of the fifty subjects selected for the study, thirty-nine had a family history for Diabetes, eleven had a family history for Hypertension, thirteen had a family history for Obesity and twelve had a family history for Heart diseases. It can be interpreted that majority of the Diabetic patients selected for the study had Diabetes as a result of the genetic factor along with other Dietary, Lifestyle and environmental factors.

"The early multiple metabolic defect can be detected in non-diabetes adolescents with parental history of type-2 diabetes. Cluster of metabolic syndrome component in these subject become a powerful determinant factor for insulin resistance" (Makbul A et al., 2018).

4.1.3 Diabetic Profile

Table 5. Diabetic Profile of selected subjects

Characteristics		Number	Percentage
Duration of Diabetes	0-5 years	21	42
	6-10 years	16	32
	11-15 years	6	12
	16-20 years	6	12
	>20 years	1	2
Diabetes Treatment	OHA	37	74
	OHA and Insulin	9	18
	Diet and exercise	4	8

Figure 7. Duration of Diabetes of selected subjects

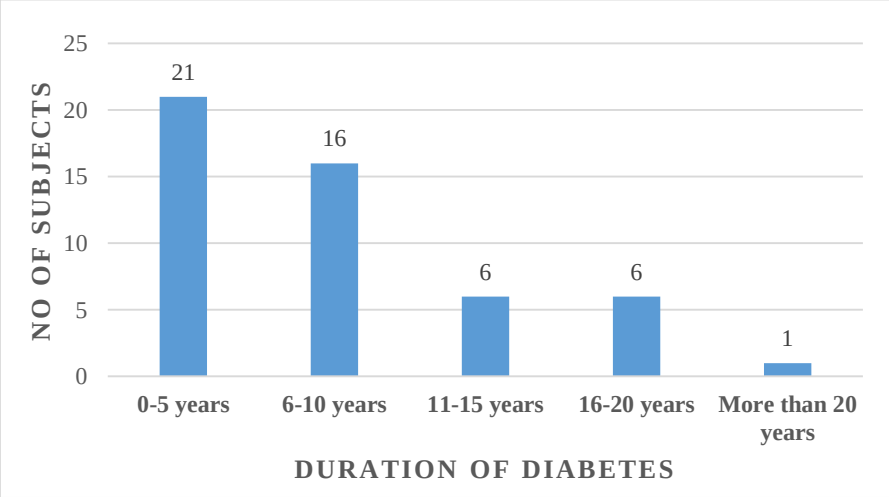


Table 5 and Figure 7 shows the Duration of Diabetes of the selected 50 patients. Duration of Diabetes was divided into 6 categories: 0-5 years, 6-10 years, 11-15 years, 16-20 years and more than 20 years. About 42% had Diabetes for 0-5 years, 32% had Diabetes for 6-10 years, 12% had Diabetes for 11-15 years, 12% had Diabetes for 16-20 years and 2% had Diabetes for more than 20 years. Majority of the selected patients were under treatment of Diabetes from 0-10 years.

Figure 8. Diabetes treatment of selected subjects

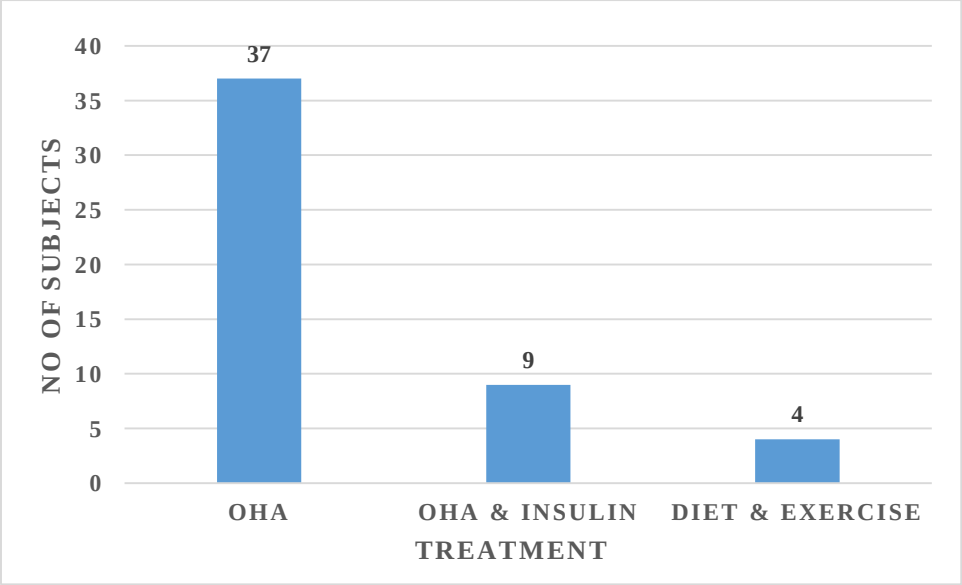


Table 5 and Figure 8 shows the Diabetes treatment of selected subjects. About 74% of the subjects were able to manage Diabetes with the help of Oral Hypoglycemic Agents (OHA), about 18% needed Insulin along with OHA to manage Diabetes and 8% were able to manage Diabetes by Diet and exercise without any medicine.

4.1.4 Assessment of Nutritional Profile

4.1.4.1 Anthropometric Assessment

"Anthropometry has a long tradition of assessing nutritional and health status of adults, as this is an inexpensive, non-invasive method that provides detailed information on different components of body structure, especially muscular and fat components" (Bhattacharya A et al., 2019).

"Nutritional Anthropometry has been defined as "measurements of the variation of the physical dimensions and the gross composition of the human body at different age levels and degrees of nutrition". Anthropometric assessments are of two types: growth and body composition, and have been widely used for the assessment of nutritional status of both children and adults. The selection of the ideal single or a combined use of anthropometric indicators depends upon the sensitivity and specificity of the indicator chosen" (Shetty Prakash., 2003).

A) HEIGHT

Table 6. Height range of selected subjects

Height (in cms)	No. of Subjects	Percentage
141-150	2	4
151-160	18	36
161-170	18	36
171-180	9	18
>180	3	6

Figure 9. Height range of selected subjects

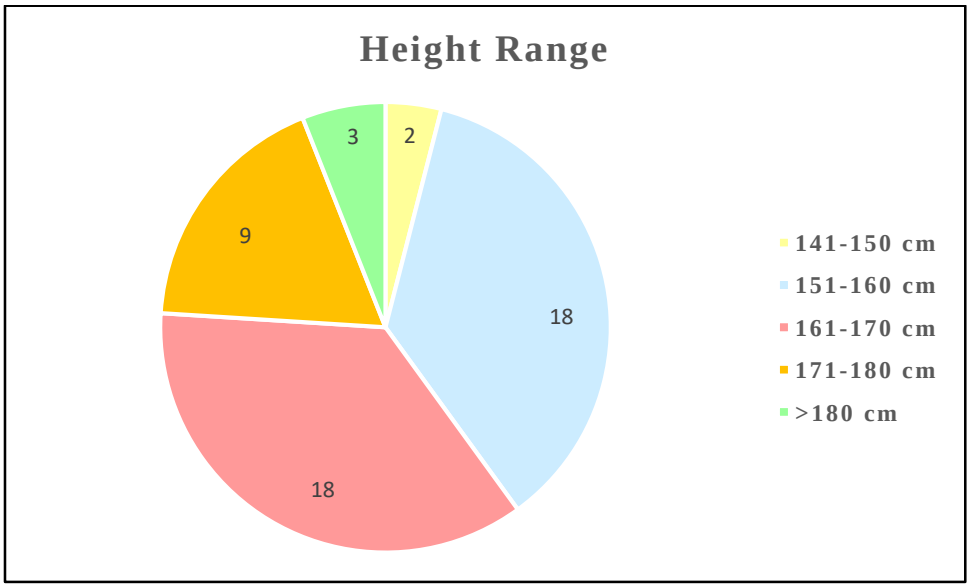


Table 6 and Figure 9 depicts the Height range of the selected subjects. Two patients were in the height range of 141-150 cm, eighteen patients were of the height range 151-160 cm, eighteen patients were of the height range 161-170 cm, nine patients were of the height range of 171-180 cm, three patients were of the height range of >180 cm.

B) WEIGHT

Table 7. Weight Range

Weight(in kg)	No. of Subjects	Percentage
41-60	5	10
61-80	33	66
81-100	10	20
101-120	2	4

Figure 10. Weight range of selected subjects

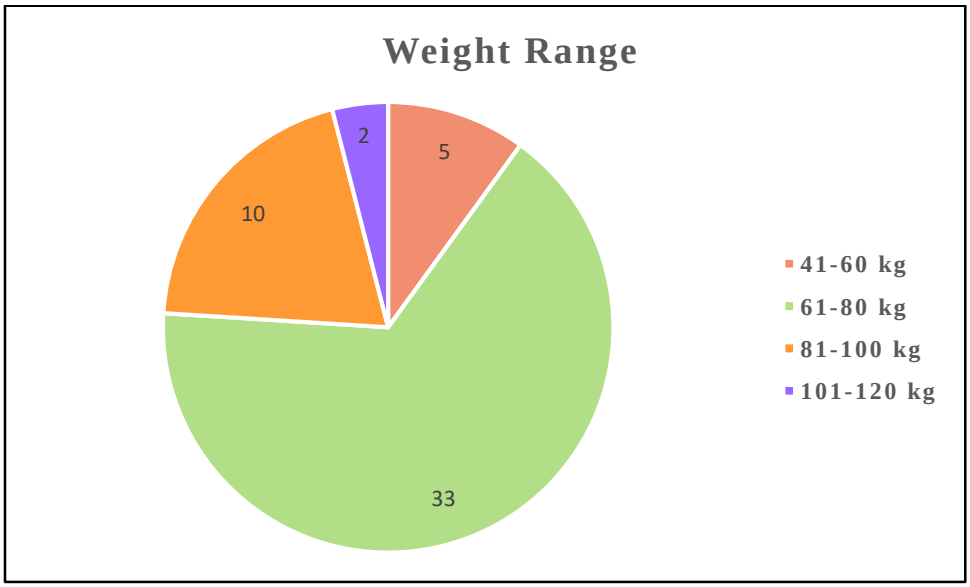


Table 7 and Figure 10 depicts the weight range of the selected subjects. Five patients had their weight between 41-60 kg, thirty-three patients had their weight between 61-80 kg, ten patients had their weight between 81-100 kg and two patients had their weight between 101-120 kg. So a majority of the patients i.e. 66% had their weight between 61-80 kg.

C) BMI CLASSIFICATION

Table 8. BMI Classification of selected subjects

BMI (Kg/m^2)	No of Subjects	Percentage
18.5-24.9	16	32
25-29.9	24	48
30-35.9	9	18
36-39.9	1	2
>40	0	0

Figure 11. BMI Classification of selected subjects

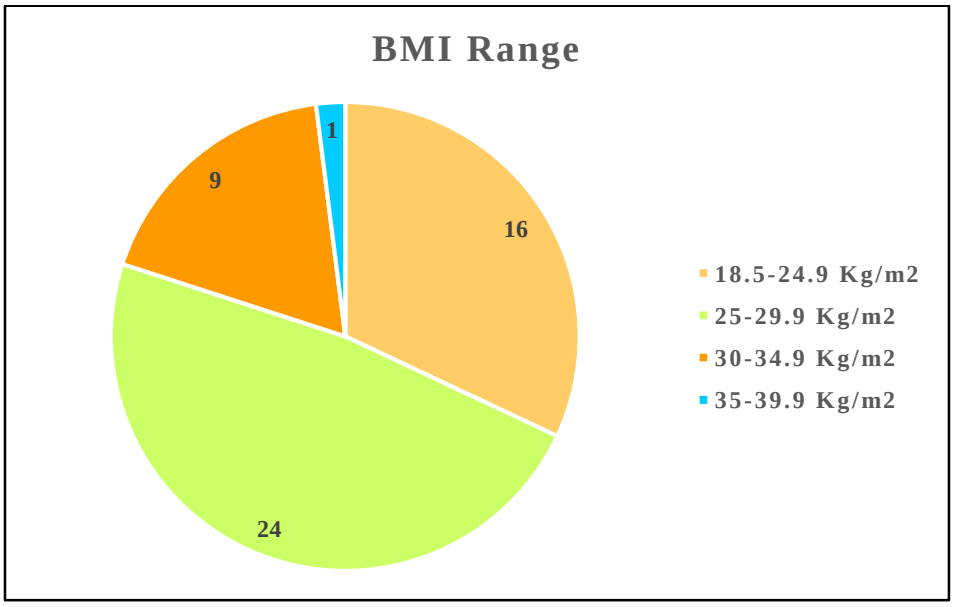


Table 8 and Figure 11 depicts the BMI Classification of selected subjects. WHO classification for BMI was used to categorize the BMI of the selected patients. Sixteen patient had a normal BMI range of 18.4-22.9 Kg/m^2, twenty-four patients had a Pre obese BMI range of 25-29.9 Kg/m^2, nine patients had Obesity Class I BMI range of 30-34.9 Kg/m^2, one patient had Obesity Class II BMI range of 35-39.9 Kg/m^2. None of the patients were underweight or in the category of Obese Class III.

"Prevalence of diabetes mellitus, hypertension and dyslipidaemia was estimated within BMI categories, as was distribution of BMI levels among individuals with these diseases. Mean BMI was 27.8 kg/m^2 for SHIELD and 27.9 kg/m^2 for NHANES. Increased BMI was associated with increased prevalence of diabetes mellitus, hypertension and dyslipidaemia in both studies. However, these metabolic diseases were present at all levels of BMI" (Bays H.E, et al., 2007).

D) WAIST CIRCUMFERENCE

Table 9. Waist circumference range of selected subjects

Waist circumference (in cm)	No. of Subjects	Percentage
<88	33	66
88-99	10	20
>100	7	14

Figure 12. Waist circumference range

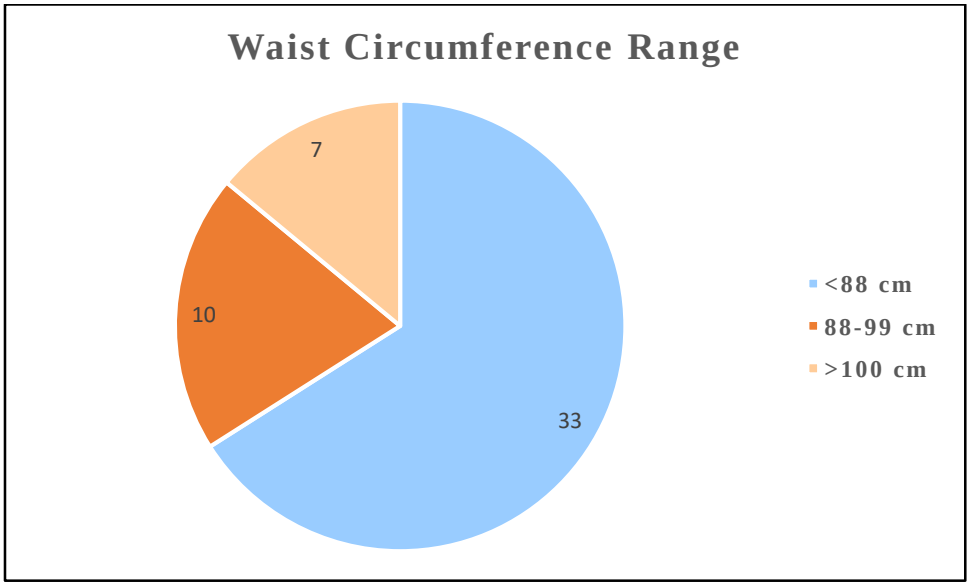


Table 9 and Figure 12 depicts the Waist circumference of the selected patients. The data collected shows that 66% of the patients had waist circumference < 88 cm, 20% patients had a waist circumference between 88-99 cm and 14% patients had a waist circumference >100 cm. However, due to the ongoing pandemic of COVID 19, some of the patients were skeptical in getting their waist circumference measured, as a result their waist size was taken into account to measure the waist circumference. Waist circumference is one of the NCEP ATP III criteria to find out Metabolic Syndrome, so

this criterion was eliminated in the current study and the remaining 4 criteria were used to find out the incidence of Metabolic Syndrome.

4.1.4.2 Biochemical Assessment

"Biochemical assays are one aspect of a complete nutritional assessment that provides valuable information in the determination of an individual's nutritional status and the identification of any nutrient deficiencies or excesses. As part of this nutritional assessment, specific biochemical tests are ordered to substantiate further or to rule out nutrient deficiencies or excesses gleaned from the clinical, dietary, and anthropometric components of the complete nutritional assessment" (Stiles N.J et al., 1995).

"There is no single parameter that can thoroughly assess nutritional status or monitor nutritional therapy. However, a set of laboratory parameters in the clinical routine (e.g., complete blood count, lipid profile, electrolytes, liver parameters) may provide valuable information about a patient's nutritional status (e.g., proof of nutrient deficiency, information about the aetiology of malnutrition, follow-up nutritional therapy), about the severity and activity of the disease, and about changes in body composition" (Reber Emilie et al., 2019).

"The risk factors like high TG, low HDL, high BP, and high fasting glucose were found higher particularly in younger population which may lead to diagnosis & complications of diabetes, hypertension and lipid abnormality. Due to changing physiology in young and middle age population these individuals are moving towards metabolic syndrome easily and needs frequent monitoring, preventive checkups, and lifestyle changes to prevent complications" (Bhosale VV et al., 2019).

In the present study, biochemical analysis of the subjects was done based on the NCEP ATP III criteria as follows:

A) FASTING BLOOD GLUCOSE

Table 10. Fasting blood glucose of selected subjects

Fasting Plasma Glucose	Metabolic Syndrome		Total No. Of Subjects	Percentage
	Positive	Negative		
< 100 mg/dL	2	1	3	6
101-125 mg/dL	8	5	13	26
>125 mg/dL	17	17	34	68
Total	**27**	**23**	**50**	**100**

Figure 13. Fasting blood glucose of selected subjects

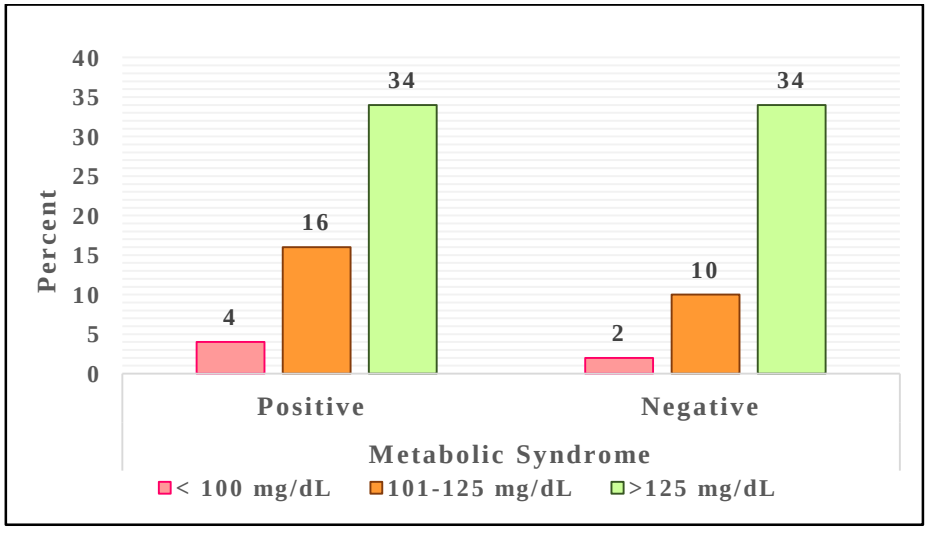


Table 10 and Figure 13 represents the Fasting Blood Sugar values of selected patients and the incidence of Metabolic syndrome. Of the 50 subjects, three patients (6%) had a Fasting blood glucose value of < 100 mg/dL: two of which had Metabolic syndrome, thirteen patients (26%) had a fasting blood glycose value of 101-125 mg/dL.: eight of

which had Metabolic syndrome, thirty-four patients (68%) had a fasting blood glucose value of >125 mg/dL: seventeen of which had Metabolic Syndrome.

B) SERUM TRIGLYCERIDE

Table 11. Serum Triglyceride levels of selected subjects

Triglyceride	Metabolic Syndrome		Total No. of Subjects	Percentage
	Positive	Negative		
< 150 mg/dL	7	12	19	38
150-199 mg/dL	7	6	13	26
200-499 mg/dL	13	4	17	34
>500 mg/dL	0	1	1	2
Total	**27**	**23**	**50**	**100**

Figure 14. Serum Triglyceride level of selected subjects

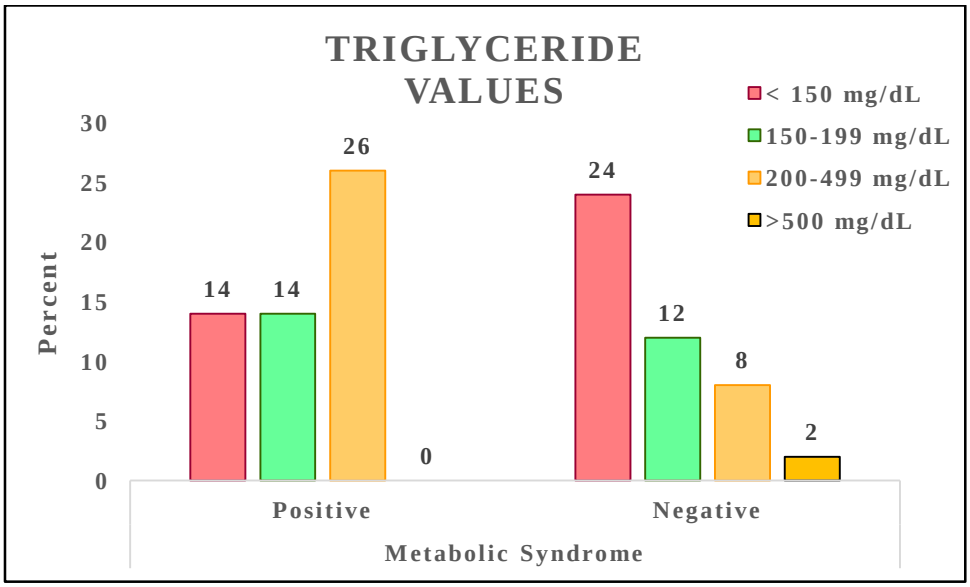


Table 11 and Figure 14 represents the Triglyceride values of selected subjects. Nineteen subjects (38%) had a triglyceride value of < 150 mg/dL; seven of which had Metabolic

syndrome, thirteen subjects (26%) had a triglyceride value between 150-199 mg/dL: seven of which had Metabolic Syndrome, seventeen subjects (34%) had a triglyceride value of 200-499 mg/dL: thirteen of which had Metabolic Syndrome, one patient (2%) had a triglyceride value of > 500 mg/dL without the presence of Metabolic syndrome.

C) HIGH DENSITY LIPOPROTEIN

Table 12. High Density Lipoprotein (HDL) Levels of selected subjects

HDL	Metabolic Syndrome		Total No. of Subjects	Percentage
	Positive	Negative		
< 55 mg/dL	14	5	19	38
>55 mg/dL	13	18	31	62
Total	**27**	**23**	**50**	**100**

Figure 15. HDL levels of selected subjects

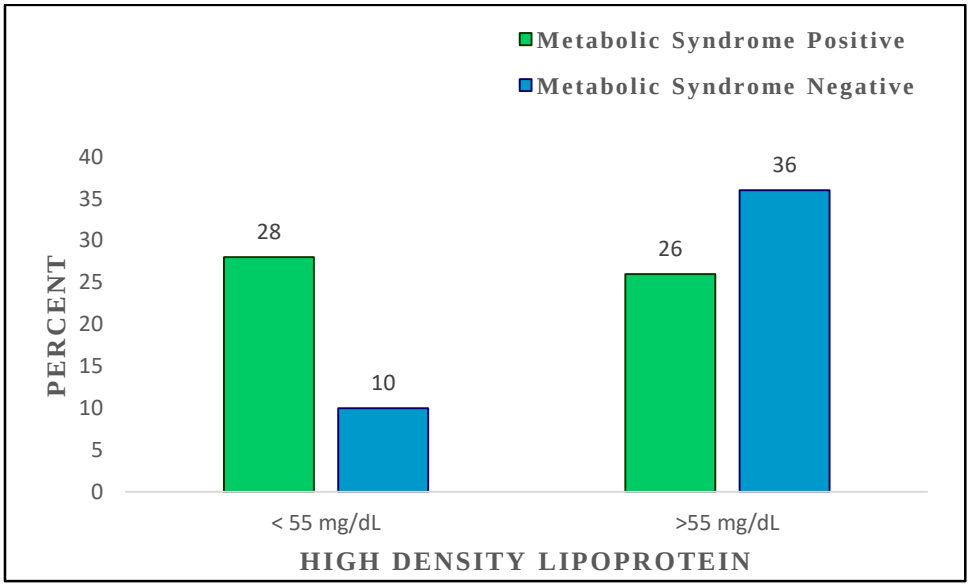


Table 12 and Figure 15 represents the HDL levels of selected subjects. Nineteen subjects (38%) had a HDL level of < 55 mg/dL out of which fourteen were positive for

Metabolic syndrome, thirty-one subjects had a HDL level of > 55 mg/dL out of which thirteen were positive for Metabolic syndrome.

D) BLOOD PRESSURE

Table 13. Blood Pressure of selected subjects

Blood Pressure	Metabolic Syndrome		Total No Of Subjects	Percentage
	Positive	Negative		
< 130/85 mmHg	16	23	39	78
>130/85 mmHg	11	0	11	22
Total	**27**	**23**	**50**	**100**

Figure 16. Blood pressure of selected subjects

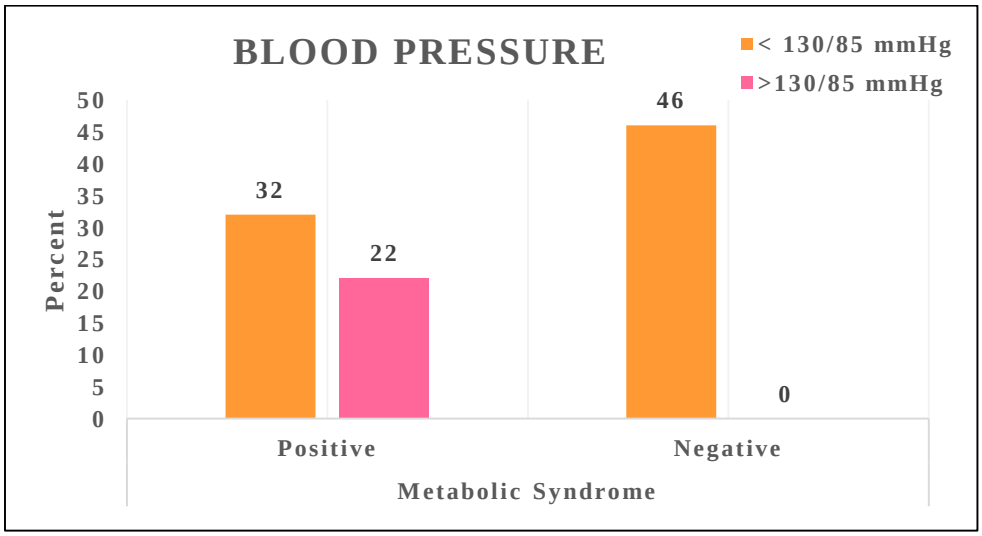


Table 13 and Figure 16 represents the Blood pressure of selected subjects. Thirty-nine subjects (78%) had a blood pressure < 130/85 mmHg of which sixteen had reported the presence of Metabolic syndrome because they were on medicines which help them maintain the Blood pressure. Eleven subjects had a blood pressure of > 130/85 mmHg, with presence of Metabolic syndrome.

E) HbA1C

Table 14. HbA1C levels of selected subjects

HbA1C levels	Metabolic Syndrome		Total No of Subjects	Percentage
	Positive	Negative		
6-8	12	12	24	48
8.1-10	8	6	14	28
>10	7	5	12	24
Total	**27**	**23**	**50**	**100**

Figure 17. HbA1C levels of selected subjects

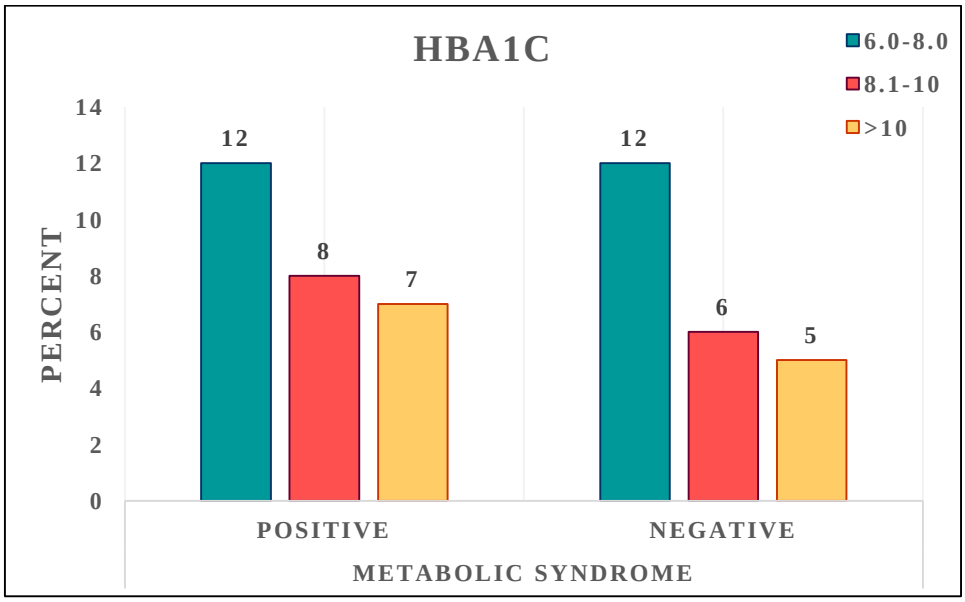


Table 14 and Figure 17 represents the HbA1C levels of the selected subjects and this represents how well the patients had their Diabetes under control. Twenty-four subjects (48%) had a HbA1C range between 6-8: out of which twelve were positive for Metabolic syndrome. Fourteen subjects had a HbA1C range of 8.1-10: eight of which were positive for Metabolic Syndrome. Twelve subjects had a HbA1C range of > 10

and seven of them had Metabolic syndrome. The HbA1C levels indicate that the patients had a poor control on their Diabetes.

4.1.4.3 Dietary Assessment

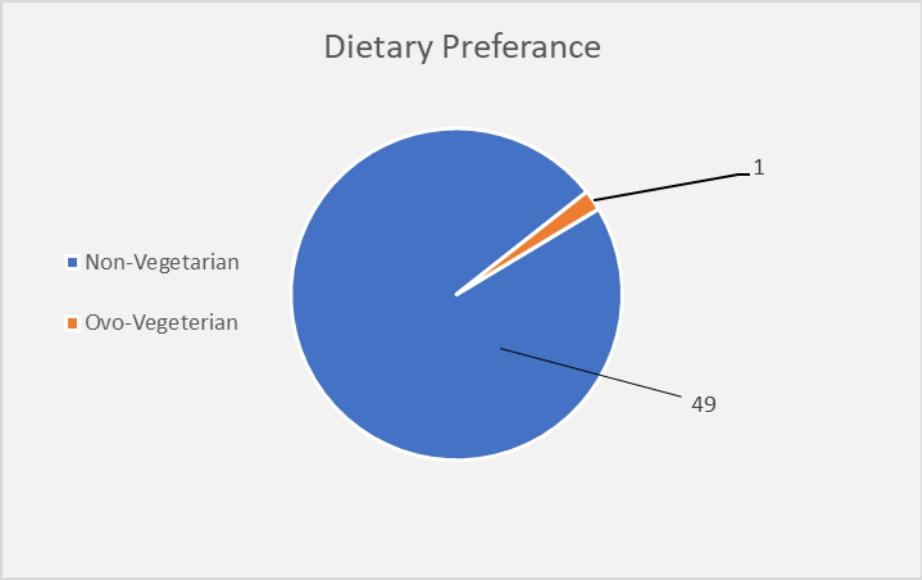
A) DIETARY PREFERENCE

Table 15. Dietary Preference of Selected Subjects

	No. of Subjects	Percentage
Non-Vegetarian	49	98
Ovo-Vegeterian	1	2

Table 15 and Figure 18 indicate the Dietary Preference pattern of selected subjects and it was found that 98% of the patients were Non-Vegetarians, and only 2% were Ovo-Vegetarian. None of the subjects were pure vegetarian. The people consumed egg, meat, fish, chicken, beef and pork.

Figure 18. Dietary Preference of selected subjects



B) DIETARY HABITS

Table 16. Dietary Habits of selected subjects

Consumption	No. of Subjects	Percentage
Consumption of Rice/Day		
Once	27	54
Twice	22	44
Thrice	1	2
Habit of Reusing the Oil		
Reusing	41	82
Non Reusing	9	18
Combination of Oils		
Yes	27	54
No	23	46
Preferred form of consuming Flesh Foods		
Fried	3	6
Gravy	45	90
Grilled	2	4
Frequency of Snacking from Outside		
Daily	8	16
Weekly	17	34
Monthly	10	20
Occasionally	13	26
Never	2	4
Habit of Skipping the Meal		

Consumption	No. of Subjects	Percentage
Yes	20	40
No	30	60
Skipped Meal		
Breakfast	9	45
Lunch	7	35
Dinner	4	20
Daily Vegetable Consumption Pattern		
Yes	35	70
No	7	14
Sometimes	8	16
Daily Fruit Consumption Pattern		
Yes	34	68
No	16	32
Preferred Rice		
White	21	42
Brown	18	36
Red	6	12
No Preference	4	8
Not Consuming Rice	1	2
Habit of Drinking Carbonated Drinks		
Weekly	1	2
Monthly	9	18
Occasionally	17	34
Never	23	46

Table 16 indicates the Dietary Habits of selected subjects. The rice consumption pattern of the subjects was categorized as once, twice and thrice per day and it was found that 54% had rice once a day, 44% had rice twice a day and only 2% had rice for all three meals each day.

82% of the subjects reused the oil after deep frying and 18% discarded the oil after deep frying. 54% of the subjects used combination of oil including coconut, sunflower, rice bran, olive and palm oil and 46% of the subjects used only coconut oil.

The most preferred form of Non veg consumption was in the form of gravy for 90% of the subjects, 6% preferred non veg in the fried form and 4% in the grilled form.

The frequency of snacking from outside was also recorded and was found that 16% ate some snacks from outside daily, 34% snacked outside weekly, 20% snacked outside monthly, 26% occasionally ate snacks from outside and 4% never snacked from outside.

Habit of skipping the meal was recorded along with the meal skipped. 40% skipped their meal of which 45% skipped breakfast, 35% skipped lunch and 20% skipped dinner for various reasons. 60% subjects ate all 3 meals.

Among fifty subjects, 35 (70%) had the habit of consuming vegetable every day, seven (14%) did not have the habit of consuming vegetable every day and eight (16%) had the habit of consuming vegetables sometimes.

The table also depicts that 68% had the habit of consuming fruits daily and 32% did not have the habit of consuming fruits on a daily basis.

The preferred rice for 42% of subjects was white rice, 36% preferred brown rice, 12% preferred red rice, 8% had no specific preference and 2% had stopped consuming rice. The habit of drinking carbonated beverages was also recorded. 2% consumed these weekly, 18% consumed carbonated drinks on a monthly basis, 34% consumed these occasionally and 46% never consumed carbonated drinks.

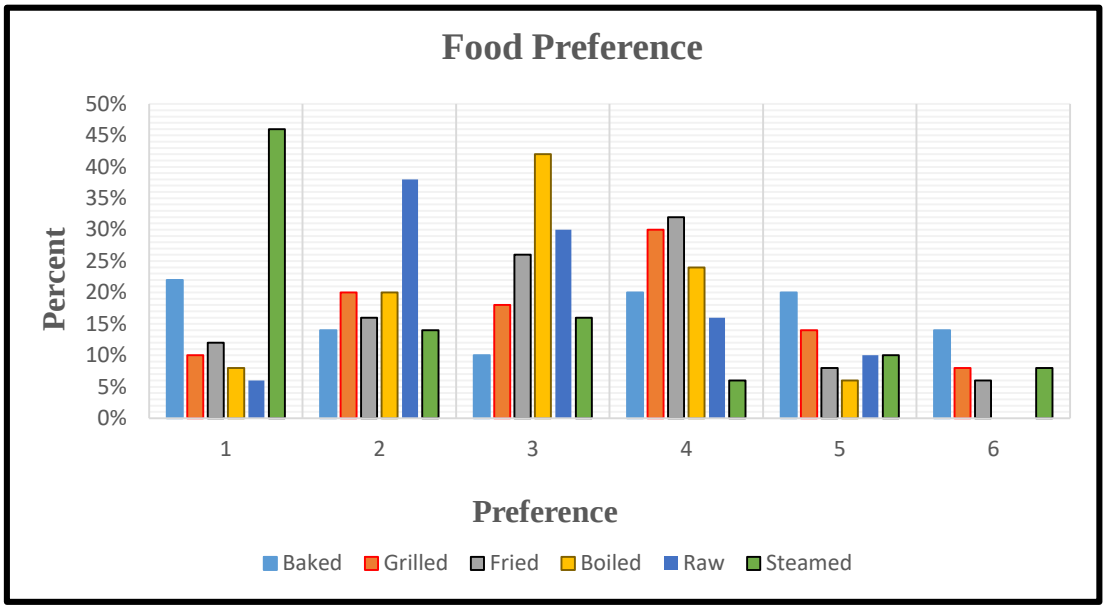
C) FOOD PREFERENCE

Table 17. Food preference of selected subjects

Preference	Baked	Grilled	Fried	Boiled	Raw	Steamed
1	22%	10%	12%	8%	6%	46%
2	14%	20%	16%	20%	38%	14%
3	10%	18%	26%	42%	30%	16%
4	20%	30%	32%	24%	16%	6%
5	20%	14%	8%	6%	10%	10%
6	14%	8%	6%	0%	0%	8%

Table 17 and Figure 19 represents the preference of food based on the cooking method. The preference was rated from 1 to 6: where 1 is the most preferred and 6 is the least preferred. The highest preferred method was steaming (46%), the 2nd most preferred method was raw foods, 3rd most preferred method was boiled, 4th most preferred method was frying, 5th preferred method was baking and the least preferred method was grilled.

Figure 19. Food preference of selected subjects



D) FOOD FREQUENCY PATTERN

Table 18. Food Frequency Pattern of Selected Subjects

Ser	Foods	Frequency of Consumption				
		Daily	Weekly	Monthly	Rarely	Never
1.	**Cereals**					
	Millets	-	4%	4%	90%	2%
	Rice	98%	2%	-	-	-
	Wheat	66%	28%	4%	2%	-
	Oats	2%	10%	8%	76%	4%
	Brown rice	32%	-	4%	58%	6%
2.	**Pulses**					
	Bengal gram	2%	66%	26%	6%	-
	Black gram	-	66%	28%	6%	-
	Green gram	-	64%	28%	8%	-

Ser	Foods	Frequency of Consumption				
		Daily	**Weekly**	**Monthly**	**Rarely**	**Never**
	Lentil	4%	26%	32%	38%	-
	Soya-bean	-	18%	18%	42%	22%
	Chickpea	-	22%	64%	12%	2%
	Black Chickpea	2%	96%	-	2%	-
3.	**Green Leafy Vegetables**					
	Cabbage	12%	78%	2%	2%	6%
	Amaranth	-	76%	14%	4%	6%
	Spinach	2%	72%	18%	2%	6%
	Fenugreek	-	66%	24%	4%	6%
	Drumstick	-	66%	20%	6%	8%
4.	**Roots & Tubers**					
	Carrot	26%	76%	-	-	2%
	Potato	20%	76%	-	2%	2%
	Sweet potato	2%	6%	10%	80%	2%
	Yam	-	20%	16%	62%	2%
	Tapioca	-	14%	30%	54%	2%
	Beetroot	-	38%	30%	30%	2%
	Onion	50%	46%	2%	2%	-
5.	**Other Vegetables**					
	Tomato	100%	-	-	-	-
	Cauliflower	-	88%	2%	10%	-
	Lady’s finger	-	98%	2%	-	-

Ser	Foods	Frequency of Consumption				
		Daily	**Weekly**	**Monthly**	**Rarely**	**Never**
	Beans	2%	94%	4%	-	-
	Cucumber	16%	70%	4%	10%	-
	Ash gourd	-	8%	52%	40%	-
	Bottle gourd	-	6%	82%	12%	-
	Ridge gourd	-	6%	84%	10%	-
	Plantain	2%	12%	72%	14%	-
	Pumpkin	-	-	56%	44%	-
6.	**Fruits**					
	Apple	20%	58%	18%	2%	2%
	Banana	44%	36%	16%	2%	2%
	Pomegranate	2%	36%	46%	14%	2%
	Papaya	6%	60%	26%	6%	2%
	Watermelon	-	16%	62%	20%	2%
	Muskmelon	2%	8%	66%	22%	2%
	Pear	-	6%	58%	34%	2%
	Guava	4%	50%	32%	12%	2%
	Custard apple	-	8%	38%	52%	2%
	Pineapple	-	8%	36%	54%	2%
	Passion fruit	-	4%	26%	68%	2%
	Figs	-	6%	24%	68%	2%
	Orange	16%	74%	4%	4%	2%
7.	**Milk and Milk Products**					

Ser	Foods	Frequency of Consumption				
		Daily	**Weekly**	**Monthly**	**Rarely**	**Never**
	Milk	94%	2%	-	-	4%
	Cheese	-	2%	10%	48%	40%
	Curd	18%	38%	20%	8%	16%
	Paneer	-	10%	36%	24%	30%
	Buttermilk	2%	28%	32%	26%	12%
8.	**Flesh Foods**					
	Mutton	-	24%	38%	10%	28%
	Chicken	2%	56%	26%	2%	14%
	Beef	-	18%	34%	24%	24%
	Egg	26%	70%	4%	-	-
	Fish	32%	62%	2%	2%	2%
	Pork	-	4%	14%	22%	60%
9.	**Nuts**					
	Almonds	38%	22%	22%	14%	4%
	Cashew	22%	22%	34%	18%	4%
	Pista	10%	22%	22%	38%	4%
	Dates	20%	24%	26%	26%	4%
	Walnut	6%	28%	20%	42%	4%
	Peanuts	16%	36%	22%	24%	2%
	Coconut	90%	10%	-	-	-
10.	**Beverages**					
	Tea	92%	2%	-	2%	4%

Ser	Foods	Frequency of Consumption				
		Daily	**Weekly**	**Monthly**	**Rarely**	**Never**
	Coffee	26%	6%	16%	46%	6%
	Soft drinks	-	4%	4%	46%	46%
	Alcohol	2%	-	8%	14%	76%
11.	**Processed Foods**					
	Pickles	2%	6%	32%	56%	4%
	Pappads	-	14%	70%	14%	2%
	Jam	-	-	-	28%	72%
12. .	**Sweets**					
	Sugar	34%	-	-	2%	64%
	Jaggery	2%	2%	-	8%	88%
	Honey	2%	-	2%	6%	90%
	Sugar free	-	-	2%	2%	96%

The Food Frequency questionnaire was used to assess the dietary intake of individuals. The foods were grouped into 12 categories. Table 18 reveals the frequency of consumption of the various food groups.

In the cereals food group, rice was most consumed (98%), followed by wheat (66%). Millets, oats and brown rice were rarely consumed by majority of the population.

Pulses were mostly consumed twice or thrice a week. The most preferred pulses were Bengal gram dal (66%), green gram dal (66%), black gram dal (64%), black chickpea (96%).

Green leafy vegetables were consumed on a weekly basis, most preferred were cabbage (78%), amaranth (76%) and spinach (72%).

Carrot (76%), potato (76%), onion (90%) were the most consumed roots and tubers, sweet potato, tapioca, tam, beetroot was also occasionally consumed.

Tomato was daily consumed by all the 50 patients, among the other vegetables, cauliflower (88%), beans (94%), okra (98%), cucumber (80%) were majorly consumed, the gourd varieties, plantain and pumpkin were consumed monthly once or twice.

Among the fruits, the most consumed were banana (80%), papaya (60%), apple (70%), orange (74%), guava (50%). Other fruits were occasionally consumed.

Milk was consumed on a daily basis by 94% of subjects, other dairy products were less frequently consumed.

Flesh foods were majorly consumed by the subjects. Egg (90%), fish (92%), chicken (58%) were highest consumed. Beef, mutton, pork was occasionally consumed.

Among the nuts coconut was used daily by 90% of subjects. Other nuts were consumed weekly, monthly or occasionally.

Tea was consumed daily by 92% subjects, coffee, soft drinks, alcohol was less frequently consumed.

Among the processed foods, papaddam was consumed at least 2-3 times a month, pickles were consumed occasionally and jams were less frequently consumed.

Sugar was used daily by about 34% subjects. Jaggery, honey and sugar free were rarely used.

E) DIETARY ASSESSMENT

24 Hour Recall Method

The 24-hour dietary recall method consists of precisely recalling, describing and quantifying the intake of foods and beverages consumed in the 24-hour period prior to, or during the day before the interview, from the first intake in the morning until the last foods or beverages consumed at night (before going to bed or later, in the case of those who get up at midnight and eat and/or drink something). The information should describe the type of food and its characteristics (fresh, precooked, frozen, canned, preserved), the net quantity consumed, method of preparation, commercial brands, sauces, dressings (type of fats and oils used), condiments, liquids, multivitamin supplements and food supplements, as well as the time and place of consumption (at home, away from home), etc.

In this study, fifty subject's 3 days 24-hour recall (2 working days and a holiday) is analysed and the results are as discussed below:

(a) Total Calorie Intake

Table 19. Daily Calorie intakes of selected subjects

		Metabolic Syndrome		Total	Percentage
		Positive	Negative		
Total Calories	< 1600 Kcal	16	14	30	60
	>1600 Kcal	11	9	20	40
Total		26	24	50	100

Figure 20. Daily Calorie Intake of selected subjects

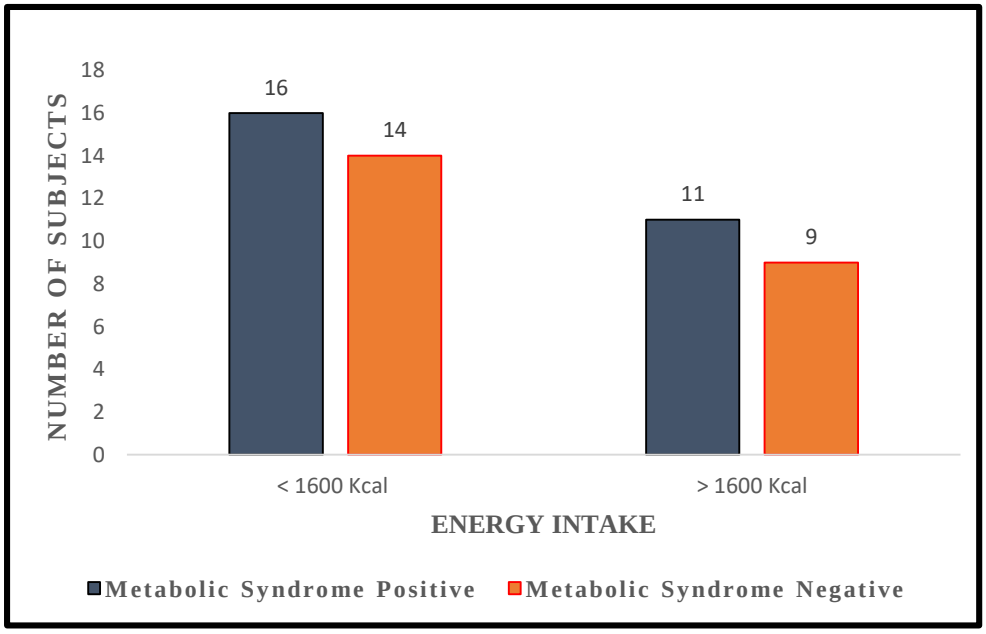


Table 19 and Figure 20 depicts the total calorie intake of the selected subjects was calculated using the Ntutive app. About thirty subjects had a calorie intake of < 1600 Kcal per day out of which sixteen were found to have Metabolic syndrome. Twenty subjects had a calorie intake of > 1600 Kcal of which eleven were found to have Metabolic syndrome.

"Lower physical activity, but not excessive calorie intake, is independently associated with the prevalence of MetS in the elderly with T2DM. In our routine work, encouraging physical activity might contribute to preventing MetS and subsequent atherosclerotic disease in the elderly, rather than strict management of abnormal laboratory parameters using multiple drugs" (Lijima K et al., 2012).

(b) Total Protein Intake

Table 20. Total daily Protein Intake of selected subjects

		Metabolic Syndrome		Total	Percentage
		Positive	Negative		
Protein	20-30 g	0	2	2	4
	31-40 g	6	5	11	22
	41-50 g	11	12	23	46
	>51 g	10	4	14	28
Total		26	24	50	100

Figure 21. Total daily Protein Intake of selected subjects

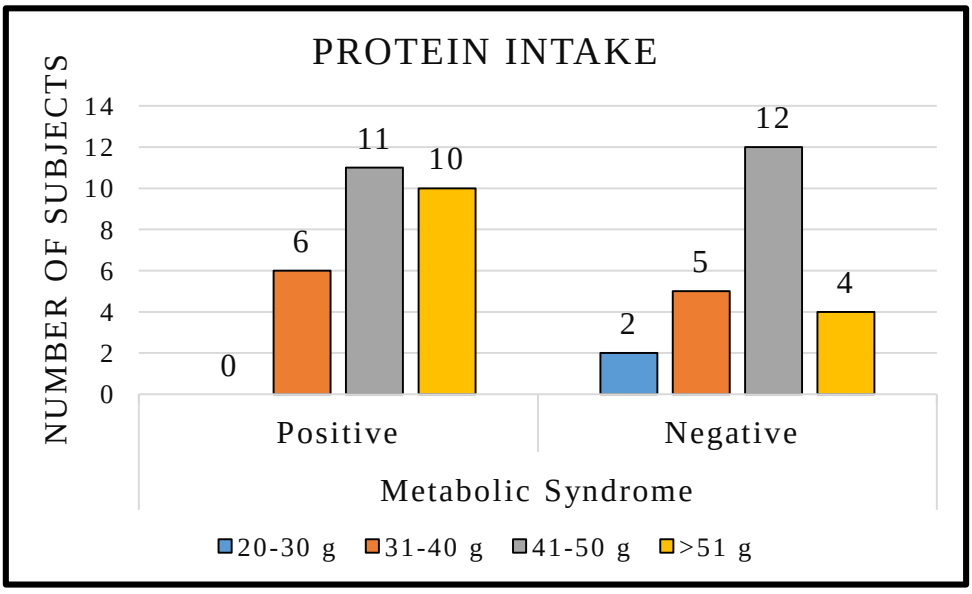


Table 20 and Figure 21 depicts the total protein intake of selected subjects. The protein intake was grouped into 4 categories as 20-30 g, 31-40 g, 41-50 g, and more than 50 g. Two patients had a daily protein consumption of 20-30 g and they did not have Metabolic syndrome, eleven patients consumed 31-40 g of protein daily of which six had Metabolic syndrome, twenty-three patients had a daily protein intake of 41-50 g, of which eleven had Metabolic syndrome, and fourteen patients had a daily protein intake of > 50 g, out of which ten had Metabolic syndrome. The protein consumed was mostly from Non Veg sources.

(c) Total Fat Intake

Table 21. Total daily Fat intake of selected subjects

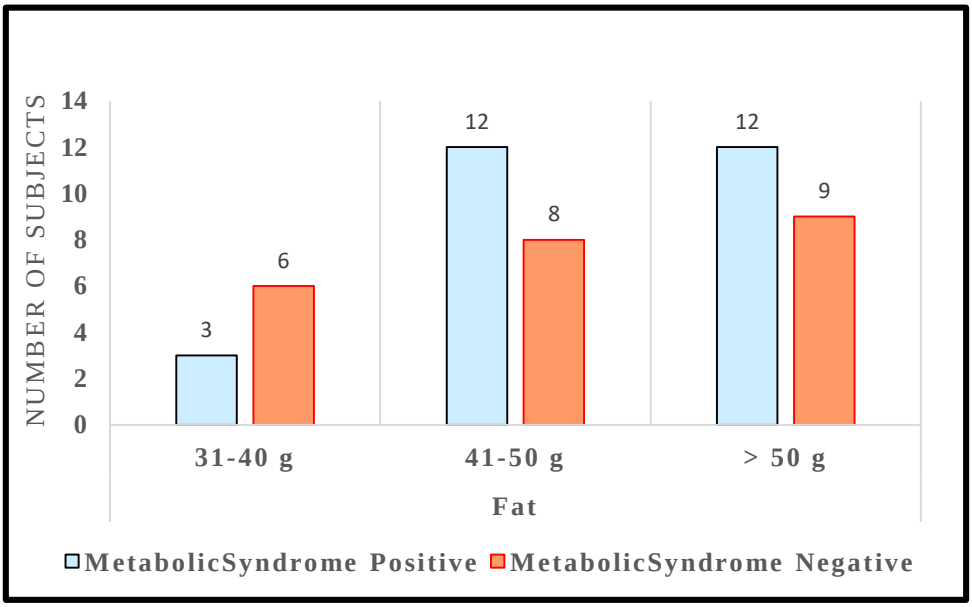
		Metabolic Syndrome		Total	Percentage
		Positive	Negative		
Fat	31-40 g	3	6	9	18
	41-50 g	12	8	20	40
	>50 g	12	9	21	42
Total		26	24	50	100

Table 21 and Figure 22 depicts the total fat intake of the selected subjects. The fat intake was grouped as 31-40 g, 41-50 g and > 50 g. Nine patients had a fat intake of 31-40 g of which three had Metabolic syndrome; twenty patients had a daily fat intake of 41-50 g and twelve of them had Metabolic syndrome; twenty-one patients had a daily fat intake of > 50 g and twelve of which had Metabolic syndrome. Higher fat intake was associated with increased Triglyceride levels and thus increased incidence of Metabolic Syndrome.

“The effects of dietary SFAs on MetS will be influenced by other specific nutrients. Replacement of SFA by MUFA and PUFA has been associated with a decrease in MetS. Dietary recommendations should emphasize on different qualities of fat intake, not only to reduce total fat intake, to obtain health benefits in adults” (Julibert A et al., 2019).

A study by Aljada et al., 2005 has shown that “a high dietary fat intake is associated with an oxidative stress and an activation of the proinflammatory transcription factor, that is, nuclear factor kappa-beta (NFB). In contrast, a diet rich in fruits and fibres has no inflammation-inducing capacity compared with a high-fat diet even if it has the same calories content.”

Figure 22. Total daily fat intake of selected subjects



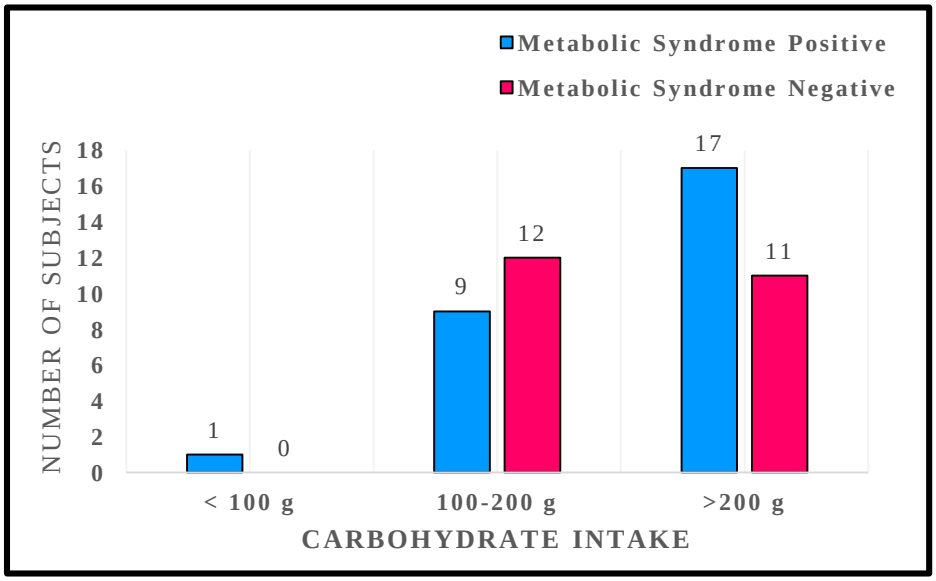
(d) Total Carbohydrate Intake

Table 22. Total daily carbohydrate intake

		Metabolic Syndrome		Total	Percentage
		Positive	Negative		
CHO	< 100 g	1	0	1	2
	100-200 g	9	12	21	42
	>200 g	17	11	28	56
Total		26	24	50	100

Table 22 and Figure 23 depicts the Total Carbohydrate intake of the selected subjects. It was found that one patient had a daily carbohydrate intake of less than 100 g who reported positive for Metabolic syndrome, twenty-one patients consumed 100-200 g of carbohydrate daily out of which nine had Metabolic syndrome, and twenty-eight patients had a daily carbohydrate intake of > 200 g out of which seventeen had Metabolic syndrome. Higher incidence of Metabolic syndrome was found in patients who ate > 200 g carbohydrate each day.

Figure 23. Daily Carbohydrate Intake of Selected subjects



(e) Total Fiber Intake

Table 23. Daily Fiber Intake of selected subjects

		Metabolic Syndrome		Total	Percentage
		Positive	Negative		
Fibre	<25 g	15	14	29	58
	>25 g	12	9	21	42
Total		26	24	50	100

Figure 24. Daily Fiber Intake of selected subjects

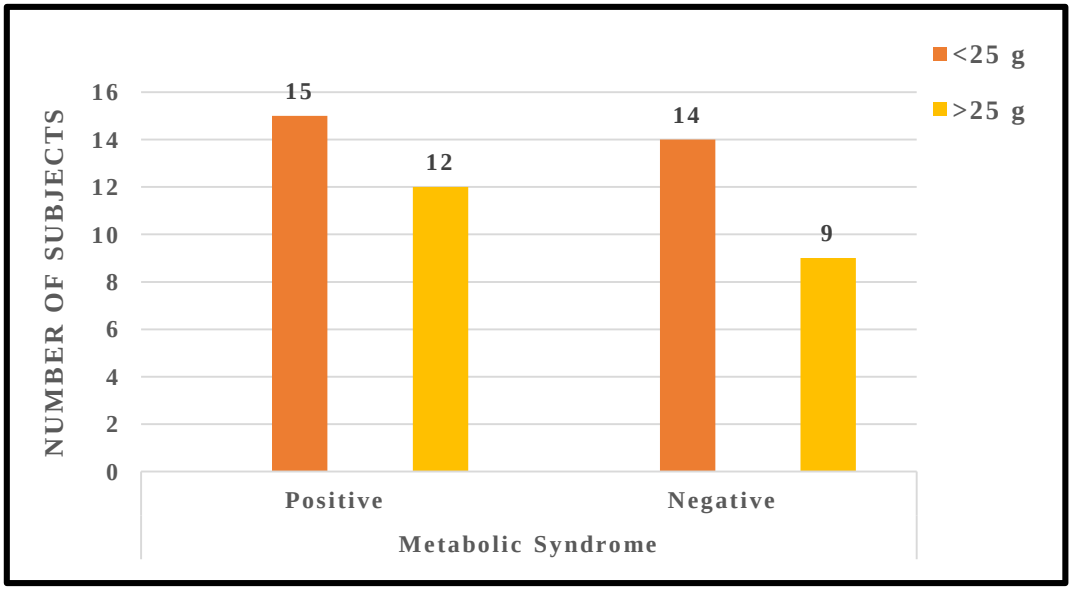


Table 23 and Figure 24 depicts the total fiber intake of selected subjects. Patients were grouped based on the fiber intake of < 25 g and > 25 g. 58% of patients had a fiber intake of < 25 g, out of which fifteen had Metabolic syndrome, 42% of patients had a fiber intake of > 25 g, out of which twelve had Metabolic syndrome.

"In patients with T2D and the MetS, the inclusion of soluble fiber to the usual diet improved the MetS profile and factors associated with cardiovascular risk. It seems that soluble fiber deserves attention as the potential natural dietary supplements for use in nutritional rehabilitation of MetS profile and T2D, as it is inexpensive and shows positive results within a short span of time" (Abutair A.S et al., 2018).

F) Life Style Pattern

Table 24. Life style pattern of selected subjects

	No. of Subjects	**Percentage**
Life Style Pattern		
Sedentary	50	100
Moderate	0	0
Heavy	0	0
Exercise Pattern		
Yes	36	72
No	14	28
Sleeping Pattern		
Regular	32	64
Insomnia	0	0
Intermittent	18	36
Smoking/Alcohol Consumption Pattern		
Yes	14	28
No	36	72
Frequency of Smoking/Alcohol Consumption		

Daily	1	7
Weekly	2	14
Monthly	5	36
Occasionally	6	43

Table 24 depicts the lifestyle pattern of selected subjects. All the subjects involved in the study led a sedentary lifestyle. About 72% patients performed some sort of physical activity and 28% did not indulge in any physical activities.

The Sleeping pattern of 64% patients was normal and 36% patients had intermittent sleeping pattern.

The table also shows that fourteen (28%) patients had the habit of smoking and drinking alcohol out of which only one patient consumed it daily, two weekly, five monthly and six occasionally. Thirty-six (72%) did not have the habit of smoking or drinking alcohol. So a majority of the subjects did not enjoy smoking or alcohol.

“Among other reasons, sedentary life and the easy access to inexpensive foods contribute to the explanation of why MetS is currently so prevalent. Its treatment aims to decrease the risks of CVD and T2DM. The first and most important step is the implementation of a new lifestyle with changes in diet and physical activity, as well as the acquisition of healthier habits. Weight loss and lifestyle changes may improve individual MetS components. Behavioural interventions make it easier for individuals to incorporate and maintain these changes in their daily routines” (Hoyas et al., 2019).

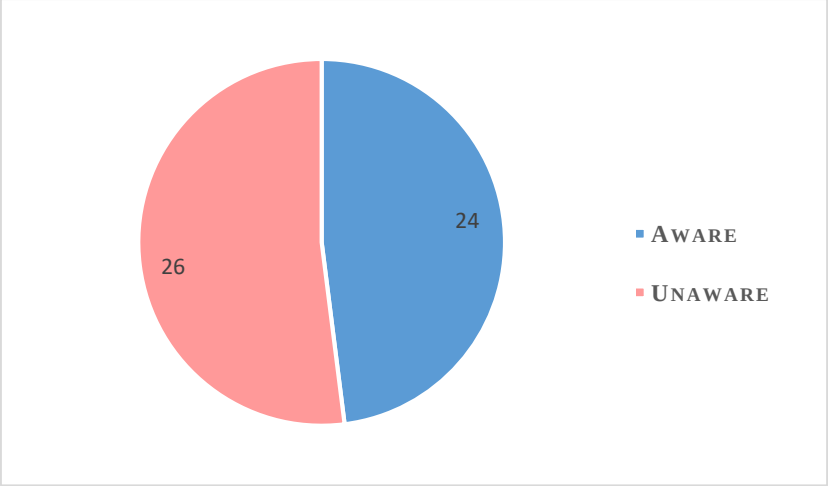
4.2 Knowledge, Attitude and Practice Analysis

4.2.1 KNOWLEDGE:

Table 25. Knowledge about Type 2 Diabetes and its occurrence

Aware	24
Unaware	26
Total	50

Figure 25. Knowledge about Type 2 Diabetes and its occurrence

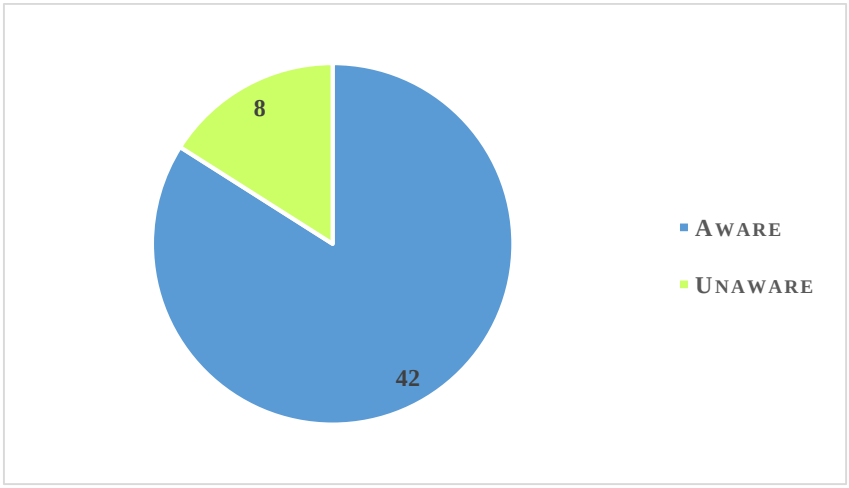


Patients were asked questions on the knowledge of Diabetes, twenty-four patients were aware and twenty-six were unaware. Knowledge about Diabetes is important to manage it effectively.

Table 26. Awareness about the complications of Diabetes

Aware	42
Unaware	8
Total	50

Figure 26. Awareness about the complications of Diabetes

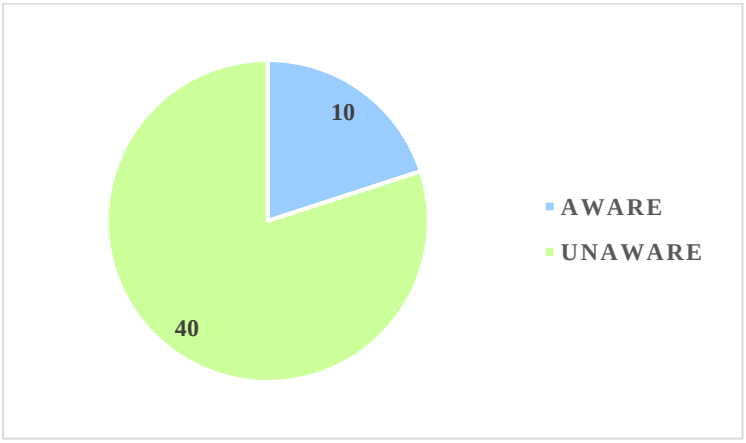


Patients were asked about the complications and the organs that can get affected due to Diabetes, and it was found that about forty-two patients were aware and could correctly answer the organs affected i.e., eyes, kidney and heart, and eight patients did not know the complications.

Table 27. Knowledge on the term Metabolic Syndrome

Aware	10
Unaware	40
Total	50

Figure 27. Knowledge on the term Metabolic Syndrome

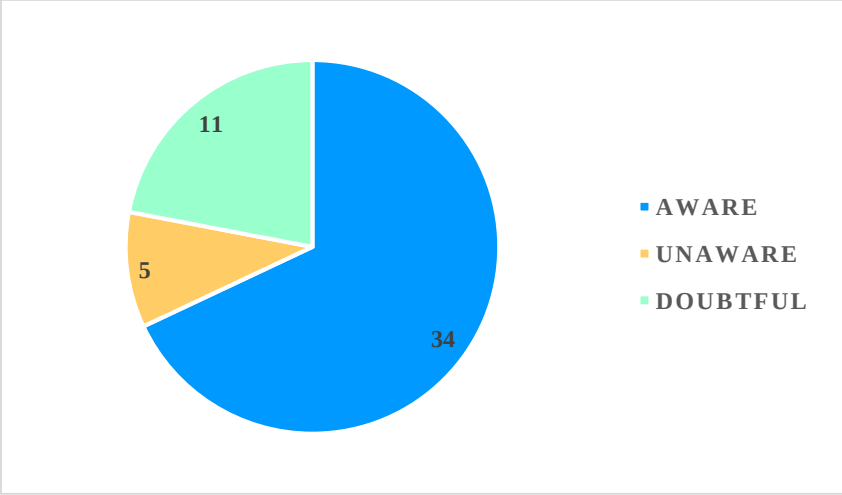


The patients were asked if they ever heard the term Metabolic syndrome; forty patients had never heard the term and the rest ten patients had heard the term but did not know what exactly it meant.

Table 28. Knowledge on the relation between Metabolic Syndrome and Type 2 Diabetes

Aware	34
Unaware	5
Doubtful	11
Total	50

Figure 28. Knowledge on the link between Metabolic Syndrome is related to Diabetes

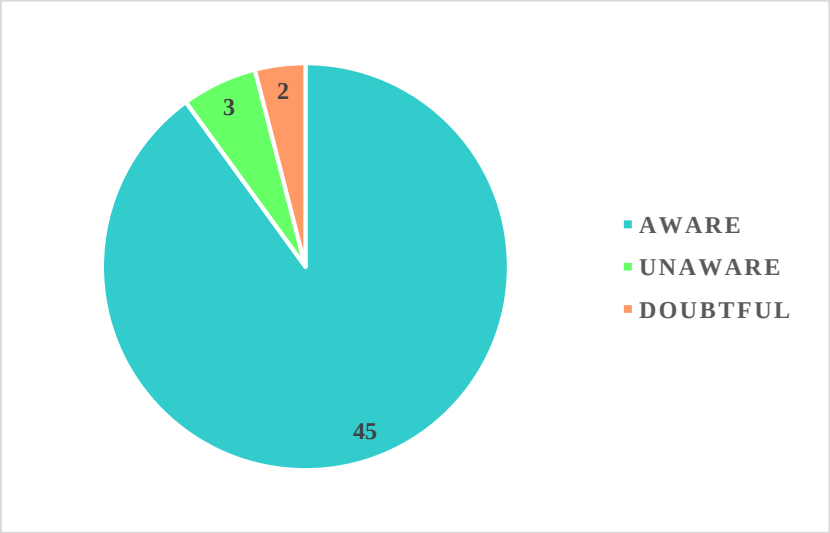


The patients were explained the term Metabolic syndrome and the NCEP ATP III criteria for a person to have Metabolic syndrome, and then the patients were asked if they think Metabolic syndrome and Diabetes could be related; it was found that thirty-four patients believed that there is a relation between Metabolic syndrome and Diabetes, eleven patients were doubtful about this and five patients believed that there could be no relation at all. There is a relation because Insulin resistance which occurs in Type 2 Diabetes is one of the contributory factor for Metabolic syndrome.

Table 29. Knowledge on the development of Metabolic syndrome due to obesity, smoking, alcohol, stress and unhealthy eating practices

Aware	45
Unaware	3
Doubtful	2
Total	50

Figure 29. Knowledge on the development of Metabolic syndrome due to obesity, smoking, alcohol, stress and unhealthy eating practices

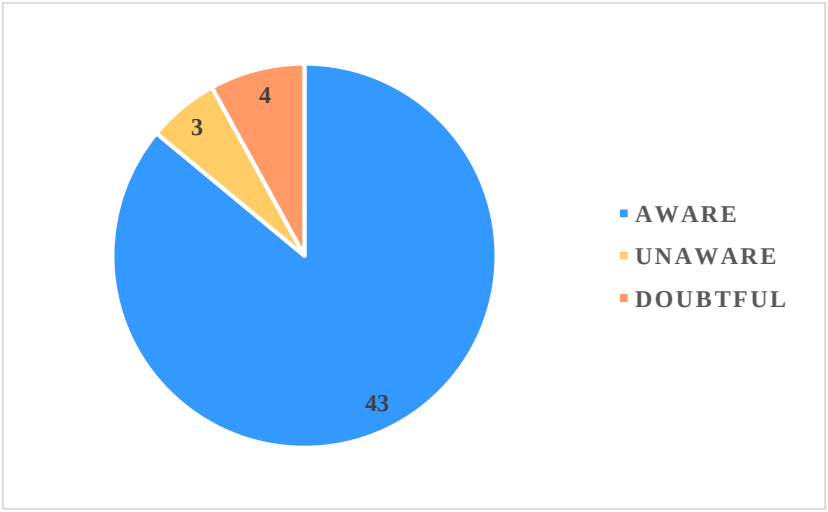


The patients were asked if obesity, smoking, alcohol, stress, unhealthy eating practices could lead to Metabolic syndrome; forty-five patients were aware, two patients found it to be doubtful and three patients were unaware.

Table 30. Knowledge on effect of family history and the chances of developing Metabolic syndrome

Aware	43
Unaware	3
Doubtful	4
Total	50

Figure 30. Knowledge on effect of family history and the chances of developing Metabolic syndrome

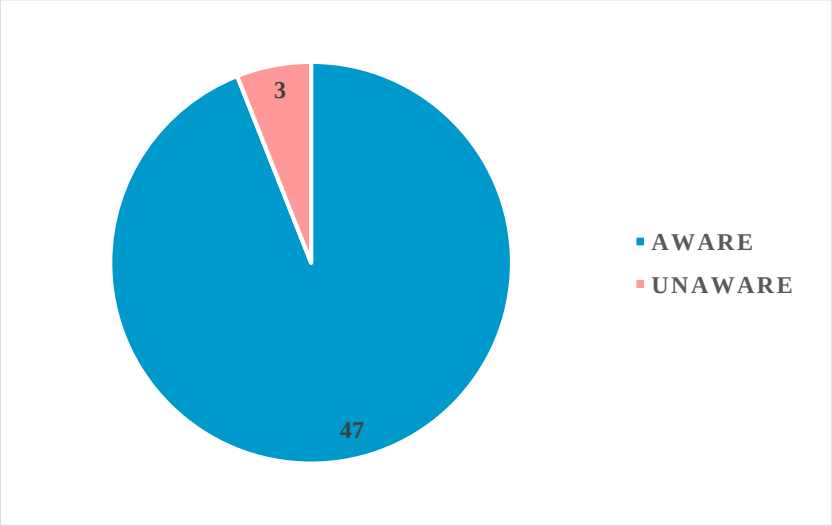


Patients were asked if there were increased chances of having Metabolic syndrome if there was a family history; forty-three patients were aware, three were unaware and four were doubtful.

Table 31. Knowledge about the increased risk for developing Diabetes or Cardiovascular diseases in a person having Metabolic syndrome

Aware	47
Unaware	3
Total	50

Figure 31. Knowledge about the increased risk for developing Diabetes or Cardiovascular diseases in a person having Metabolic syndrome

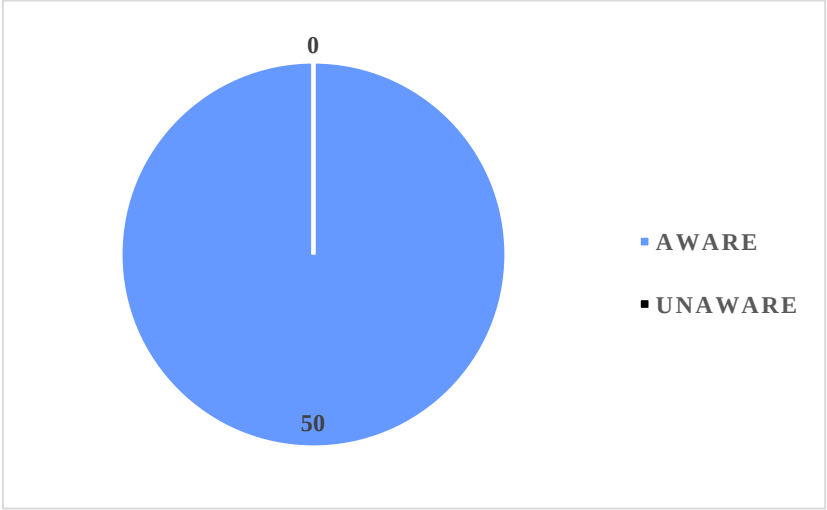


Patients were asked if a person having Metabolic syndrome has increased chances of developing Diabetes or Cardiovascular disease; forty-seven patients were aware and three did not agree to this or were unaware.

Table 32. Knowledge on the importance of awareness about Metabolic syndrome

Aware	50
Unaware	0
Total	50

Figure 32. Knowledge on the importance of awareness about Metabolic syndrome



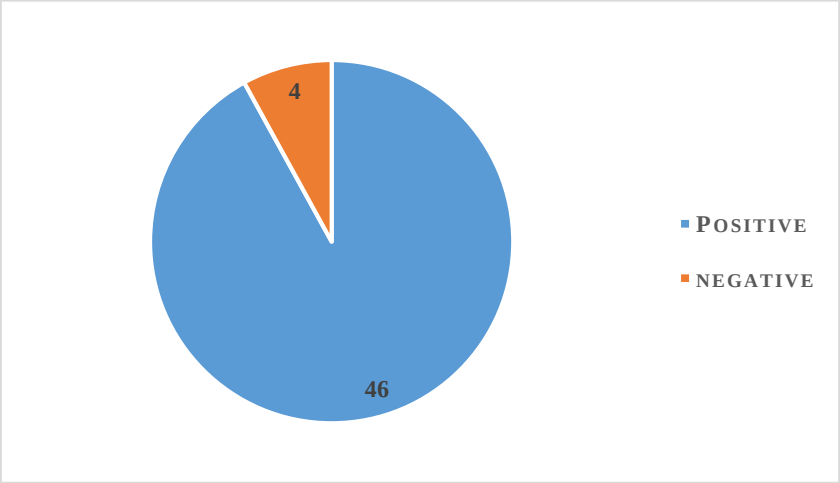
Patients were asked if awareness about Metabolic syndrome was important; all the patients were aware/sure that awareness about a condition is essential. Only if they know what the condition is, can they understand the treatment strategy and the importance of diet and lifestyle modification.

4.2.2 ATTITUDE:

Table 33. Attitude of the subjects on the management of Diabetes and Metabolic syndrome if recently diagnosed with Metabolic Syndrome

Positive Attitude	46
Negative Attitude	04
Total	50

Figure 33. Attitude of the subjects on the management of Diabetes and Metabolic syndrome if recently diagnosed with Metabolic Syndrome

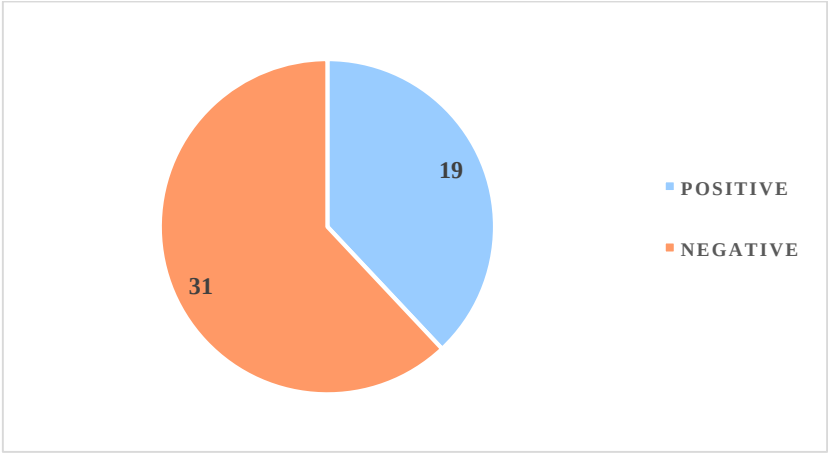


Patients were asked if they are diagnosed with Metabolic syndrome will they be able to manage it along with Diabetes; forty-six patients had a positive outlook towards this and four patients felt they will not be able to manage. The majority of patients in spite of being old, had a positive outlook.

Table 34. Attitude of the subjects on the important role of age in disease management

Positive Attitude	19
Negative Attitude	31
Total	50

Figure 34. Attitude of the subjects on the important role of age in disease management

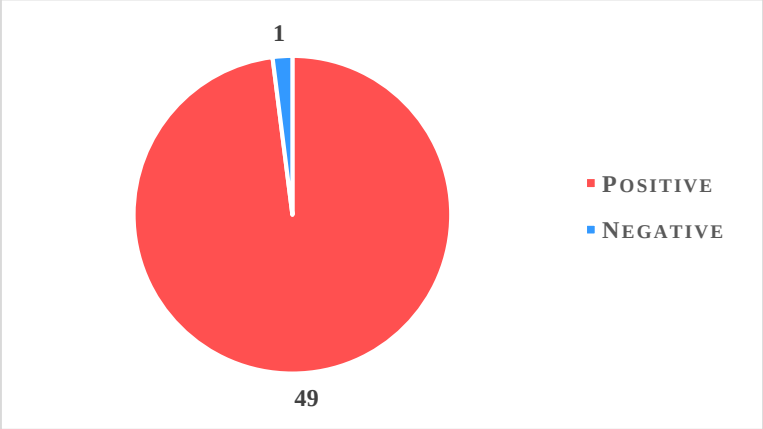


Patients were asked if young people are better able to manage any disease effectively or that age does not play a role in disease management, anyone can manage it with proper medical help; nineteen patients believed that anyone can manage a disease condition effectively with guidance and had a positive attitude and thirty-one patients believed young people are better able to manage any condition better.

Table 35. Attitude of the subjects on the importance of checking the blood sugars and lipid profile every 3 months

Positive Attitude	49
Negative Attitude	1
Total	50

Figure 35. Attitude of the subjects on the importance of checking the blood sugars and lipid profile every 3 months

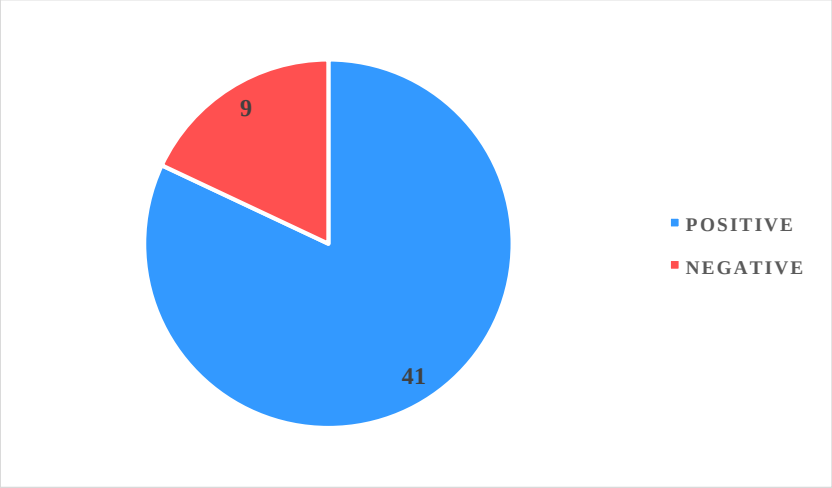


Patients were asked about the importance of getting the blood sugar and lipid profile checked every three months; forty-nine patients had a positive attitude towards getting their blood sugars and lipid profile checked and only one patient had a negative attitude towards this.

Table 36. Attitude on the importance of vegetable consumption for managing blood sugars and Metabolic syndrome

Positive Attitude	41
Negative Attitude	9
Total	50

Figure 36. Attitude on the importance of vegetable consumption for managing blood sugars and Metabolic syndrome

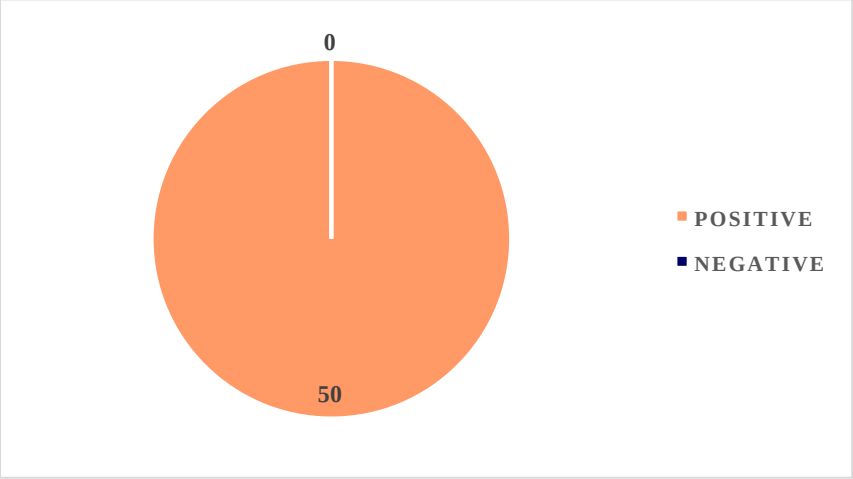


Patients were asked if daily vegetable consumption can help reduce blood sugar levels, forty-one patients said vegetables are important to help reduce blood sugars, as they had a positive attitude and nine patients did not agree to this due to their negative attitude. Vegetables have fiber and thus help in slowing down the release of glucose in the blood and thus preventing the blood sugar spikes.

Table 37. Attitude on the importance of maintaining ideal body weight in preventing the complication of Diabetes and Metabolic syndrome

Positive Attitude	50
Negative Attitude	0
Total	50

Figure 37. Attitude on the importance of maintaining ideal body weight in preventing the complication of Diabetes and Metabolic syndrome

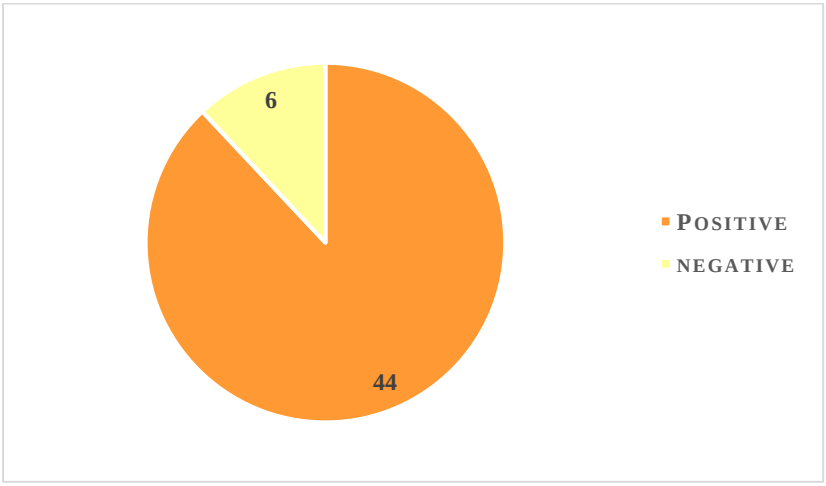


Patients were asked the importance of maintaining weight and all the patients believed that it is important to maintain an ideal body weight.

Table 38. Attitude on the choice of fruit consumption; whole fruit or fruit juice

Whole fruit/ Positive	44
Fruit juice/ Negative	6
Total	50

Figure 38. Attitude on the choice of fruit consumption; whole fruit or fruit juice

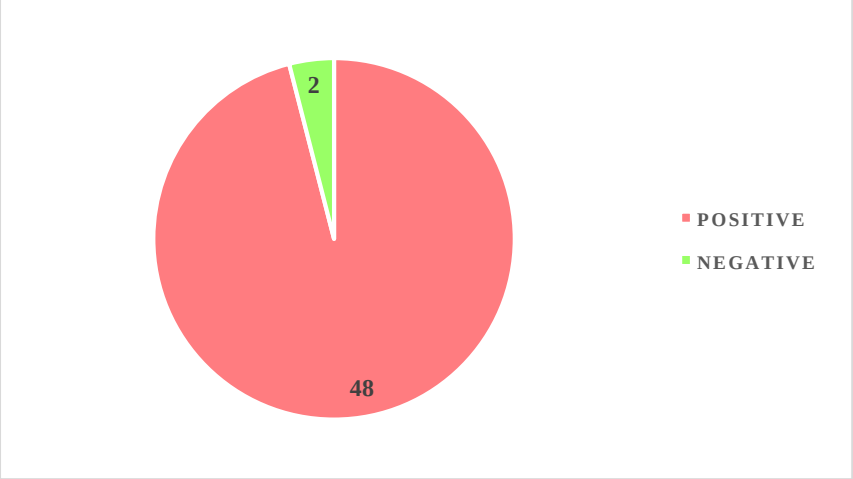


Patients were asked if whole fruit or a raw fruit is better or a fruit juice is better and forty-four patients had a positive attitude and said a whole fruit is better for a person having Diabetes and six people had a negative attitude towards this and said fruit juice is better for a person having Diabetes.

Table 39. Attitude on the importance of nuts

Positive Attitude	48
Negative Attitude	2
Total	50

Figure 39. Attitude on the importance of nuts

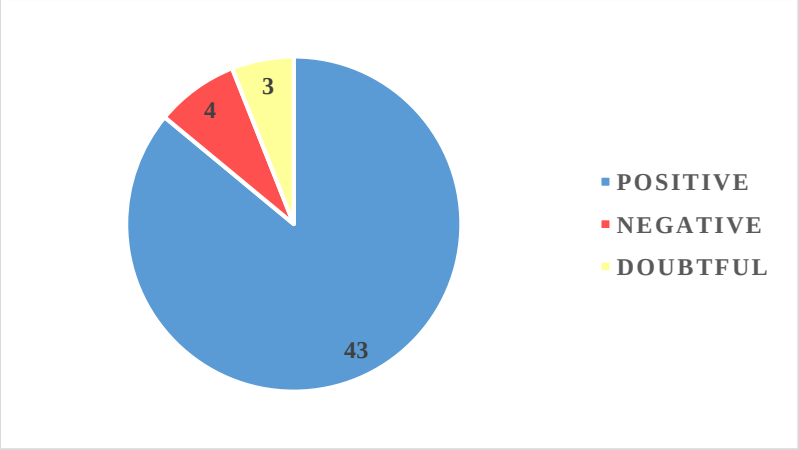


Patients were asked if having nuts is beneficial to our body; forty-eight patients had a positive attitude and also said we should have it in limited amount and 2 patients had a negative attitude said it is not beneficial.

Table 40. Attitude on limiting or quitting smoking alcohol and consumption for preventing the occurrence of Metabolic syndrome

Positive Attitude	43
Negative Attitude	4
Doubtful	3
Total	50

Figure 40. Attitude on limiting or quitting smoking and alcohol consumption for preventing the occurrence of Metabolic syndrome

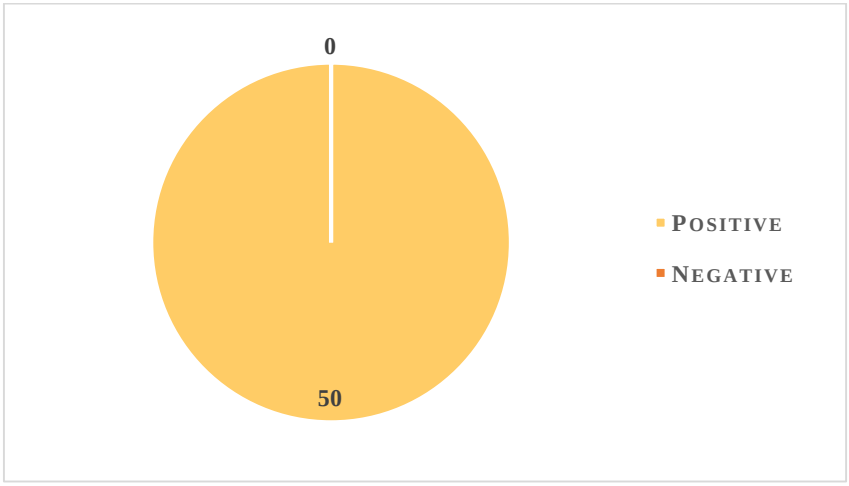


Patients were asked if alcohol consumption should be limited or people should not consume it; forty-three patients had a positive attitude, four had a negative attitude and 3 were doubtful about this.

Table 41. Attitude on the importance of managing stress

Positive Attitude	50
Negative Attitude	0
Total	50

Figure 41. Attitude on the importance of managing stress

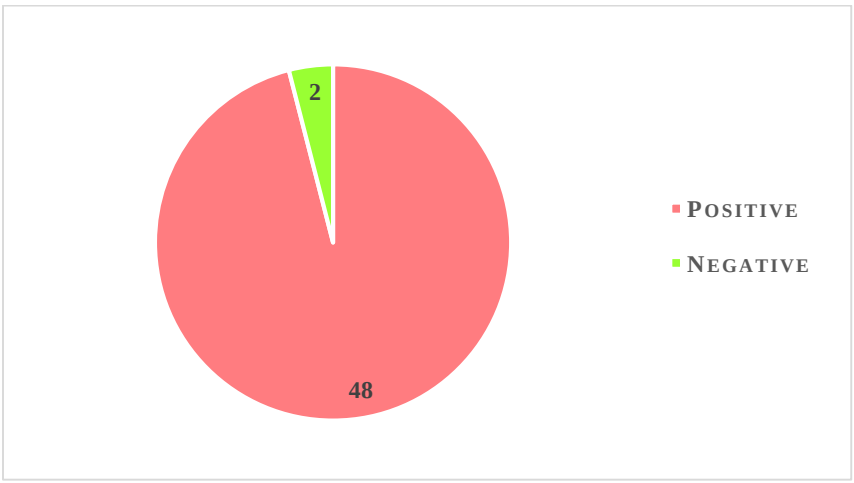


Patients were asked if managing stress was important to stay healthy and all the patients had a positive attitude towards this.

Table 42. Attitude on the importance of chewing food slowly

Positive Attitude	48
Negative Attitude	2
Total	50

Figure 42. Attitude on the importance of chewing food slowly



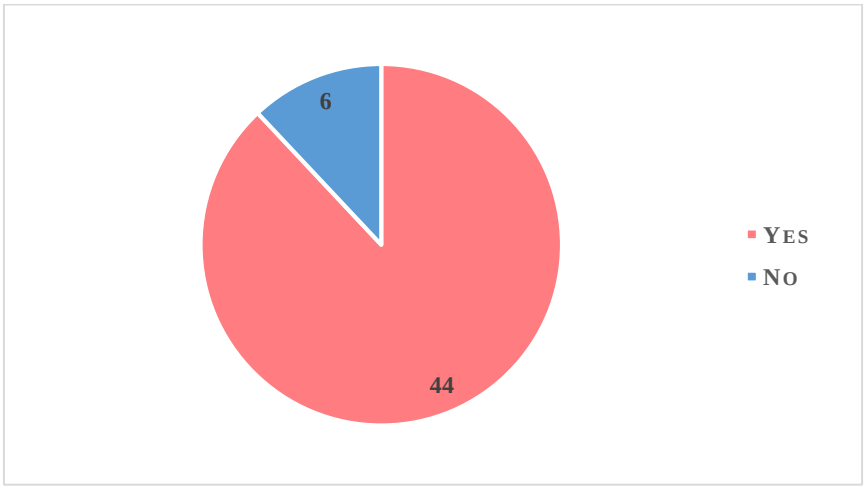
Patients were asked if chewing food slowly was important and forty-eight patients had a positive attitude and two patients had a negative attitude.

PRACTICE:

Table 43. Practice of eating a whole fruit

Yes	44
No	6
Total	50

Figure 43. Practice of eating a whole fruit

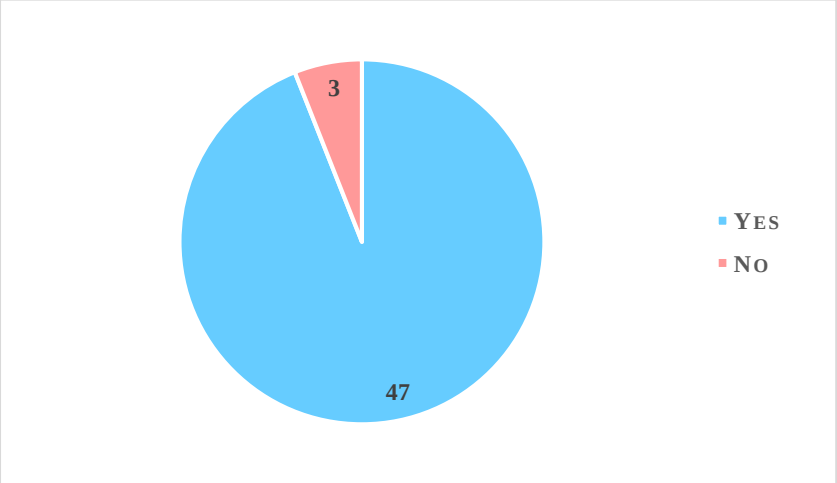


Patients were asked if they eat a whole fruit or have fruit juice; it was found that forty-four had whole fruit and six had it as a juice.

Table 44. Practice of having Green leafy vegetables

Yes	47
No	3
Total	50

Figure 44. Practice of having Green leafy vegetables

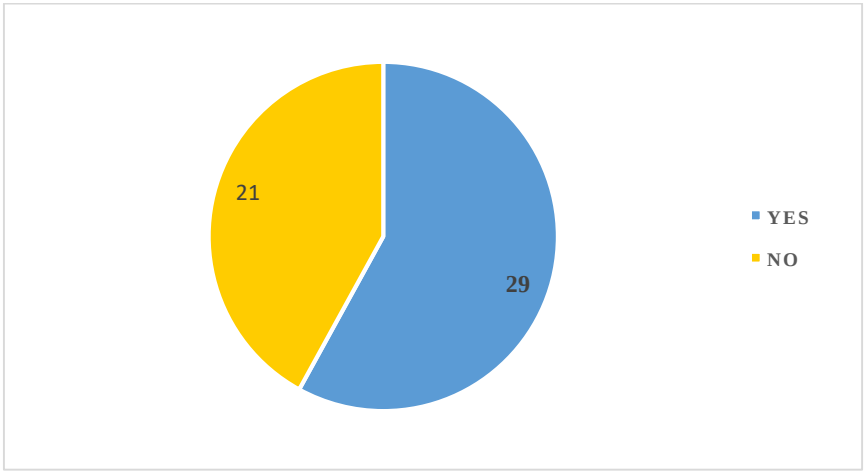


Patients were asked if they had green leafy vegetables; it was found that forty-seven had green leafy vegetables and three did not have them.

Table 45. Practice of monitoring blood sugars using Glucometer at home

Yes	29
No	21
Total	50

Figure 45. Practice of monitoring blood sugars using Glucometer at home

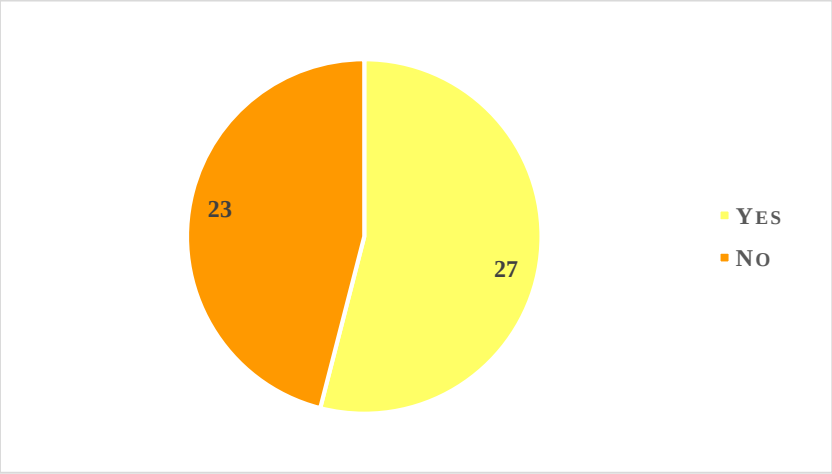


Patients were asked if they monitor their blood sugars at home using a glucometer; and it was found that twenty-nine patients checked their blood sugars using a glucometer at home and twenty-one did not.

Table 46. Practice of using combination of oils

Yes	27
No	23
Total	50

Figure 46. Practice of using combination of oils

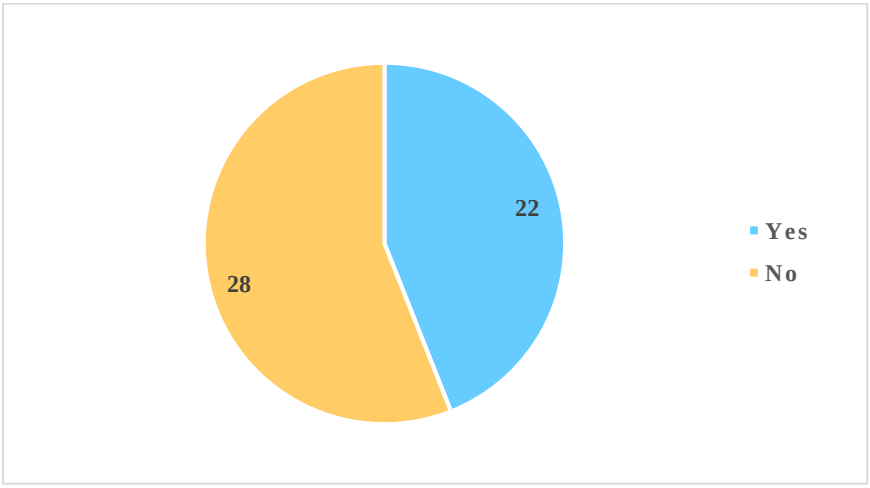


Patients were asked if they use different oils at home; twenty-seven used different oils and the majority oils used were coconut oil, sunflower oil, palm oil, rice bran oil and olive oil, twenty-three patients used only coconut oil.

Table 47. Practice of including pulses every day in your meal

Yes	22
No	28
Total	50

Figure 47. Practice of including pulses every day in your meal

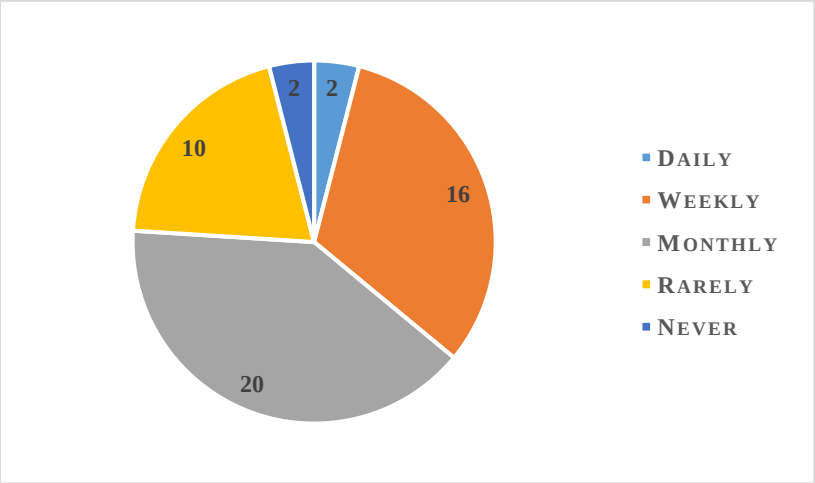


Patients were asked if they eat pulses every day; twenty-two patients had pulses daily and twenty-eight did not. The patients got protein from some form of non veg foods.

Table 48. Practice of eating food from outside

Daily	2
Weekly	16
Monthly	20
Rarely	10
Never	2
Total	50

Figure 48. Practice of eating food from outside

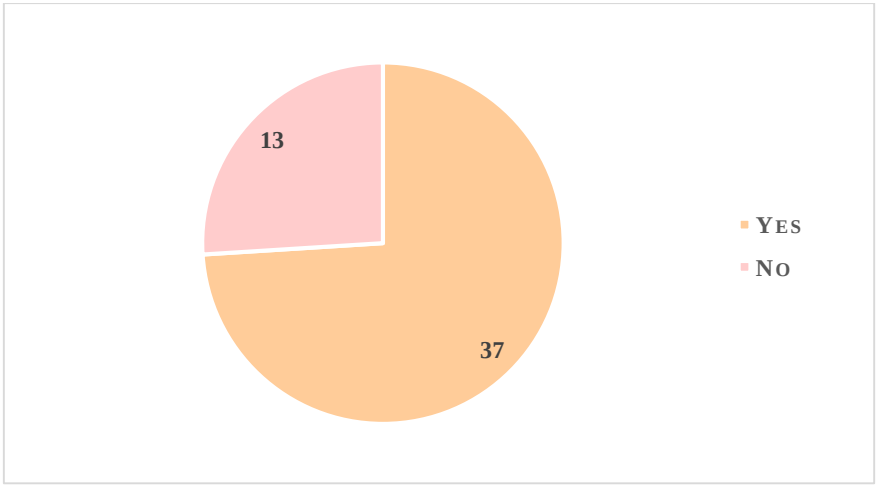


Patients were asked their frequency of snacking from outside; two patients ate from out daily, sixteen patients ate from out weekly, twenty patients monthly, ten patients rarely and two never ate anything from outside.

Table 49. Practice of managing Hypoglycemia by eating a candy or sugar

Yes	37
No	13
Total	50

Figure 49. Practice of managing Hypoglycemia by eating a candy or sugar

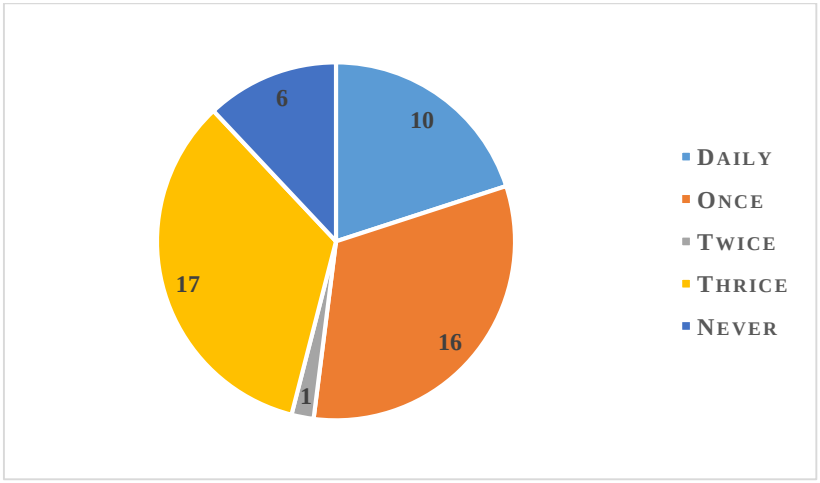


Patients were asked if they manage hypoglycemia by eating a candy or sugar; thirty-seven patients said that they eat a chocolate or something sweet and thirteen patients said they did not experience hypoglycemia, so were not aware about this.

Table 50. Practice of eating fish in a week

Daily	10
Once	16
Twice	1
Thrice	17
Never	6
Total	50

Figure 50. Practice of eating fish in a week

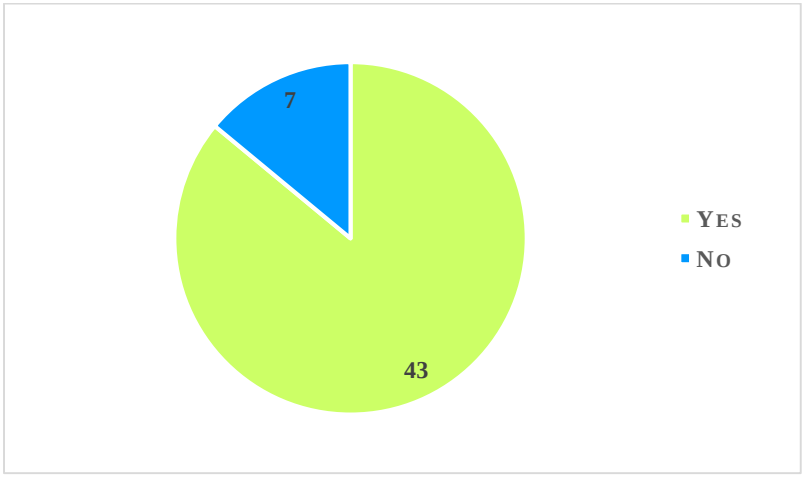


Patients were asked about their fish consumption pattern. Ten patients had fish daily, sixteen patients had fish once a week, one patient had fish twice a week, seventeen patients had fish thrice a week, six patients never had fish.

Table 51. Practice of consuming 8 glasses water everyday

Yes	43
No	7
Total	50

Figure 51. Practice of consuming 8 glasses water everyday

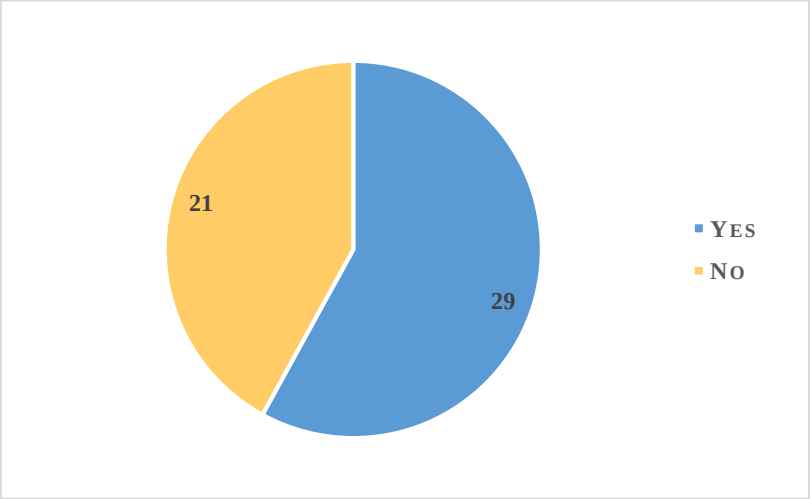


The water consumption pattern of patients was recorded and it was found that; forty-three patients drank 8 glasses water every day and seven patients did not consume 8 glasses water daily.

Table 52. Practice of checking HbA1C levels checked every 3 months

Yes	29
No	21
Total	50

Figure 52. Practice of checking HbA1C levels checked every 3 months



Patients were asked if they checked their HbA1C levels every 3 months; twenty-nine patients checked it every 3 months and twenty-one patients did not get it checked.

4.2.3 CORELATION BETWEEN KNOWEDGE, ATTITUDE AND PRACTICE OF SELECTED PATIENTS:

A) Correlation between intake of carbohydrate, protein, fat, fiber and incidence of Metabolic syndrome:

Figure 53. Correlation between Carbohydrate intake and incidence of Metabolic syndrome

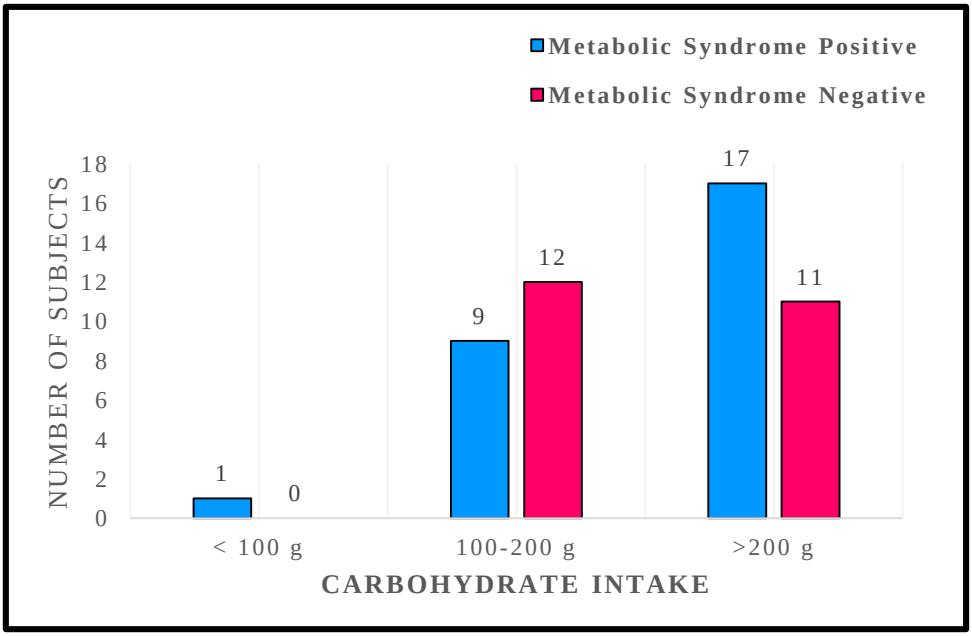


Figure 54. Correlation between Protein intake and incidence of Metabolic syndrome

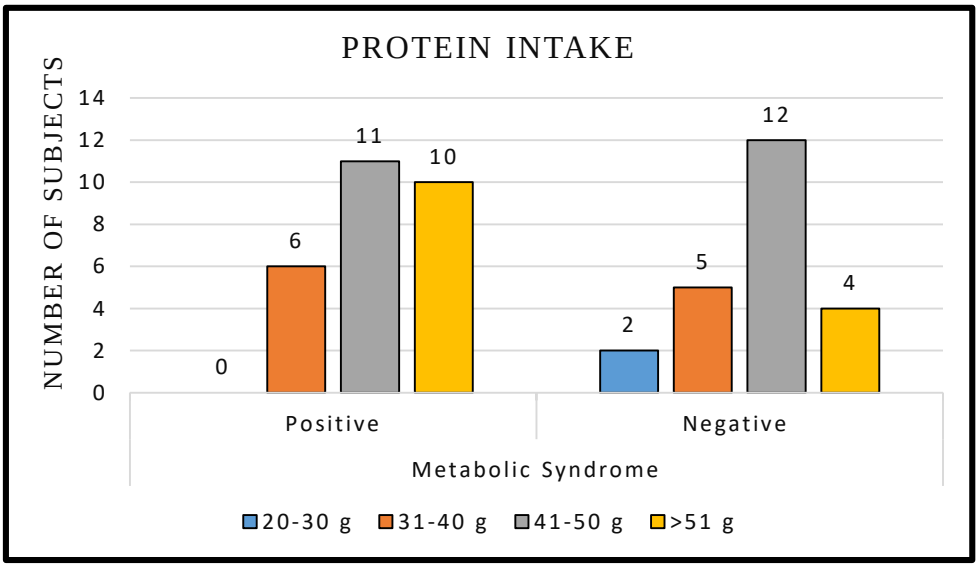


Figure 55. Correlation between Fat intake and incidence of Metabolic syndrome

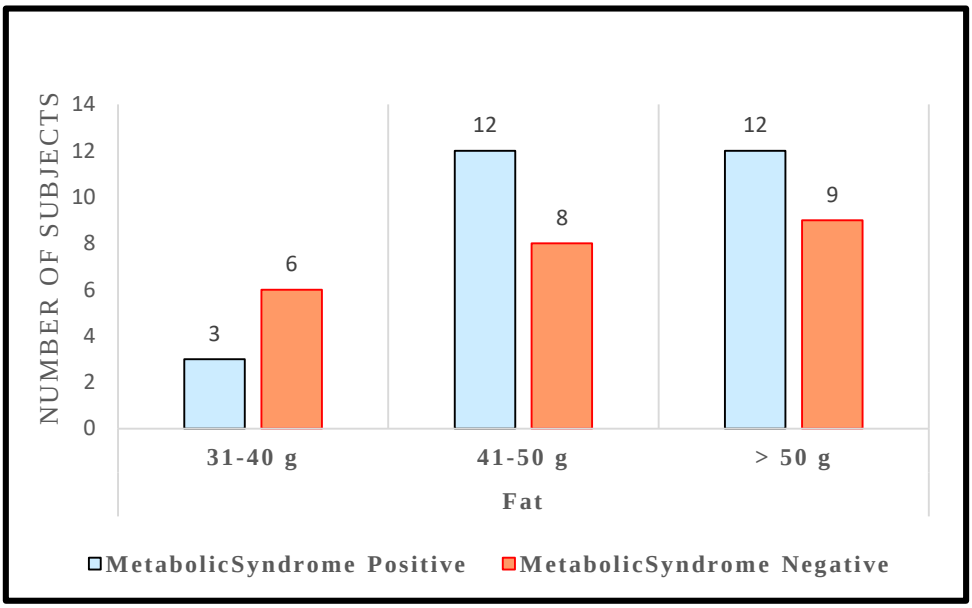
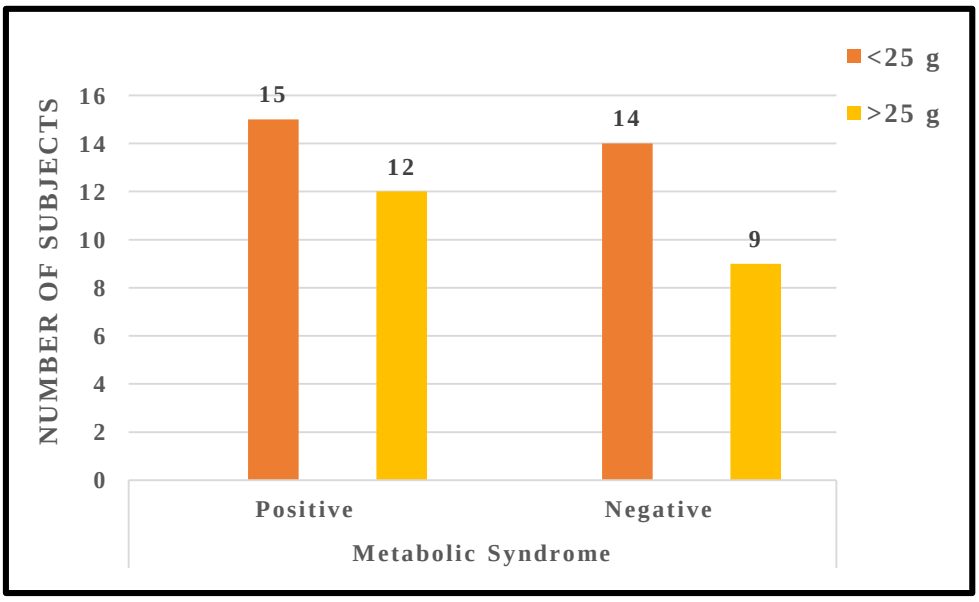


Figure 56. Correlation between Fiber intake and incidence of Metabolic syndrome



The above figures indicate the intake of carbohydrate, protein, fat, fiber and incidence of Metabolic syndrome. It was observed that people who consumed increased amounts of carbohydrates, the incidence of Metabolic syndrome was greater. Twenty-eight out of fifty patients had a daily carbohydrate intake of > 200 g, out of which seventeen had

Metabolic syndrome. Moderate carbohydrate consumption i.e., 100-200 g was consumed by twenty-one patients out of which nine had Metabolic syndrome. < 100 g carbohydrate was consumed by one patient and he had Metabolic syndrome. It can be interfered that high carbohydrate intake along with other factors (high fat intake, low fiber intake) can be a reason for the increased incidence of Metabolic syndrome.

Two patient had a protein intake of 20-30 g and they did not have Metabolic syndrome, eleven patients had a protein intake of 31-40 g out of which six had Metabolic syndrome, twenty-three patients had a protein intake of 41-50 g out of which eleven had Metabolic syndrome, fourteen patients had a protein intake of > 50 g out of which ten had Metabolic syndrome. It can therefore be interpreted that a complex of factors led to high incidence of Metabolic syndrome even at high protein intakes.

The fat intake was grouped as 31-40 g, 41-50 g and > 50 g. Nine patients had a fat intake of 31-40 g of which three had Metabolic syndrome; twenty patients had a daily fat intake of 41-50 g and twelve of them had Metabolic syndrome; twenty-one patients had a daily fat intake of > 50 g and twelve of which had Metabolic syndrome. Higher fat intake was associated with increased Triglyceride levels and thus increased incidence of Metabolic Syndrome.

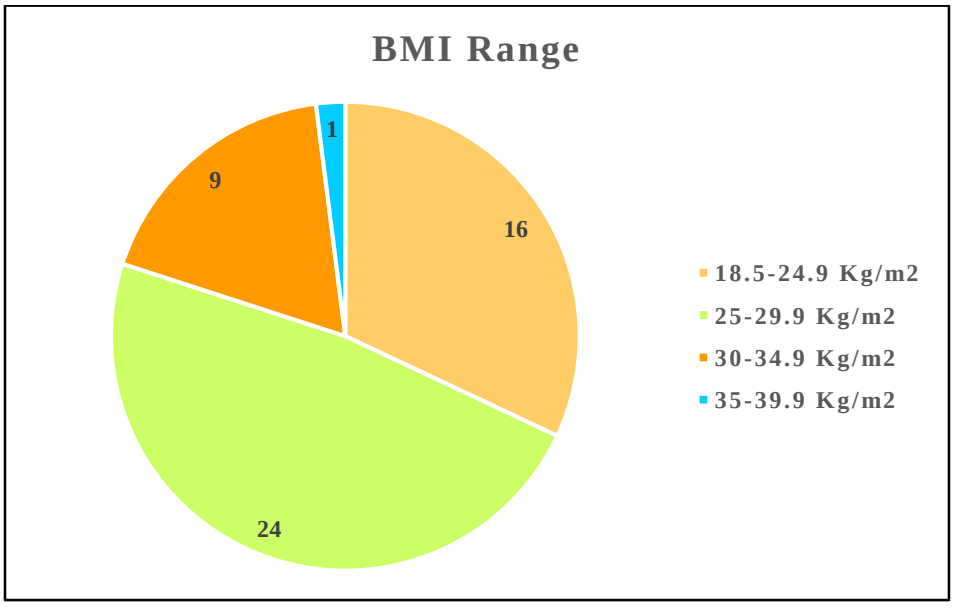
Patients were grouped based on the fiber intake of < 25 g and > 25 g. 58% of patients had a fiber intake of < 25 g, out of which fifteen had Metabolic syndrome, 42% of patients had a fiber intake of > 25 g, out of which twelve had Metabolic syndrome. It can be associated that low fiber intake along with other dietary factors is associated with increased incidence of Metabolic syndrome.

B) Correlation between the knowledge on maintaining weight and the Actual practices reflected in their BMI:

Table 53. (i) Knowledge on the importance of maintaining an ideal body weight to stay away from complications of Diabetes Mellitus and (ii) Knowledge on the importance of weight reduction to reduce blood sugar levels

	(i)	(ii)
Aware	50	43
Unaware	0	7
Total	50	50

Figure 57. BMI range of selected patients



During the interview schedule when the patients were asked if maintaining body weight is important to stay away from the complications of Diabetes, all fifty patients were

aware about this, which concludes that they have the knowledge about the importance of maintaining weight; and when they were asked if weight reduction helps in lowering blood sugar levels, forty-three patients agreed and seven disagreed to it.

But while assessing their actual practice using the BMI classification, it can be seen that only sixteen patients had a normal BMI between 18.5-24.9 Kg/m^2, twenty-four patients were in the pre obese range of 25-29.9 Kg/m^2, nine patients were in the Obese class I range of 30-34.9 Kg/m^2, one patient was in the Obese class II range of 35-39.9 Kg/m^2. It is evident that though the patient had the knowledge of the importance of maintaining ideal body weight, their current weight was on the higher side.

C) Correlation between unhealthy eating and the risk of developing Diabetes and Metabolic syndrome versus the actual food consumption pattern:

Table 54. Knowledge on the increased chances of developing Diabetes and Metabolic syndrome due to unhealthy eating habits, high fat foods and processed foods

Aware	49
Unaware	1
Total	50

Figure 58. Frequency of eating outside

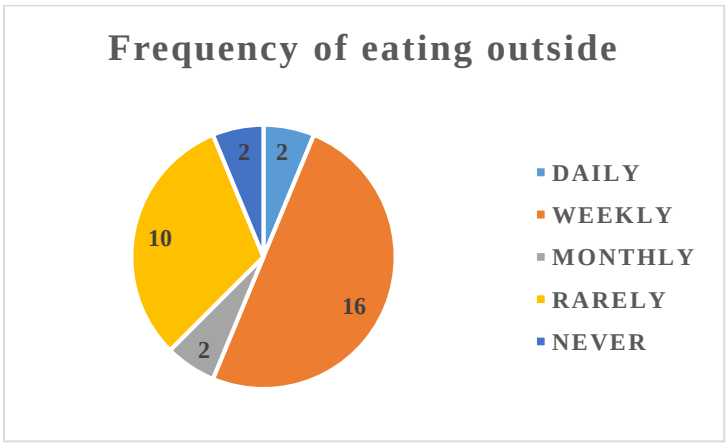


Figure 59. Chips, puffs, bakery item consumption

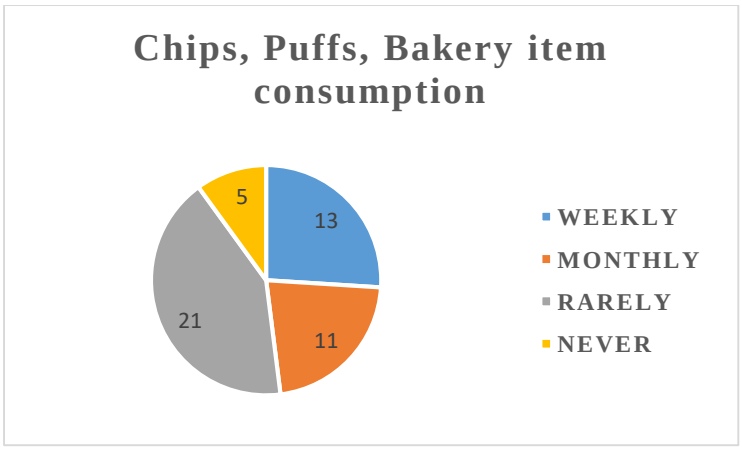
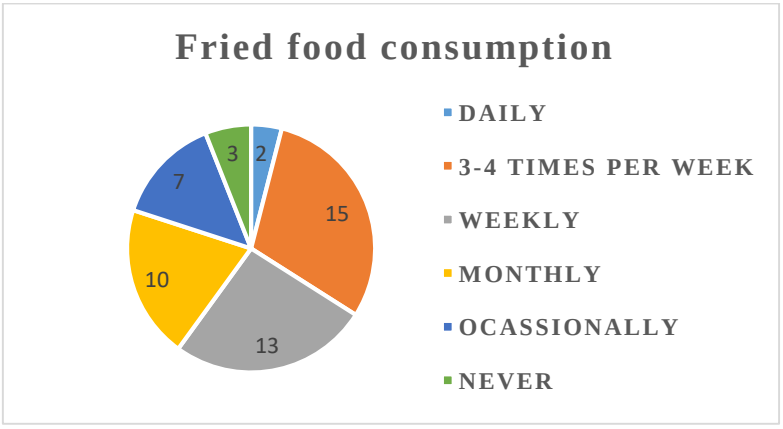


Figure 60. Fried food consumption



When the patients were asked if unhealthy foods, processed foods and high fat foods increase the chances of developing Diabetes and Metabolic syndrome, forty-nine patients were aware. it can be inferred that patients have knowledge about the risks associated with unhealthy eating.

But while assessing their actual practice in terms of the frequency of eating outside, it was found that two patients ate out daily, sixteen patients ate out weekly, two patients ate out monthly and two rarely ate from outside.

Patients consumption of chips, puffs, and other bakery items was also recorded and it was found that thirteen patients had these weekly, eleven patients had these monthly, twenty-one patients had these rarely and five never had these.

Patients consumption of fried foods indicated that two out of fifty patient had some fried food daily, fifteen of them had fried foods 3-4 times per week, thirteen of them had it at least once a week, ten had it monthly and seven of them never had fried foods.

It can be inferred that though the patients have the knowledge of healthy eating, they sometime tend to not follow those in their practice. Fried foods were maximum consumed during the evening snack time along with tea. It is therefore important to explain the patients about the healthy alternatives for the fried foods.

D) Correlation between Daily Fat intake and Triglyceride levels of the patients:

Figure 61. Daily fat intake of selected subjects

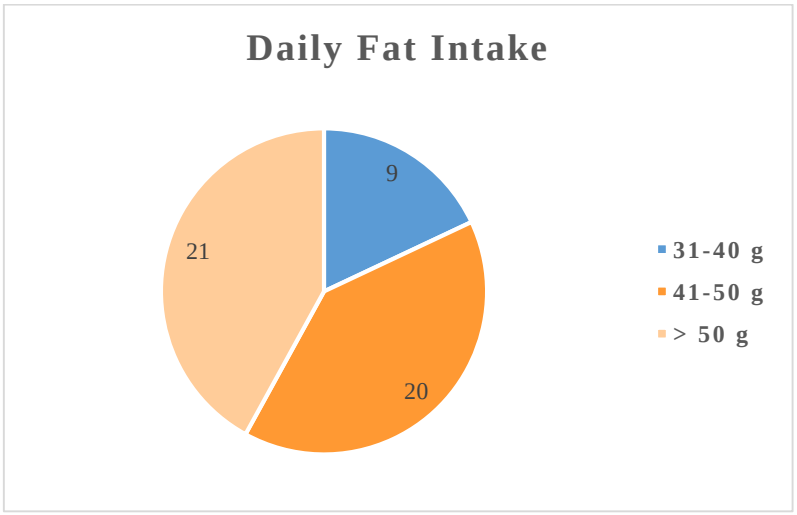
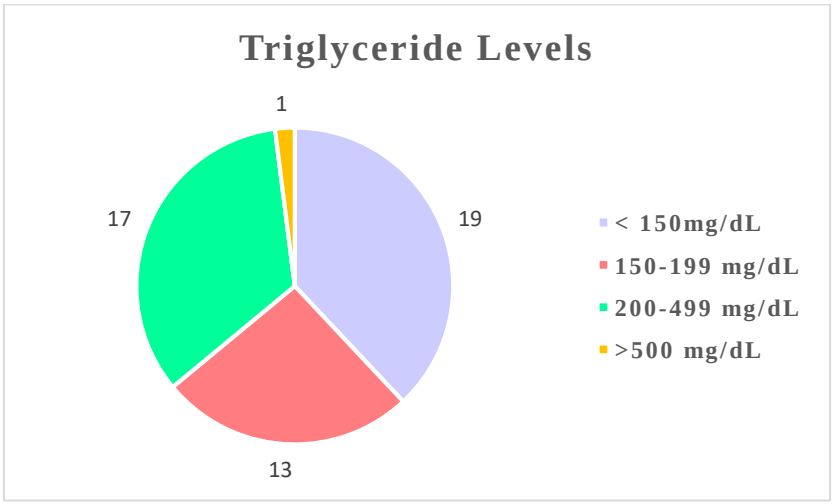


Figure 62. Triglyceride level of selected subjects



The daily fat intake of nine patients was between 31-40 g, twenty patient consumed about 41-50 g fat and twenty-one patients consumed > 50 g fat daily.

The triglyceride level of nineteen patients was normal i.e., < 150 mg/dL, twenty-two patients had a higher triglyceride level of > 150 mg/dL. It can be inferred that a high fat intake leads to a high triglyceride levels.

E) Correlation between knowledge of fiber consumption and their actual consumption pattern:

Figure 63. Knowledge on the importance of fiber rich foods help to control the blood sugar levels

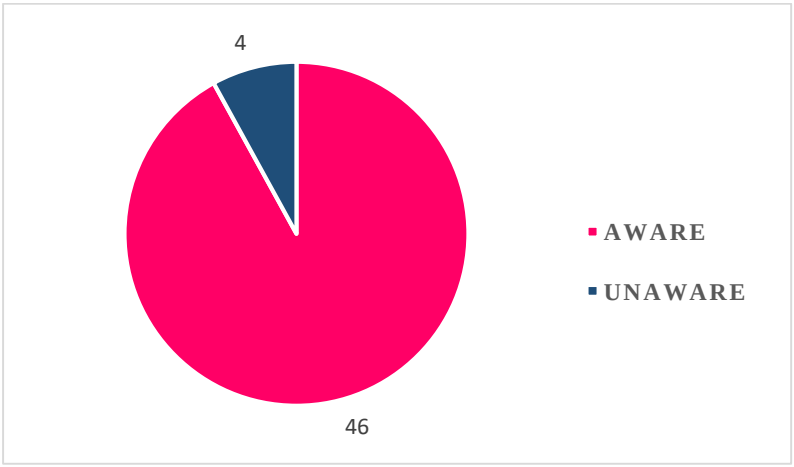


Figure 64. Fiber consumption of selected subjects

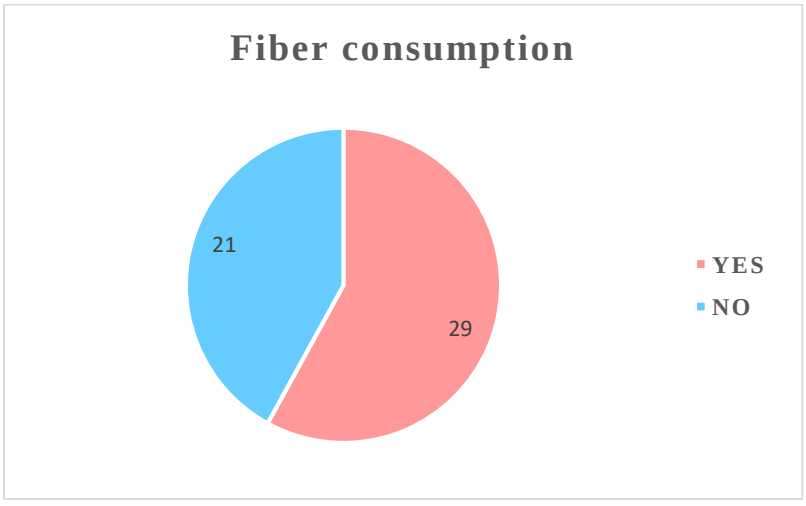
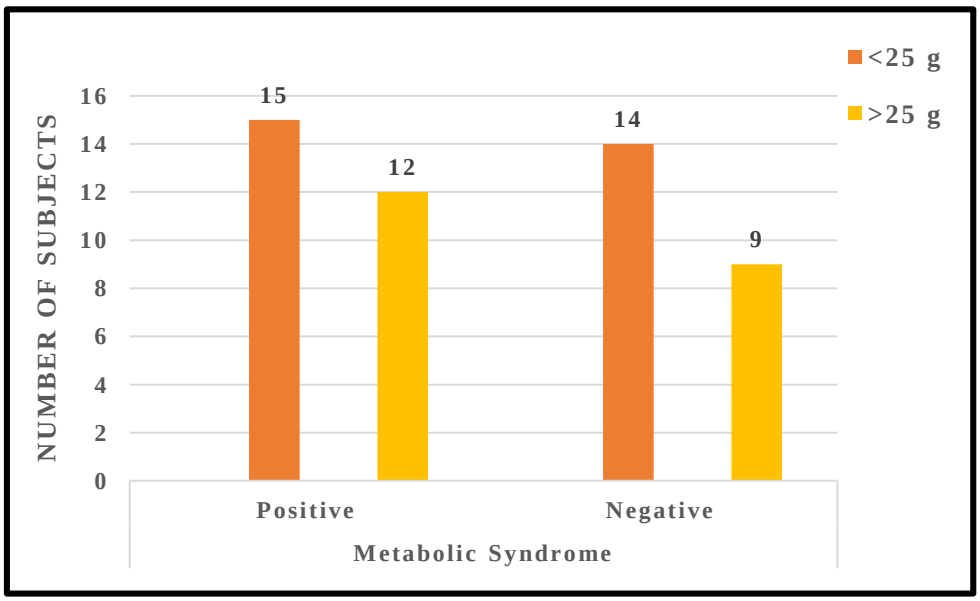


Figure 65. Fiber intake and Metabolic Syndrome



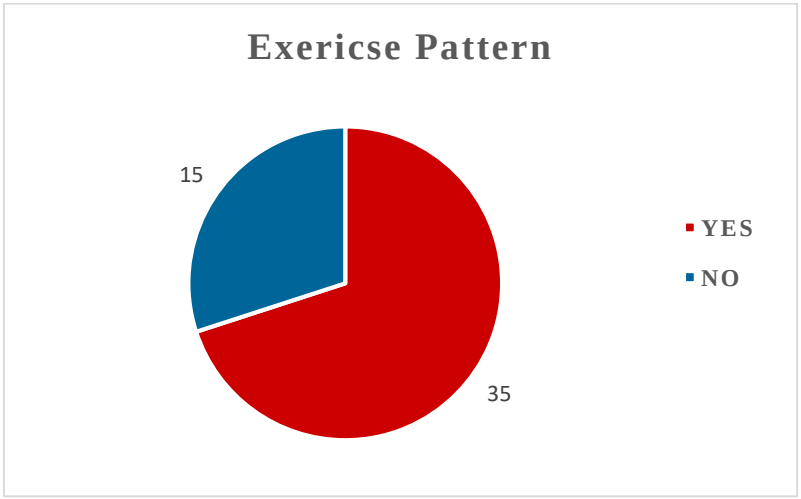
When the patients were asked about the importance of fiber in controlling blood sugar levels, forty-six patients believed that high fiber foods help to lower blood sugar levels and four of them disagreed to this fact. But when their actual fiber eating practice were analyzed, it was observed that the twenty-nine patients had fiber daily and twenty-one did not take fiber. The total fiber intake of twenty-nine patients was < 25g and only twenty-one patients had a daily fiber intake of > 25 g.

F) Correlation between the knowledge of the importance of exercise versus the actual exercise pattern:

Table 55. Knowledge on the importance of exercise can help to manage Diabetes and Metabolic Syndrome

Aware	50
Unaware	0
Total	50

Figure 66. Daily exercise pattern of selected subjects



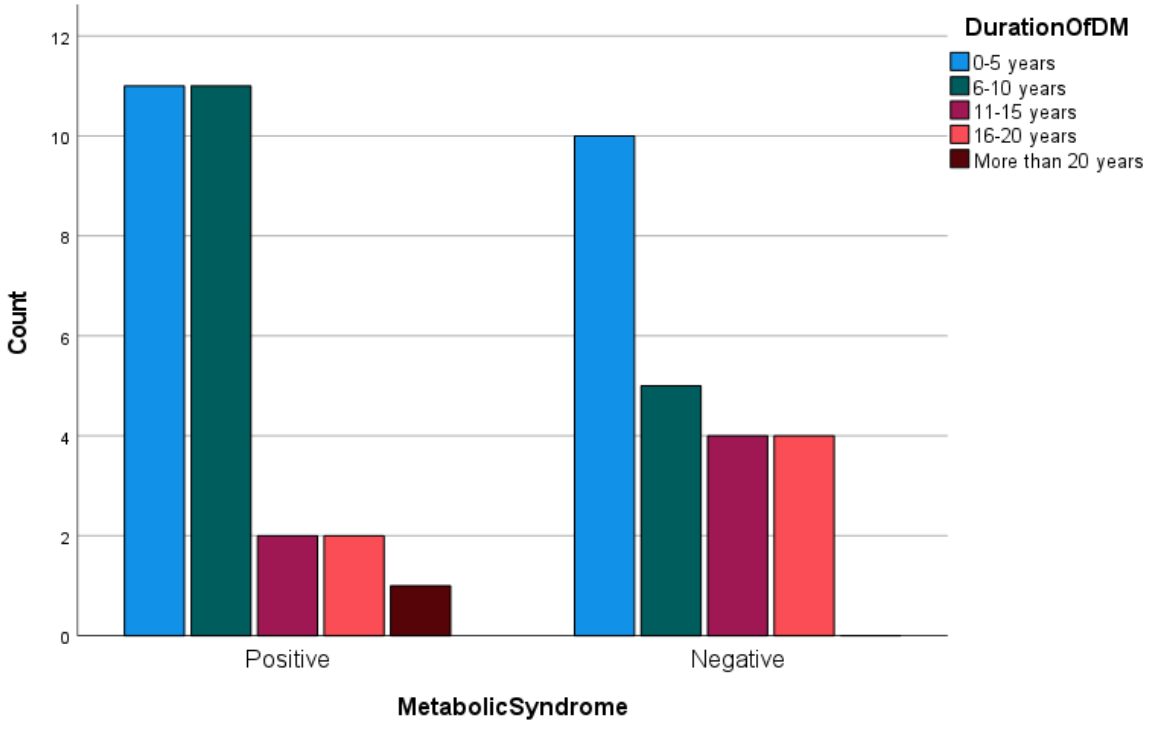
When asked about the importance of exercise, all the patients believed that exercise is important to help reduce blood sugar levels, but when asked about their daily exercise pattern, only thirty-five patients did some exercise daily and fifteen patients did not do any exercise.

G) Correlation between Duration of Diabetes and incidence of Metabolic Syndrome:

Table 56. Duration of Diabetes and incidence of Metabolic syndrome incidence

		Metabolic Syndrome		Total
		Positive	Negative	
Duration of Diabetes Mellitus	0-5 years	11	10	21
	6-10 years	11	5	16
	11-15 years	2	4	6
	16-20 years	2	4	6
	More than 20 years	1	0	1

Figure 67. Duration of Diabetes and incidence of Metabolic syndrome incidence



Metabolic syndrome is a group of interconnected factors namely lipid abnormalities, high blood pressure, diabetes or pre-diabetes that are seen in an individual. It is a complex web of metabolic factors that have a 2-fold risk of cardio vascular diseases and a 5-fold risk of Diabetes (Lee Lana et al., 2012).

Diabetes and Metabolic syndrome are related to each other. The duration of Diabetes was categorized as 0-5 years, 6-10 years, 11-15 years, 16-20 years and > 20 years. It was observed that twenty-one patients had Diabetes for 0-5 years and that higher incidence of Metabolic syndrome was found in this category i.e., eleven patients had Metabolic syndrome, sixteen patients had Metabolic syndrome for 6-10 years and eleven of them had Metabolic syndrome, six patients had Diabetes for 11-15 years and two of them had Metabolic syndrome, six patients had Diabetes for 16-20 years and two of them had Metabolic syndrome, one patient had Diabetes for more than 20 years and also had Metabolic syndrome. Metabolic syndrome was found to be present in Diabetic patients in all the duration range. As the number of years of having Diabetes increases, people become more familiar with the condition and manage them better hence the reduced incidence of Metabolic syndrome in patients having Diabetes for more than 11 years.

4.2.4 Mean and Standard Deviation

Table 57. Mean anthropometric results of selected subjects

Anthropometric Measurements	Standard	Mean and Standard Deviation
Waist circumference (cm)	≤88 cm (NCEP ATP III Criteria)	86.42±10.72
BMI (Kg/m^2)	18.5 – 24.9 Kg/m^2 (WHO)	27.26±3.82

Among the 50 subjects, the mean waist circumference (86.42±10.72) was within the range of the standard value. However, due to the COVID 19 pandemic, some of the patients were not willing to get their waist circumference measured, so the waist size was taken into account. So there could be deviation in the values.

Among the 50 subjects, the mean BMI (27.26±3.82) was higher the standard range of 18.5-24.9 kg/m^2.

Table 58. Mean Biochemical results of selected subjects

Biochemical Parameters	Standard (NCEP ATP III Criteria)	Mean and Standard Deviation
Fasting Blood Sugar	≥110 mg/dL	162.96±52.18
Systolic Blood Pressure	≥ 130 mm Hg	136.06±16.6
Diastolic Blood Pressure	≥ 85 mm Hg	79.14±8.76
Triglyceride	≥ 150 mg/dL	188.56±86.26
HDL	< 40 mg/dL	50.98±6.93

Among the selected 50 subjects, the mean fasting blood glucose level (162.96±52.18) was higher than the standard value of ≥110 mg/dL. The mean systolic blood pressure value (136.06±16.6) was slightly higher than the standard value. The mean diastolic blood pressure was (79.14±8.76) was lower than the standard value. The mean triglyceride value (188.56±86.26) was higher than the standard value. The mean HDL value (50.98±6.93) was higher than the standard value.

Table 59. Mean Nutrient intake of selected subjects

Nutrient	Standard (ICMR 2020)	Mean and Standard Deviation
Energy	1880 Kcal	1505.71±271.3
Protein	39.6 g	46.13±11.04
Fat	22.5 g	49.67±10.29

The mean energy intake (1505.71±271.3) of the selected subjects was lower than the standard ICMR recommendation of 2020. The mean protein intake (46.13±11.04) was higher than the standard value. The mean fat intake (49.67±10.29) was higher than the standard value.

4.3 Testing of Hypothesis

4.3.1 Pearson correlation test results

Pearson correlation test were used to find out the correlation between the variables.

Table 60. Correlation between Calorie intake and Fasting blood sugar

		Calorie intake	Fating Blood Sugar
Calorie intake	Pearson correlation	1	.371**
	Sig. (2 tailed)		.008
	N	50	50
Fating blood sugar	Pearson correlation	.371**	1
	Sig. (2 tailed)	.008	
	N	50	50

**. Correlation is significant at the 0.01 level (2-tailed).

Null hypothesis was formulated as “there is no correlation between calorie intake and fasting blood sugar”, and the alternative hypothesis was formulated as “there is correlation between the two variables.” It was examined that there is correlation between the two variables with a r value of .371. the p value of .008 indicates that there is statistically significant correlation between the two variables. Thus the null hypothesis formulated was rejected and the alternative hypothesis was accepted.

Table 61. Correlation between Fat intake and Serum Triglycerides levels

		Triglycerides	Fat Intake
Triglyceride	Pearson correlation	1	-0.151
	Sig. (2 tailed)		.294
	N	50	50
Fat Intake	Pearson correlation	-0.151	1
	Sig. (2 tailed)	.294	
	N	50	50

Null hypothesis was formulated as “there is no correlation between fat intake and triglyceride values.” And the alternative hypothesis as “there is a correlation between fat intake and triglyceride.” It was interpreted that there is a negative correlation between fat intake and triglyceride with a r = -0.151 and p = 0.294 indicates that there is no statistically significant correlation between the two variables. Thus the null hypothesis was rejected and alternative hypothesis was accepted.

Table 62. Correlation between Calorie intake and Body Mass Index

		Calorie intake	BMI
Calorie intake	Pearson correlation	1	-.293*
	Sig. (2 tailed)		.039
	N	50	50
BMI	Pearson correlation	.293*	1
	Sig. (2 tailed)	.039	
	N	50	50

*. Correlation is significant at the 0.01 level (2-tailed).

The null hypothesis was formulated as “there is no correlation between calorie intake and BMI” and the alternative hypothesis was formulated as “there is correlation between calorie intake and BMI.” The Pearson value (r) of -0.293 indicates that there is a negative correlation between the two variables. The p value of 0.039 indicates that there is a statistically significant correlation between the two variables. Thus the null hypothesis was rejected and alternative hypothesis was accepted.

Table 63. Correlation between Fat intake and Body Mass Index

		Fat intake	BMI
Fat intake	Pearson correlation	1	.012
	Sig. (2 tailed)		.936
	N	50	50
BMI	Pearson correlation	.012	1
	Sig. (2 tailed)	.936	
	N	50	50

The null hypothesis was formulated as “there is no correlation between fat intake and BMI” and the alternative hypothesis was formulated as “there is a correlation between fat intake and BMI.” The r value of 0.012 indicates that there is a weak correlation between fat intake and BMI. The p value of 0.936 indicates that the variables are not statistically significantly correlated. Thus the null hypothesis was rejected and alternative hypothesis was accepted.

Table 64. Correlation between Body Mass Index and Serum Triglycerides levels

		BMI	Triglycerides
BMI	Pearson correlation	1	-.041
	Sig. (2 tailed)		.775
	N	50	50
	Sig. (2 tailed)	.775	
	N	50	50

The null hypothesis was formulated as “there is no correlation between BMI and Triglycerides” and the alternative hypothesis was formulated as “there is a correlation between BMI and Triglycerides.” The Pearson value (r) of -0.041 indicates that there is a weak negative correlation between BMI and Triglycerides. The p value of 0.775 shows that the variables are not statistically significantly correlated. Thus the null hypothesis was rejected.

SUMMARY AND CONCLUSION

5. SUMMARY AND CONCLUSION

Metabolic Syndrome is a collection of interrelated factors which include abdominal obesity, dyslipidaemia, hypertension, insulin resistance that increases a person's risk for Cardiovascular diseases and Diabetes. It is a serious condition which can be modified by lifestyle modifications: physical activity and dietary modifications. The study entitled **PREVALANCE AND KAP STUDY OF METABOLIC SYNDROME IN TYPE 2 DIABETIC PATIENTS** was undertaken with the following objectives: to check the prevalence of Metabolic syndrome in Type 2 Diabetic patients, to assess the knowledge, attitude and practice of patients about Type 2 Diabetes and Metabolic syndrome, to estimate the nutritional status of the patients, to create an intervention program to create awareness among the people.

The study was initiated by collecting as much data regarding Metabolic syndrome: its causes, risk factors, diagnostic criteria, prevalence, treatment and also its connection with Type 2 Diabetes Mellitus from the previous studies, articles, journals and books on Metabolic syndrome. A self-structured KAP questionnaire and sociodemographic questionnaire was designed and the patients were assessed over an interview. The NCEP ATP III criteria was used to assess the patients for the incidence of Metabolic syndrome.

The subjects were chosen from Silverline Hospital, Ernakulam District. A total of 50 patients having Type 2 Diabetes Mellitus of the age group 30-60 years participated in the study. Data obtained from the patients was consolidated and analysed using IBM SPSS software. The results obtained are summarised as follows:

1. Of the 50 patients selected, 27 had Metabolic Syndrome based on the NCEP ATP III criteria.

2. Majority of the patients who visited the hospital were between the age group of 51-60 years. Sixteen subjects were between 41-50 years and six were between 30-40 years.

3. Twenty-eight subjects were men and 22 were women.

4. By assessing the hereditary pattern, it was observed that thirty-nine subjects had a family history for Diabetes, eleven had a family history for Hypertension, thirteen had a family history for Obesity, and twelve had a family history for Heart diseases.

5. The duration of Diabetes of selected subjects shows that twenty-one patients had Diabetes for 0-5 years, sixteen had it between 6-10 years, six had it between 11-15 years, six had it for 16-20 years and only one subject had Diabetes for more than 20 years.

6. Their treatment regimen provided information that thirty-seven subjects were using Oral Hypoglycaemic agents (OHA) for their treatment, nine were taking both Insulin and OHA and only 4 patients were managing it by diet and exercise.

7. The weight range of selected subjects shows that five patients weighed between 41-60 kg, thirty-three patients weighed between 61-80 kg, ten patients weighed between 81-100 kg, 2 patients weighed between 101-120 kg.

8. The BMI classification provides information that sixteen subjects had a normal BMI range of 18.4-22.9 Kg/m^2, twenty-four subjects had a Pre obese BMI range of 25-29.9 Kg/m^2, nine subjects had Obesity Class I BMI range of 30-34.9

Kg/m^2, one subject had Obesity Class II BMI range of 35-39.9 Kg/m^2. None of the subjects were underweight or in the category of Obese Class III.

9. The data obtained from the waist circumference measurements, a criteria used to assess Metabolic syndrome were nor accurate because the patients were skeptical in getting their measurements done due to ongoing COVID-19 pandemic. So this measurement was excluded from the criteria to assess the incidence of Metabolic syndrome.

10. The biochemical data were collected from the Hospital records. The Fasting blood sugar value indicates that three subjects (6%) had a fasting blood glucose value of < 100 mg/dL: two of which had Metabolic syndrome, thirteen subjects (26%) had a fasting blood glycose value of 101-125 mg/dL.: eight of which had Metabolic syndrome, thirty-four subjects (68%) had a fasting blood glucose value of >125 mg/dL: seventeen of which had Metabolic Syndrome.

11. The Serum Triglyceride values reflects that nineteen subjects (38%) had a triglyceride value of < 150 mg/dL; seven of which had Metabolic syndrome, thirteen subjects (26%) had a triglyceride value between 150-199 mg/dL: seven of which had Metabolic Syndrome, seventeen subjects (34%) had a triglyceride value of 200-499 mg/dL: thirteen of which had Metabolic Syndrome, one patient (2%) had a triglyceride value of > 500 mg/dL without the presence of Metabolic syndrome.

12. The High Density Lipoprotein (HDL) levels show that nineteen subjects (38%) had a HDL level of < 55 mg/dL out of which fourteen were positive for Metabolic syndrome, thirty-one subjects had a HDL level of > 55 mg/dL out of which thirteen were positive for Metabolic syndrome.

13. The blood pressure of selected subjects indicated that thirty-nine subjects (78%) had a blood pressure < 130/85 mmHg of which sixteen had reported the presence of Metabolic syndrome because they were on medicines which help them maintain the Blood pressure. Eleven subjects had a blood pressure of > 130/85 mmHg, with presence of Metabolic syndrome.

14. The HbA1C values of selected subjects shows how well the patients had their Diabetes under control. Twenty-four subjects (48%) had a HbA1C range between 6-8: out of which twelve were positive for Metabolic syndrome. Fourteen subjects had a HbA1C range of 8.1-10: eight of which were positive for Metabolic Syndrome. Twelve subjects had a HbA1C range of > 10 and seven of them had Metabolic syndrome. The HbA1C levels indicate that the patients had a poor control on their Diabetes.

15. The Dietary preference of selected subjects shows that forty-nine were non vegetarian and only one subject was ovo-vegetarian.

16. The dietary habits provide information that forty-one subjects had the habit of reusing oil and nine did not. Twenty-seven subjects used combination of oils and twenty-three did not. Forty-five preferred non-veg in gravy form, three in fried form and two subjects preferred it in the grilled form. Twenty subjects had the habit of skipping meal and thirty did mot. Thirty-five subjects had vegetables every day and sixteen did not. Thirty-four subjects had fruit daily and sixteen did not.

17. The Daily calorie intake of selected subjects was calculated using the Ntutive app. About thirty subjects had a calorie intake of < 1600 Kcal per day out of which sixteen were found to have Metabolic syndrome. Twenty subjects had

a calorie intake of > 1600 Kcal of which eleven were found to have Metabolic syndrome.

18. Total protein intake of selected subjects shows that two subjects had a daily protein consumption of 20-30 g, eleven subjects consumed 31-40 g of protein daily of which six had Metabolic syndrome, twenty-three subjects had a daily protein intake of 41-50 g, of which eleven had Metabolic syndrome, and fourteen subjects had a daily protein intake of > 50 g, out of which ten had Metabolic syndrome. The protein consumed was mostly from Non Veg sources.

19. Total fat intake of selected subjects indicates that nine subjects had a fat intake of 31-40 g of which three had Metabolic syndrome; twenty subjects had a daily fat intake of 41-50 g and twelve of them had Metabolic syndrome; twenty-one subjects had a daily fat intake of > 50 g and twelve of which had Metabolic syndrome. Higher fat intake was associated with increased Triglyceride levels and thus increased incidence of Metabolic Syndrome.

20. Total carbohydrate intake of selected subjects shows was found that one patient had a daily carbohydrate intake of less than 100 g, twenty-one subjects consumed 100-200 g of carbohydrate daily, and twenty-eight subjects had a daily carbohydrate intake of > 200 g. Higher incidence of Metabolic syndrome was found in patients who ate > 200 g carbohydrate each day.

21. Total fiber intake of selected subjects twenty-nine (58%) subjects had a fiber intake of < 25 g, out of which fifteen had Metabolic syndrome, twenty-one (42%) subjects had a fiber intake of > 25 g, out of which twelve had Metabolic syndrome.

22. The lifestyle pattern of selected subjects shows that all the patients led a sedentary lifestyle. Thirty-six patients did some form of exercise and fourteen

did not. Thirty-two subjects had a regular sleeping pattern and eighteen had intermittent sleep. Fourteen subjects consumed alcohol or cigarette and thirty-six did not.

23. The knowledge assessment of selected subjects shows that twenty-four subjects had knowledge about Type 2 Diabetes and its occurrence and twenty-six were not aware, forty-two subjects were also aware about the complications of the same and eight were not.

24. About forty subjects had never heard the term Metabolic syndrome and ten had heard about the term but did not know what it meant.

25. Patients were explained about the term Metabolic syndrome and the NCEP ATP III criteria for Metabolic Syndrome and asked if Metabolic syndrome and Diabetes were related. Thirty-four subjects were believed that there is a relation, eleven subjects were doubtful and five subjects felt there could be no relation at all.

26. The knowledge on the development of Metabolic syndrome due to obesity, smoking, alcohol, stress, unhealthy eating practices showed that forty-five subjects were aware about this, two subjects were doubtful and three subjects were unaware.

27. Knowledge on chances of development of Metabolic syndrome due to the effect of family history shows that forty-three subjects believed that having a family history could increase the chances, four were doubtful and three were unaware.

28. Knowledge on the increased chances of development of cardiovascular disease and diabetes in people having Metabolic syndrome was assessed and shows that forty-seven subjects felt the risk was higher, three were unaware.

29. Patients were asked if awareness about Metabolic syndrome was important. All the subjects felt it was important to be aware about this.

30. Patients were asked if they are diagnosed with Metabolic syndrome will they be able to manage it along with Diabetes; forty-six subjects had a positive outlook towards this and four subjects felt they will not be able to manage. The majority of subjects in spite of being old, had a positive outlook.

31. Patients were asked if young people are better able to manage any disease effectively or that age does not play a role in disease management, anyone can manage it with proper medical help; nineteen subjects believed that anyone can manage a disease condition effectively with guidance and had a positive attitude and thirty-one subjects believed young people are better able to manage any condition better.

32. Patients were asked about the importance of getting the blood sugar and lipid profile checked; forty-nine subjects had a positive attitude towards getting their blood sugars and lipid profile checked and only one subject had a negative attitude towards this.

33. Patients were asked if daily vegetable consumption can help reduce blood sugar levels, forty-one patients agreed to it, as they had a positive attitude and nine subjects did not agree due to their negative attitude towards this. Vegetables have fiber and thus help in slowing down the release of glucose in the blood sugar thus preventing the blood sugar spikes.

34. Patients were asked the importance of maintaining weight and all the subjects believed that it is important to maintain an ideal body weight.

35. Patients were asked if whole fruit or a raw fruit is better or a fruit juice is better and forty-four subjects had a positive attitude and said a whole fruit is

better and six subjects had a negative attitude towards this and said fruit juice is better.

36. Patients were asked if having nuts is beneficial to our body; forty-eight subjects had a positive attitude and also said we should have it in limited amount and 2 subjects had a negative attitude said it is not beneficial.

37. Patients were asked if alcohol consumption should be limited or people should not consume it; forty-three subjects had a positive attitude, four had a negative attitude and 3 were doubtful about this.

38. Patients were asked if managing stress was important to stay healthy and all the subjects had a positive attitude towards this.

39. Patients were asked if chewing food slowly was important and forty-eight subjects had a positive attitude and two subjects had a negative attitude.

40. Patients were asked if they eat a whole fruit or have fruit juice; it was found that forty-four had whole fruit and six had it as a juice.

41. Patients were asked if they had green leafy vegetables; it was found that forty-seven had green leafy vegetables and three did not have them.

42. Patients were asked if they monitor their blood sugars at home using a glucometer; and it was found that twenty-nine subjects checked their blood sugars using a glucometer and twenty-one did not.

43. Patients were asked if they use different oils at home; twenty-seven subjects used a combination of oils; and the majority oils used were coconut oil, sunflower oil, palm oil, rice bran oil and olive oil, twenty-three subjects used only coconut oil.

44. Patients were asked if they eat pulses every day; twenty-two subjects had pulses daily and twenty-eight did not. The patients got protein from some form of non veg foods.

45. Patients were asked their frequency of snacking from outside; two subjects ate from out daily, sixteen subjects ate from out weekly, twenty subjects monthly, ten subjects rarely and two never ate anything from outside.

46. Patients were asked if they manage hypoglycemia by eating a candy or sugar; thirty-seven patients said that they eat a chocolate or something sweet and thirteen subjects said they did not experience hypoglycemia, so were not aware about this.

47. Patients were asked about their fish consumption pattern. Ten subjects had fish daily, sixteen subjects had fish once a week, one subject had fish twice a week, seventeen subjects had fish thrice a week, six subjects never had fish.

48. The water consumption pattern of subjects was recorded and it was found that; forty-three subjects drank 8 glasses water every day and seven subjects did not consume 8 glasses water daily.

49. Patients were asked if they checked their HbA1C levels every 3 months; twenty-nine subjects checked it every 3 months and twenty-one subjects did not get it checked.

50. Correlation between intake of carbohydrate, protein, fat, fiber and incidence of Metabolic syndrome was assessed and found that subjects who had an increased consumption of carbohydrates, the incidence of Metabolic syndrome was higher. Subjects who had a higher protein intake also had increased incidence of Metabolic syndrome probably due to the action of other factors. Higher fat

intake was associated with increased incidence of Metabolic syndrome. Lower fiber intake was associated with increased intake of Metabolic syndrome.

51. Correlation between the knowledge on maintaining weight and the Actual practices reflected in their BMI was assessed and found that all fifty subjects agreed, which concludes that they have the knowledge about the importance of maintaining weight; and when they were asked if weight reduction helps in lowering blood sugar levels, forty-three subjects agree and seven disagreed to it. When their practices were assessed by measuring the Body Mass Index, it was found that majority of the subjects were pre-obese and obese.

52. Correlation between unhealthy eating and the risk of developing Diabetes and Metabolic syndrome versus the actual food consumption pattern was assessed, forty-nine subjects were aware. It can be observed that subjects have knowledge about the risks associated with unhealthy eating. It can be inferred that though the patients have the knowledge of healthy eating, they sometime tend to not follow those in their practice. Fried foods were maximum consumed during the evening snack time along with tea. It is therefore important to explain the patients about the healthy alternatives for the fried foods.

53. Correlation between Fat intake and Serum Triglyceride levels, it was observed that the daily fat intake of nine subjects was between 31-40 g, twenty subjects consumed about 41-50 g fat and twenty-one subjects consumed > 50 g fat daily. The triglyceride level of nineteen subjects was normal i.e., < 150 mg/dL, twenty-two subjects had a higher triglyceride level of > 150 mg/dL. It can be inferred that a high fat intake leads to a high triglyceride levels.

54. Correlation between knowledge of fiber consumption and their actual consumption pattern, forty-six subjects believed that high fiber foods help to

lower blood sugar levels and four of them disagreed to this fact. But when their actual fiber eating practice were analysed, it was observed that the twenty-nine patients had fiber daily and twenty-one did not take fiber. The total fiber intake of twenty-nine patients was < 25g and only twenty-one patients had a daily fiber intake of > 25 g.

55. Correlation between the knowledge of the importance of exercise versus the actual exercise pattern: When asked about the importance of exercise, all the patients believed that exercise is important to help reduce blood sugar levels, but when asked about their daily exercise pattern, only thirty-five subjects did some exercise daily and fifteen subjects did not do any exercise

56. Correlation between Duration of Diabetes and incidence of Metabolic Syndrome: Diabetes and Metabolic syndrome are related to each other. It was observed that twenty-one subjects had Diabetes for 0-5 years and that higher incidence of Metabolic syndrome was found in this category i.e., eleven subjects had Metabolic syndrome, sixteen subjects had Metabolic syndrome for 6-10 years and eleven of them had Metabolic syndrome, six subjects had Diabetes for 11-15 years and two of them had Metabolic syndrome, six subjects had Diabetes for 16-20 years and two of them had Metabolic syndrome, one subject had Diabetes for more than 20 years and also had Metabolic syndrome. Metabolic syndrome was found to be present in Diabetic patients in all the duration range. As the number of years of having Diabetes increases, people become more familiar with the condition and manage them better hence the reduced incidence of Metabolic syndrome in patients having Diabetes for more than 11 years.

57. Among the 50 subjects, the mean waist circumference (86.42±10.72) was within the range of the standard value. However, due to the COVID 19

pandemic, some of the patients were not willing to get their waist circumference measured, so the waist size was taken into account. So there could be deviation in the values. Among the 50 subjects, the mean BMI (27.26±3.82) was higher the standard range of 18.5-24.9 kg/m2.

58. Among the selected 50 subjects, the mean fasting blood glucose level (162.96±52.18) was higher than the standard value of ≥110 mg/dL. The mean systolic blood pressure value (136.06±16.6) was slightly higher than the standard value. The mean diastolic blood pressure was (79.14±8.76) was lower than the standard value. The mean triglyceride value (188.56±86.26) was higher than the standard value. The mean HDL value (50.98±6.93) was higher than the standard value.

59. The mean energy intake (1505.71±271.3) of the selected subjects was lower than the standard ICMR recommendation of 2020. The mean protein intake (46.13±11.04) was higher than the standard value. The mean fat intake (49.67±10.29) was higher than the standard value.

60. The Pearson Correlation test results indicate that there is a correlation between: Calorie intake and Fating blood sugar (r= .371). Negative correlation between Fat intake and Serum Triglyceride levels (r= -0.151). Negative correlation between Calorie intake and Body Mass Index (r= -0.293). Correlation between Fat intake and Body Mass Index (r= 0.012). Negative correlation between Body Mass Index and Triglyceride (r= -0.041).

CONCLUSION

The present study points out that Metabolic syndrome is prevalent among Type 2 Diabetic patients and they are not aware of its presence. The subjects have some knowledge about Type 2 Diabetes. They are not aware about Metabolic syndrome. But when explained the components and the diagnosing criteria, they were able to link the questions asked related to Metabolic Syndrome. The subjects were aware about healthy eating practices to manage Diabetes but their practices do not reveal the same. So the importance of a balanced diet has to be reinforced and healthy snacking options have to be provided. It is important to keep a check on the patient's dietary practices. It is a well-known fact that Metabolic syndrome can lead to Diabetes, but if was found that many Type 2 Diabetic patients especially those having Diabetes for 0-10 years had increased incidence of Diabetes. An attempt to impart awareness about Type 2 Diabetes and Metabolic syndrome was made by creating a booklet which can be sent to all the patients.

LIMITATIONS

- Sample size was limited due to a decline in the number of patients visiting the hospital due to COVID 19 pandemic.
- Some patients were hesitating in getting their waist circumference measured due to COVID 19 pandemic.

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APPENDIX

INTERVIEW SCHEDULE TO ELICIT INFORMATION ABOUT RISK FACTORS OF METABOLIC SYNDROME IN TYPE 2 DIABETICS

PERSONAL DETAILS.

Name :

Age :

Sex :

SOCIO ECONOMIC DATA.

Type of family: Nuclear/ Joint

Marital status : single / married / widow

Religion : Hindu/ Christian/ Muslim

Qualification :

Occupation :

MEDICAL HISTORY.

Age of onset of DM (Yrs.) :

Duration of DM (Months/Yrs.) :

Diabetes treatment :

(a) OHA (b) Insulin (c) OHA & Insulin (d) Diet & exercise

Complication(s) : Yes / No

If yes, please indicate which complication(s) you have:

(a) Hypertension (b) Dyslipidemia (c) Retinopathy (d) Nephropathy

(e) CVD (f) PVD (g) Foot infection

FAMILY HISTORY.

Diabetes : Yes / No

Hypertension : Yes / No

Obesity : Yes / No

Heart diseases : Yes / No

NUTRITIONAL ASSESSMENT.

1. Anthropometric Measurement

(a) Height :

(b) Weight :

(c) BMI :

(d) Waist circumference :

2. Biochemical Analysis

(a) Serum triglyceride level :

(b) Blood pressure :

(c) HDL Cholesterol :

(d) Fasting plasma glucose :

3. Dietary Assessment

(a) Food consumption pattern:
Vegetarian/Ovo-vegetarian/ Lactovegetarian/Nonvegetarian

(b) Consumption of rice in a day: Once/Twice/Thrice/Four Times/No

(c) Do you have the habit of reusing the cooked oil? Yes/No

(d) Mostly used cooking method for flesh foods: Frying/Gravy/Both

(e) Do you use combination oil for cooking? Yes/No
If yes Specify :

(f) How often you snack from outside? Daily/weekly/monthly/occasionally/no
(g) Do you replace your meal with bakery items? Yes/No

(h) Do you skip any of your meal? Yes/No
If yes, Specify : Breakfast / Lunch / Dinner

(i) Do you eat vegetables every day? Yes/No

(j) Do you eat fruits every day? Yes / No

(k) Which is your preferred rice? White rice/ Brown rice

(l) Are you a regular junk food consumer? Yes / No

(m) Are you the person most responsible for planning or preparing the meals in your household? No/Yes/Refused/Don't Know/Not Sure

(n) Do you have the habit of drinking carbonated or caffeine containing beverages? Daily/ Weekly/ Monthly/ Occasionally/ No

(o) Are you aware that there is availability of Skimmed/Homogenized Toned/ Full Cream Milk/ Standardized Milk?

4. Lifestyle Pattern

(a) Are you working?

If working Specify the job:

(b) Do you exercise regularly? Yes/No

i) If yes, what type?

ii) How much time you spent for doing exercise?

(c) Pattern of sleep: Regular Sleep/ Insomnia/ Intermittent Sleep

(d) Do you consume alcohol or smoke? Yes/ No

If yes, how often? Daily/ Weekly/ Monthly/Occasionally

FOOD PREFERENCE QUESTIONNAIRE

Items	**Number as Priority**
Fried	
Baked	
Boiled	
Grilled	
Steamed	
Raw	

FOOD FREQUENCY PATTERN

Ser	**Foods**	**Frequency of Consumption**			
		Daily	**Weekly**	**Monthly**	**Rarely**
1.	**Cereals**				
	Millets				
	Rice				
	Wheat				
	Oats				
	Brown rice				
2.	**Pulses**				
	Bengal gram				
	Black gram				
	Green gram				
	Lentil				
	Soya-bean				
	Chickpea				
3.	**Green Leafy Vegetables**				
	Cabbage				
	Amaranth				
	Spinach				
	Fenugreek				

	Drumstick				
4.	**Roots & Tubers**				
	Carrot Potato				
	Sweet potato				
	Yam				
	Tapioca				
	Beet root				
5.	**Other Vegetables**				
	Tomato				
	Cauliflower				
	Lady's finger				
	Beans				
	Cucumber				
	Ash gourd				
	Bottle gourd				
	Ridge gourd				
	Plantain				
	Pumpkin				
6.	**Fruits**				
	Apple				
	Banana				
	Pomegranate				
	Papaya				
	Watermelon				
	Muskmelon				
	Pear				
	Guava				
	Custard apple				
	Pineapple				
	Passion fruit				
	Figs				

7.	**Milk and Milk Products**				
	Milk				
	Cheese				
	Curd				
	Yogurt				
	Buttermilk				
	Paneer				
8.	**Flesh Foods**				
	Mutton				
	Chicken				
	Beef				
	Fish				
	Egg				
	Pork				
9.	**Nuts**				
	Almonds				
	Cashew				
	Pista				
	Dates				
	Walnut				
	Peanuts				
	Coconut				
10.	**Beverages**				
	Tea				
	Coffee				
	Soft drinks				
	Alcohol				
11.	**Processed Foods**				
	Pickles				
	Pappads				
	Jam				
12.	**Sweets**				

	Sugar				
	Jaggery				
	Honey				
	Sugar free				

24 HOUR RECALL

Time	**Menu**	**Serving Size**	**Ingredients**	**Quantity Gms/ml**
Early Morning 0700-0800 Hrs				
Breakfast 0800-0900 Hrs				
Mid-Morning 1000-1100 Hrs				
Lunch 1300-1400 Hrs				
Evening 1600-1700 Hrs				
Late Evening 1800- 1900 Hrs				
Dinner 2000-2100 Hrs				
Bedtime 2200-2300 Hrs				

KNOWLEDGE, ATTITUDE, PRACTICE QUESTIONNAIRE

Knowledge.

1. Do you know what is Type 2 Diabetes?
   - ○ Yes
   - ○ No

2. Do you know how Type 2 Diabetes occurs?
   - ○ Yes
   - ○ No

3. Are you aware of the complications of type 2 Diabetes?
   - ○ Yes
   - ○ No

4. Do you think diet and exercise is important in managing type 2 Diabetes?
   - ○ Yes
   - ○ No

5. Have you heard of the term Metabolic syndrome?
   - ○ Yes
   - ○ No

6. Do you know how to find out if you have metabolic syndrome or not?
   - ○ Yes
   - ○ No

7. Do you think Metabolic syndrome is related to Diabetes?
   - ○ Yes
   - ○ No

8. Do you think Metabolic syndrome can lead to Diabetes?

- ○ Yes
- ○ No

9. Do you think obesity can lead to the development of Metabolic syndrome?

- ○ Yes
- ○ No

10. Do you think smoking and alcohol can lead to development of Metabolic syndrome?

- ○ Yes
- ○ No

11. Can a family history of obesity, Hypertension increase a person's chances of developing Metabolic syndrome?

- ○ Yes
- ○ No

12. Can unhealthy foods increase the chances of developing Metabolic syndrome?

- ○ Yes
- ○ No

13. Can a balanced diet and exercise help to prevent development of Metabolic syndrome?

- ○ Yes
- ○ No

14. Do you think stress has a role to play in Metabolic Syndrome?

- ○ Yes
- ○ No

15. Do you think managing diabetes can help manage Metabolic syndrome?

- ○ Yes
- ○ No

16. Are you aware of the complications of Metabolic syndrome?

- ○ Yes
- ○ No

17. Do you think a person having Metabolic syndrome has increased risk for developing Diabetes or Cardiovascular diseases?

- ○ Yes
- ○ No

18. Do you think awareness about Metabolic syndrome can help to prevent its complication?

- ○ Yes
- ○ No

19. Do you think Metabolic syndrome can affect you day to day activities?

- ○ Yes
- ○ No

20. Do you think Metabolic syndrome can be life threatening?

- ○ Yes
- ○ No
- ○

Attitude.

1. Do you think exercise can help manage Diabetes and Metabolic syndrome?

- ○ Yes
- ○ No

2. Do you think diet modification help manage Diabetes and Metabolic syndrome?

- ○ Yes
- ○ No

3. If you are diagnosed with metabolic syndrome, you think you can manage both Diabetes and Metabolic syndrome?

- ○ Yes
- ○ No

4. Do you think age plays a role in disease management?

- ○ Yes
- ○ No

5. Do you think high fat foods like junk foods or processed foods are bad for health?

- ○ Yes
- ○ No

6. Do you think it is important to get you blood sugars and lipid profile checked every 3 months?

- ○ Yes
- ○ No

7. Do you think eating more vegetables help you manage Diabetes and Metabolic syndrome?

- ○ Yes
- ○ No

8. Do you think maintaining an ideal body weight is important to stay away from complications?

- ○ Yes
- ○ No

9. Do you think eating a whole fruit is better than having a fruit juice?

- ○ Yes
- ○ No

10. Do you think eating nuts is beneficial?

- ○ Yes
- ○ No

11. Do you think weight reduction will help to reduce your blood sugar levels?

- ○ Yes
- ○ No

12. Do you think it is important to take Medicines on time to manage your blood sugar levels?

- ○ Yes
- ○ No

13. Do you think smoking and alcohol should be limited or not be consumed?

- ○ Yes
- ○ No

14. Do you think Diet and exercise has an important role to play in controlling blood sugars apart from taking medicines?

- ○ Yes
- ○ No

15. Do you think managing stress is important?

- ○ Yes
- ○ No

16. Do you think eating millets helps to reduce blood sugars?

- ○ Yes
- ○ No

17. Do you think eating fish is good for health?
    - ○ Yes
    - ○ No

18. Do you think egg white is better than eating a whole egg?
    - ○ Yes
    - ○ No

19. Do you think it is important to have small frequent meals?
    - ○ Yes
    - ○ No

20. Do you think chewing food slowly is important?
    - ○ Yes
    - ○ No

Practice.

1. Do you exercise every day?
    - ○ Yes
    - ○ No

2. Do you eat whole fruit or make it a juice?
    - ○ Whole fruit
    - ○ Juice

3. Do you have green leafy vegetables?
    - ○ Yes
    - ○ No

4. Do you monitor your blood sugars using glucometer at home?
    - ○ Yes
    - ○ No

5. Do you use a combination of oils?
    - ○ Yes
    - ○ No

6. Do you eat small regular meals?
    - ○ Yes
    - ○ No

7. Do you consume 2-3 litres water per day?
    - ○ Yes
    - ○ No

8. Do you take your medicine and insulin on time as prescribed?
    - ○ Yes
    - ○ No

9. Do you get your HbA1C levels checked every three months?
    - ○ Yes
    - ○ No

10. How often do you eat fried foods?
    - ○ Once a week
    - ○ More than thrice a week.

11. Do you eat chips, pastry, puffs and other bakery items? If yes then how often?
    - ○ Weekly
    - ○ Monthly
    - ○ Rare

12. Do you eat fibre rich foods like millets, bajra, brown rice, ragi, oats?
    - ○ Yes
    - ○ No

13. Do you include pulses every day in your meal?
    - ○ Yes
    - ○ No

14. How often do you eat sweets?
    - ○ Daily
    - ○ Weekly
    - ○ Monthly

15. Do you use honey or jaggery instead of sugar?
    - ○ Yes
    - ○ No

16. How often do you eat outside?
    - ○ Weekly
    - ○ Monthly
    - ○ Rare

17. Do you manage Hypoglycaemia by eating a candy or sugar?
    - ○ Yes
    - ○ No

18. How many times a week you eat fish?
    - ○ Once
    - ○ Thrice
    - ○ Everyday

19. Do you consume soda, aerated drinks?
    - ○ Yes
    - ○ No

20. Do you smoke or consume alcohol?
    - ○ Yes
    - ○ No

NUTRITION INTERVENTION BOOKLET

DIABETES MELLITUS

Diabetes is a chronic metabolic disorder that prevents the body to utilize glucose completely or partially. It is characterized by raised glucose level in the blood and alterations in carbohydrate, protein and fat metabolism. This can be due to failure of formation of insulin or liberation or action.

Prevalence: One in six people with Diabetes in the world is from India. The numbers place the country among the top 10 countries for people with Diabetes, coming in at Number 2 with an estimated 77 million Diabetics (IDF Diabetes Atlas 2019).

TYPES OF DIABETES

Type 1 Diabetes: This is also known as Insulin Dependent Diabetes Mellitus (IDDM). This occurs in younger age group. There is inability of the pancreas to produce insulin and so they are dependent on Insulin throughout their life.

Type 2 Diabetes: This is also knows as Non-Insulin Dependent Diabetes Mellitus (NIDDM). It develops slowly and is milder and more stable. Insulin may be produced by pancreas but the action is impaired. It occurs mainly due to lifestyle changes such as reduced physical activity, not eating a balanced diet.

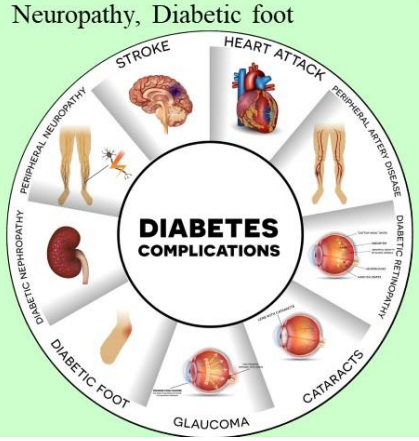
Gestational Diabetes: Occurs during pregnancy and terminates after delivery. However, if proper lifestyle is not followed it can re occur as Type 2 Diabetes.

CAUSES

- Genetic
- Abdominal fat
- Dietary factors
- Stress
- Sedentary life style and lack of physical activity

COMPLICATIONS

- Hypoglycemia (low blood sugar)
- Delayed wound healing
- Increased chances of Infection
- Cataract and Retinopathy, Heart diseases
- Nephropathy (loss of kidney function)
- Neuropathy, Diabetic foot



SYMPTOMS

- Hyperglycemia: High blood sugar
- Glycosuria: Glucose in urine
- Fluid and electrolyte imbalance
- Acidosis
- Polyuria: Frequent urination; Nocturia: Frequent urination at night
- Polydipsia: Excessive thirst; Polyphagia: Excessive hunger
- Dehydration
- Fatigue and loss of weight

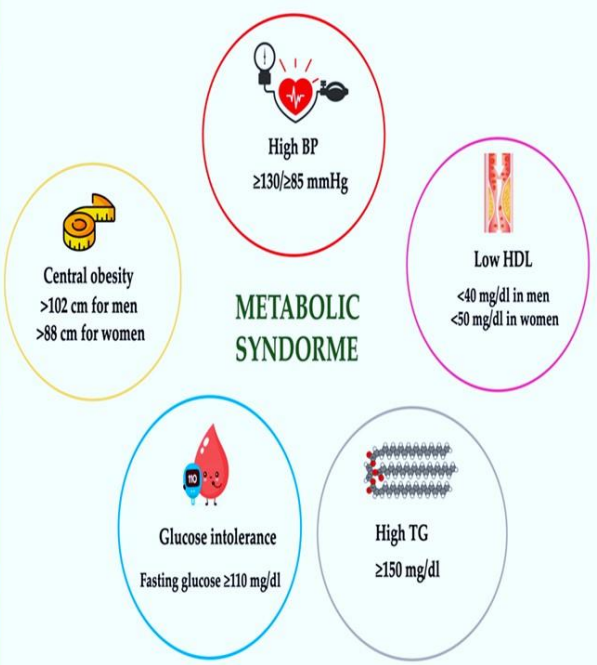
METABOLIC SYNDROME

Metabolic syndrome is defined by a cluster of interrelated factors (Central obesity, High blood pressure, Abnormal lipid profile, Insulin resistance/Type 2 Diabetes) that directly increase the risk of cardiovascular disease and Diabetes Mellitus. Individuals with Metabolic syndrome have a 30-40% probability of developing Diabetes and or Cardiovascular diseases within 20 years depending on the number of components present.

Diagnosis:

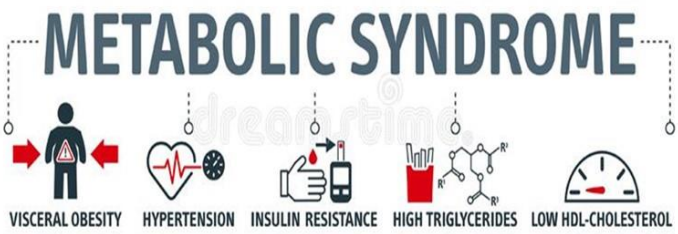
Many definitions are in use for the diagnosis of Metabolic syndrome worldwide. However, for Asians, The National Cholesterol Education Program, Adult Treatment Panel III (NCEP ATP III) criteria is most widely used.

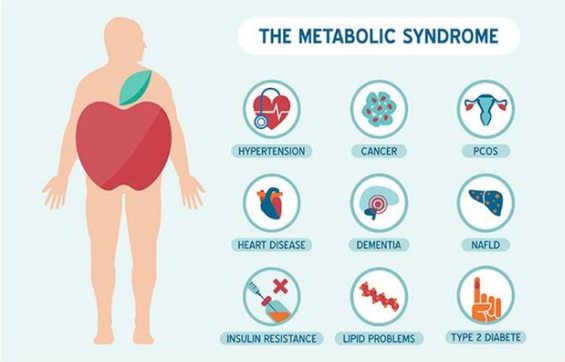
According to the NCEP ATP III criteria, a person is considered to have Metabolic syndrome if he/she has 3 or more of the following components:



COMPLICATIONS

- Type 2 Diabetes and Coronary heart disease
- Nonalcoholic fatty liver disease
- Hyperuricemia (High uric acid levels)
- Polycystic ovarian disease (PCOD)
- Obstructive sleep apnea (Difficulty sleeping)



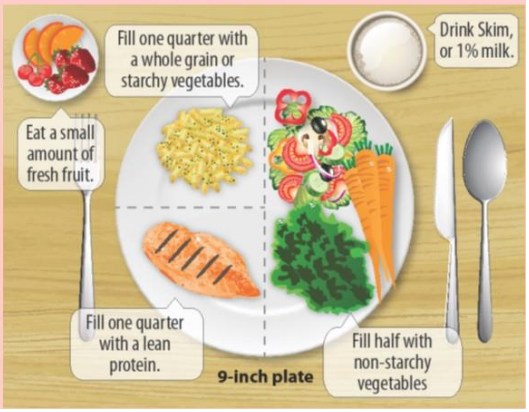


CAUSES

- Aging
- Central obesity
- Overweight
- Stress
- Type 2 Diabetes/ Insulin resistance
- Physical inactivity and sedentary lifestyle
- Smocking and Alcohol consumption
- Coronary heart disease
- Genetics
- Dietary pattern

MANAGEMENT FOR DIABETES AND METABOLIC SYNDROME

1. Physical activity for at least 30 minutes every day.
2. Take Medicines and Insulin on time as prescribed by the doctor.
3. Maintain the ideal body weight; if excess lose some weight by physical activity and dietary modifications.
4. Quit smoking and alcohol or reduce the consumption.
5. Manage stress by doing Meditation.
6. Dietary Modifications



DIETARY MODIFICATIONS

- Follow a 6 meal pattern, eat small quantities every 3-4 hours. Avoid feasting and fasting. Portion control is the key.
- Include as much vegetables as possible especially green leafy vegetables. Limit on the amount of roots and tubers like potato, sweet potato, tapioca, yam, carrot.
- Always choose a raw fruit over a fruit juice. Fruits that can be included: Apple, papaya, guava, pears, pomegranate, orange, kiwi, peaches, watermelon, muskmelon. Limit the amount of fruits like mango, custard apple, sapota, grapes, banana as they are high in sugar content. Eat one fruit per time and limit the quantity.
- Cereals like rice, chapati, ragi, millets (samai, varagu), oats can be used. Be aware of the portion size. Avoid refined flour as much as possible. All pulses can be included.
- Include low fat milk, curd, paneer in the diet.
- When you have hypoglycemia, immediately take a candy or sugar.
- Chicken, fish, egg, meat can be included in the gravy form, it is better not to fry them. Choose low fat options.
- Use oil in moderation: sunflower oil, coconut oil, groundnut oil, olive oil, ghee can be used 2-3 tsp per person per day. Use nonstick pans to reduce the amount of oil consumed. Bake or grill foods instead of deep frying.
- Including fiber rich foods such as green leafy vegetables, other vegetables, whole grains, fruits with peels, nuts and seeds can help reduce blood sugar levels and weight.
- Avoid or limit sugar intake. Use jaggery in place of sugar. Do not use sugar free.
- Choose healthy snacking options like salad, whole fruit, nuts (handful), sprouts, soup, buttermilk, lime juice (without sugar).
- Do not watch TV or mobile while eating, you can tend to eat more. Chew the food slowly.
- Drink at least 2-3 liter water every day.

പ്രമേഹവും പോഷണപരിണാമ രോഗലക്ഷണങ്ങളും

മധുമേഹം അഥവാ മൂത്രമൊഴിവ്

ഭക്ഷണത്തിൽ നിന്നു ലഭ്യമാകുന്ന ഗ്ളൂക്കോസ് പൂർണ്ണമായോ ഭാഗികമായോ ശരീരത്തിന് പ്രയോജനപ്രദമായി ഉപയോഗിയ്ക്കാൻ സാധിയ്ക്കാത്ത പോഷണപരിണാമ വിഷയകമായ ഒരു ചിരകാലിക രോഗമാണ് പ്രമേഹം. രക്തത്തിലെ ഉയർന്ന ഗ്ളൂക്കോസിന്റെ അളവും; കാർബോഹൈഡ്രേറ്റ്, പ്രോട്ടീൻ, കൊഴുപ്പിന്റെ പോഷണപരിണാമം എന്നിവയുടെ വ്യതിയാനവുമാണ് ഇതിന്റെ പ്രത്യേകത. ഇൻസുലിന്റെ ഉല്പാദനത്തിലുള്ള കുറവോ, കഴിവില്ലായ്മയോ ആണ് ഇതിനു കാരണം.

വ്യാപ്തി:

ലോകത്തിലെ ആറ് പ്രമേഹ രോഗികളിൽ ഒരാൾ ഇൻഡ്യയിൽ നിന്നാണ്. 2019ലെ ഐ. ഡി. എസ്. ഡയബെറ്റിസ് അറ്റ്ലസിന്റെ കണക്ക് പ്രകാരം, 77 ദശലക്ഷം പ്രമേഹരോഗികളുള്ള ഇൻഡ്യ, ലോകത്തിലെ ആദ്യ പത്ത് രാജ്യങ്ങളുടെ പട്ടികയിൽ രണ്ടാം സ്ഥാനത്താണ്.

വിവിധ തരങ്ങൾ:

ടൈപ്പ് 1 പ്രമേഹം:

ഇതിനെ ഇൻസുലിൻ ഡിപ്പൻഡന്റ് ഡയബെറ്റിസ് മെല്ലിറ്റസ് (IDDM) എന്നും പറയും. ചെറുപ്പക്കാരിലാണ് ഈരോഗം കണ്ടു വരുന്നത്. പാൻക്രിയാസിന് ഇൻസുലിൻ ഉല്പാദിപ്പിയ്ക്കാൻ കഴിവില്ലാത്തതിനാൽ ജീവിതകാലം മുഴുവനും ഇൻസുലിന്റെ ബാഹ്യ സ്രോതസ്സിനെ ആശ്രയിക്കേണ്ടവരാണ് ഈ രോഗികൾ.

ടൈപ്പ് 2 പ്രമേഹം:

ഇതിനെ നോൺ ഇൻസുലിൻ ഡിപ്പൻഡന്റ് ഡയബെറ്റിസ് മെല്ലിറ്റസ് എന്നും പറയും. ഇത് കൂടുതൽ രൂക്ഷമല്ലാത്തതും, ഘടനയ്ക്ക് മാറ്റമുണ്ടാകാത്തതും കാലക്രമേണ ഉണ്ടാകുന്നതുമാണ്. ഉല്പാദിപ്പിയ്ക്കപ്പെടുന്ന ഇൻസുലിന്റെ പ്രവർത്തനം തന്നെ തടസ്സപ്പെടുന്നു. വ്യായാമമില്ലായ്മ, സമീകൃതമല്ലാത്ത ആഹാരരീതി തുടങ്ങിയജീവിത ശൈലി കൊ ് സാവധാനം ഉണ്ടാകുന്നതാണ് ഈ രോഗാവസ്ഥ.

ഗർഭസംബന്ധമായ പ്രമേഹം:

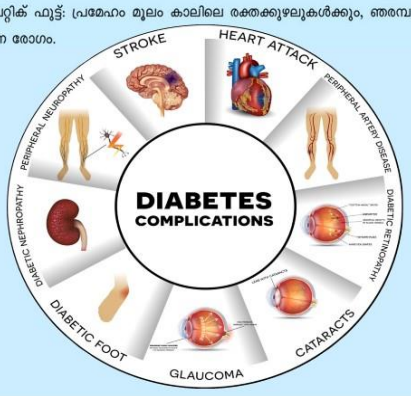
ഗർഭധാരണ കാലയളവിൽ ഉണ്ടാകുന്നതും, പ്രസവാനന്തരം അപ്രത്യക്ഷമാകുന്നതുമാണ് ഈ രോഗാവസ്ഥ. എന്നാൽ, ശരിയായ ജീവിതശൈലി തുടർന്നില്ലെങ്കിൽ ടൈപ്പ് 2 പ്രമേഹമായി വീണ്ടും പ്രത്യക്ഷപ്പെടാൻസാധ്യതയു ്

കാരണങ്ങൾ:

ജനിതകം
ജീവിതശൈലി: ഉദാസീനത
വ്യായാമമില്ലായ്മ
അടിവയറിലെ കൊഴുപ്പ്
സമീകൃതമല്ലാത്ത ആഹാരരീതി
മാനസിക പിരിമുറുക്കം

സങ്കീർണ്ണതകൾ:

ഹൈപ്പൊഗ്ലൈസീമിയ: രക്തത്തിലെ പഞ്ചസാരയുടെ കുറവ്
വ്രണങ്ങൾ കരിയാനുള്ള കാലതാമസം.
വേഗം അണുബാധ ഉണ്ടാകാനുള്ള സാദ്ധ്യത.
തിമിരവും, റെറ്റിനോപ്പതിയും (പ്രമേഹം മൂർഛിച്ച് റെറ്റിനയിലെ സൂക്ഷ്മ രക്തക്കുഴലുകൾക്ക് കേടുവന്ന് കാഴ്ച നശിയ്ക്കൽ)
ഹൃദ്രോഗങ്ങൾ
വൃക്കസംബന്ധമായ രോഗങ്ങൾ.
ന്യൂറോപ്പതി : ഞരമ്പു സംബന്ധമായ രോഗങ്ങൾ
ഡയബെറ്റിക് ഫുട്ട്: പ്രമേഹം മൂലം കാലിലെ രക്തക്കുഴലുകൾക്കും, ഞരമ്പുകൾക്കും ഉണ്ടാകുന്ന രോഗം.



ലക്ഷണങ്ങൾ:

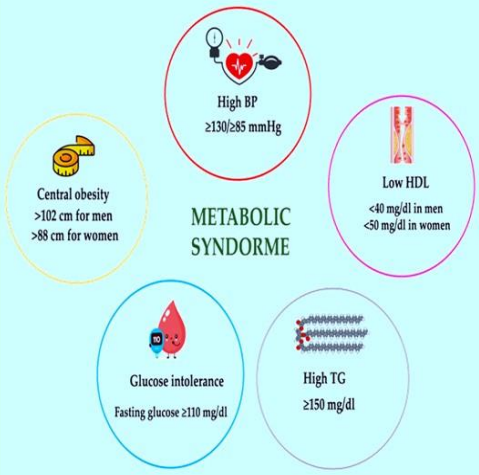
ഹൈപ്പർഗ്ലൈസീമിയ : രക്തത്തിലെ പഞ്ചസാരയുടെ ഉയർന്ന അളവ്.
ഗ്ലൂക്കസൂറിയ : മൂത്രത്തിലെ പഞ്ചസാര.
കൂടിയ്ക്കുന്ന പാനീയങ്ങളുടെയും ശരീത്തിലെ ഇലക്ട്രോലൈറ്റുകളുടെയും അസന്തുലിതാവസ്ഥ.
അസിഡോസിസ് : ശരീരത്തിലെ അമിതമായ അമ്ളത്വം.
പോളിയൂറിയ : അമിതമായ മൂത്രമൊഴിക്കൽ
നൊക്ടൂറിയ : രാത്രിയിലെ അമിതമായ മൂത്രമൊഴിക്കൽ.
പോളിഡിപ്സിയ : അമിതമായ ദാഹം
പോളിഫാജിയ : അമിതമായ വിശപ്പ്
ഡീഹൈഡ്രേഷൻ : നിർജ്ജലീകരണം
അതിക്ഷീണവും ഭാരം നഷ്ടപ്പെടലും

മെറ്റബോളിക് സിൻഡ്രോം (പോഷണപരിണാമ രോഗലക്ഷണങ്ങൾ)

അമിത വണ്ണം, ഉയർന്ന രക്തസമ്മർദ്ദം, അസാധാരണമായ അളവിൽ കൊഴുപ്പിന്റെ അളവ്, ഇൻസുലിൻ പ്രതിരോധം (ടൈപ്പ് 2 പ്രമേഹം:

നോൺ ഇൻസുലിൻ ഡിപ്പൻഡന്റ് ഡയബെറ്റിസ് മെല്ലിറ്റസ്) എന്നിവ കാരണം ഹൃദ്രോഗവും, പ്രമേഹവും പ്രത്യക്ഷത്തിൽ വർദ്ധിയ്ക്കുന്ന പ്രക്രിയയാണ് മെറ്റബോളിക് സിൻഡ്രോം (പോഷണപരിണാമരോഗലക്ഷണങ്ങൾ).

മുകളിൽ പറഞ്ഞിരിയ്ക്കുന്ന പോഷണപരിണാമ രോഗലക്ഷണങ്ങൾ 20 വർഷങ്ങൾ കൊണ്ടുള്ളവരിൽ, അസുഖലക്ഷണങ്ങളുടെ എണ്ണത്തിനനുസരിച്ച്, 30%-40% പേർക്കും, ഹൃദ്രോഗവും, പ്രമേഹവും വരാനുള്ള സാദ്ധ്യത വളരെകൂടുതലാണ്.



രോഗ നിർണ്ണയം:

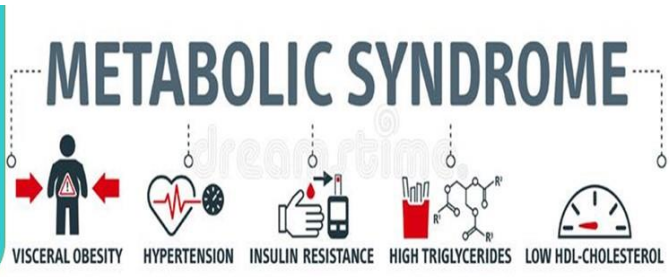
പോഷണപരിണാമ രോഗലക്ഷണങ്ങളുടെ നിർണ്ണയത്തിനായി ആഗോളമായി തന്നെ, ധാരാളം നിർവ്വചനങ്ങൾ ഉപയോഗത്തിലു ് എന്നിരുന്നാലും, ദി നാഷണൽ കൊളസ്ട്രോൾ എഡ്യൂക്കേഷൻ പ്രോഗ്രാമിന്റെ [The National Cholesterol Education Program, Adult Treatment Panel III(NCEP ATP III)] മാനദണ്ഡമാണ് ഏറ്റവും കൂടുതൽ ഉപയോഗിയ്ക്കപ്പെടുന്നത്.

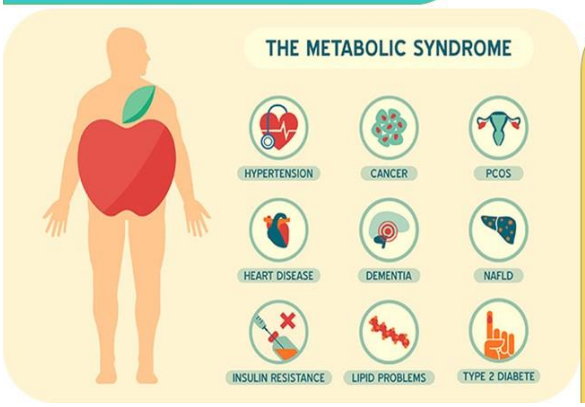
NCEP ATP III മാനദണ്ഡമനുസരിച്ച്, താഴെ കൊടുത്തിരിയ്ക്കുന്ന 3 അല്ലെങ്കിൽ അധികമോ ഘടകങ്ങൾ ഉള്ള സ്ത്രീ/പുരുഷന്മാർക്ക് മെറ്റബോളിക് സിൻഡ്രോം (പോഷണപരിണാമ രോഗലക്ഷണങ്ങൾ) ഉണ്ടെന്നു വേണം കരുതാൻ:

1. അരവണ്ണം: പുരുഷൻ > 102 സെ. മി.; സ്ത്രീ> 88 സെ. മി.
2. ട്രൈഗ്ലിസൈഡ്സ്: ≥ 150 mg/dL അല്ലെങ്കിൽ ചികിത്സയിലാണ്.
3. HDL: പുരുഷൻ< 40 mg/dL; സ്ത്രീ < 50 mg/dL.
4. രക്തസമ്മർദ്ദം: ≥ 130/85 mm.Hg. അല്ലെങ്കിൽ ചികിത്സയിലാണ്.
5. പ്രഭാത ഭക്ഷണത്തിനു മുമ്പുള്ള ഗ്ലൂക്കോസ്: ≥ 110 mg/dL.

സങ്കീർണ്ണതകൾ:

ടൈപ്പ് 2 പ്രമേഹവും ഹൃദ്രോഗവും
മദ്യപാനംകൊണ്ടല്ലാത്ത കരൾവീക്കം
ഹൈപ്പർ യൂറിസീമ (ഉയർന്ന യൂറിക് ആസിഡ്)
പോളിസിസ്റ്റിക് ഒവേറിയൻ ഡിസീസ്
ഉറക്കക്കുറവും കൂർക്കം വലിയും



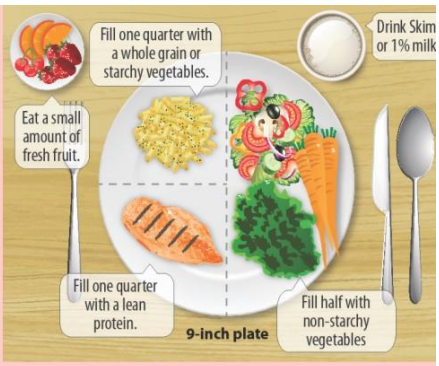


കാരണങ്ങൾ:

പ്രായവർദ്ധന
അമിത വണ്ണം
അമിത ശരീരഭാരം
മാനസിക സമ്മർദ്ദം
ടൈപ്പ് 2 പ്രമേഹം / ഇൻസുലിൻ പ്രതിരോധം
ജീവിതശൈലി: ഉദാസീനത, വ്യായാമമില്ലായ്മ
പുകവലിയും മദ്യപാനവും
ഹൃദ്രോഗം
ജനിതകം
മാനസിക പിരിമുറുക്കം

സങ്കീർണ്ണതകൾ:

ടൈപ്പ് 2 പ്രമേഹവും ഹൃദ്രോഗവും
മദ്യപാനംകൊണ്ടല്ലാത്ത കരൾവീക്കം
ഹൈപ്പർ യൂറിസീമ (ഉയർന്ന യൂറിക് ആസിഡ്)
പോളിസിസ്റ്റിക് ഒവേറിയൻ ഡിസീസ്
ഉറക്കക്കുറവും കൂർക്കം വലിയും



പ്രമേഹം, മെറ്റബോളിക് സിൻഡ്രോം എന്നിവയുടെ ക്രമീകരണം

1. ദിവസേന 30 മിനിറ്റെങ്കിലും ശാരീരിക വ്യായാമം ചെയ്യണം.
2. പുകവലി, മദ്യപാനം എന്നിവ വർജ്ജിയ്ക്കുകയോ അവയുടെ ഉപയോഗം കുറയ്ക്കുകയോ ചെയ്യുക.
3. ധ്യാനനിഷ്ഠയിൽ കൂടി മാനസിക സമ്മർദ്ദം നിയന്ത്രിയ്ക്കുക.
4. ഡോക്ടർ നിർദ്ദേശിച്ചിരിയ്ക്കുന്ന അളവിലുള്ള ഇൻസുലിനും മറ്റു മരുന്നുകളും സമയാസമയങ്ങളിൽതന്നെ കഴിയ്ക്കണം.
5. ഭാരം കൂടുതലെങ്കിൽ വ്യായാമങ്ങൾ കൊണ്ടോ, ആഹാര നിയന്ത്രണം കൊണ്ടോ ശരീര ഭാരം കാത്തുസൂക്ഷിയ്ക്കുക.
6. ആഹാരക്രമ പരിഷ്ക്കരണം:

ആഹാരക്രമ പരിഷ്ക്കരണം

- 6 തവണയുള്ള ആഹാര രീതി; 3-4 മണിക്കൂർ ഇടവിട്ട് ചെറിയ അളവിൽ കഴിക്കുക. അമിതാഹാരവും ഉപവാസവും ഒഴിവാക്കുക.
- ആഹാരത്തിൽ ധാരാളം പച്ചക്കറികൾ, പ്രത്യേകിച്ച് പച്ചിലകൾ ധാരാളം ഉൾപ്പെടുത്തുക. ഉരുളക്കിഴങ്ങ്, മധുരക്കിഴങ്ങ്, മരച്ചീനി, കാച്ചിൽ, ചേമ്പ്, ക്യാരട്ട് മുതലായ കിഴങ്ങുവർഗ്ഗങ്ങൾ പരിമിതമായി മാത്രം ഉപയോഗിയ്ക്കുക.
- പഴച്ചാറുകൾക്ക് പകരം പഴങ്ങൾ അസംസ്കൃതമായി തന്നെ കഴിയ്ക്കുക. ഉൾപ്പെടുത്താവുന്നവ: ആപ്പിൾ, പപ്പായ, പേരയ്ക്ക, പെയർ, മാതളനാരങ്ങ, ഓറഞ്ച്, പീച്ച്, തണ്ണിമത്തൻ, തയ്ക്കുമ്പളം. പഞ്ചസാരയുടെ അളവ് കൂടുതലുള്ള മാമ്പഴം, ആത്തച്ചക്ക, സീതപ്പഴം, സപ്പോർട്ട, മുന്തിരിങ്ങ, ചെറുപഴം, ഏത്തപ്പഴം എന്നിവയുടെ ഉപയോഗം, ഒരു നേരം ഒരെണ്ണം എന്ന് പരിമിതപ്പെടുത്തുക.
- ചോറ്, ചപ്പാത്തി, റാഗി, ഓട്സ്, ചോളം, ചാമ, തിന എന്നിവ ഉപയോഗിയ്ക്കാം, എന്നാൽ അവയുടെ അളവ് വളരെ അധികമാകാതെ ശ്രദ്ധിയ്ക്കുക. അതിസൂക്ഷ്മമായി നേർമ്മ വരുത്തിയ ധാന്യമാവുകൾ ഒഴിവാക്കുക.
- പയർവർഗ്ഗങ്ങൾ എല്ലാം ഉൾപ്പെടുത്താം.
- കൊഴുപ്പ് കുറവുള്ള പാൽ, തൈര്, പനീർ എന്നിവ ഉൾപ്പെടുത്താം.
- മത്സ്യം, മാംസം, മുട്ട എന്നിവയുടെ കൊഴുപ്പു കുറഞ്ഞ കറികൾ കഴിയ്ക്കാം, വറുത്തത് ഒഴിവാക്കുക.

ആഹാരക്രമ പരിഷ്ക്കരണം

- സൺഫ്ളവർ ഓയിൽ, വെളിച്ചെണ്ണ, കപ്പലണ്ടി എണ്ണ, ഒലീവ് ഓയിൽ, നെയ്യ് എന്നിവ മിതമായ അളവിൽ, ഒരാൾക്ക് ഒരു ദിവസം 2-3 ടീ സ്പൂൺ എന്ന തോതിൽ കഴിയ്ക്കാം. എണ്ണയുടെ അളവ് കുറയ്ക്കാൻ നോൺസ്റ്റിക്ക് പാത്രങ്ങളിൽ പാകം ചെയ്യാം. വറുത്തതും പൊരിച്ചതുമായ ആഹാരങ്ങൾക്ക് പകരം ഗ്രിൽ / ബേക്ക്ചെയ്തവ കഴിക്കുക.
- നാരുകൾ കൂടുതലുള്ള ഭക്ഷണപദാർത്ഥങ്ങളായ പച്ചിലകൾ, മറ്റ് പച്ചക്കറികൾ, മുഴുവനായുള്ള ധാന്യങ്ങൾ, തൊലിയോടുകൂടിയ പഴവർഗ്ഗങ്ങൾ, നട്സ്, സീഡ്സ് എന്നിവ രക്തത്തിലെ പഞ്ചസാരയുടെ അളവും ശരീരഭാരവും കുറയ്ക്കും.
- പഞ്ചസാരയുടെ ഉപയോഗം കുറയ്ക്കുകയോ ഒഴിവാക്കുകയോ ചെയ്യുക, പകരം ശർക്കര ഉപയോഗിയ്ക്കുക. ഷുഗർഫ്രീ ഉൽപ്പന്നങ്ങൾ ഉപയോഗിയ്ക്കരുത്.
- സാലഡ്, പഴങ്ങൾ (മുഴുവൻ), നട്സ് (ഒരു പിടി), മുളപ്പിച്ച ധാന്യങ്ങൾ, സൂപ്പ്, മോര്, നാരങ്ങാ വെള്ളം (പഞ്ചസാര ഇടാതെ) മുതലായ ആരോഗ്യപ്രദമായ ലഘുഭക്ഷണങ്ങൾ തെരഞ്ഞെടുക്കുക.
- രക്തത്തിൽ ഗ്ലൂക്കോസ് അംശത്തിന്റെ സാരമായ അഭാവം (ഹൈപ്പോഗ്ലൈസീമിയ) അനുഭവപ്പെടുമ്പോൾ മിഠായിയോ പഞ്ചസാരയോ കഴിയ്ക്കുക.
- ഒരു ദിവസം 2-3 ലിറ്റർ വെള്ളം കുടിയ്ക്കുക.
- കഴിയ്ക്കുമ്പോൾ മൊബൈൽ ഫോൺ, ടി. വി. എന്നിവ കാണാതിരിയ്ക്കുക, കൂടുതൽ ആഹാരം അറിയാതെ കഴിച്ചു പോകും! നന്നായി ചവച്ചരച്ച് സാവധാനം ആഹാരം കഴിയ്ക്കുക.
- ഓരോ തവണയും കഴിയ്ക്കുന്ന ആഹാരത്തിന്റെ അളവ് കൂടാതിരിയ്ക്കാൻ പ്രത്യകം ശ്രദ്ധിയ്ക്കുക.