Lipid profile among type 2 diabetes mellitus young adult patients Attending Mnazi Mmoja Hospital, Zanzibar

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LIPID PROFILE AMONG TYPE 2 DIABETES MELLITUS YOUNG ADULT PATIENTS ATTENDING MNAZI MMOJA HOSPITAL, ZANZIBAR

By

Mohammed S. Juma

A Dissertation Submitted in (Partial) Fulfillment of the Requirements for the Degree of Master of Science (Biochemistry) of Muhimbili University of Health and Allied Sciences

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CERTIFICATION

The undersigned certify that I have read and hereby recommend for acceptance of thesis/ dissertation entitled **"Lipid profile among type 2 diabetes mellitus young adult patients attending Mmoja Hospital, Zanzibar***"* in (partial) fulfilment of the requirements for the degree of Master of Science (Biochemistry) of Muhimbili University of Health and Allied Sciences.

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Dr. F. A. Dida

(Supervisor)

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Date

DECLARATION AND COPYRIGHT

I, **Juma**, **Mohammed Saleh,** declare that, this **dissertation** is my own original work and that it has not been presented and will not be presented to any other University for the similar or any other degree award.

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DEDICATION

I dedicate my dissertation work to my family and many friends. A special feeling and gratitude thanks to my loving parents, for their supportive words of encouragement at all time in my study.

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ABSTRACT

Introduction: Diabetes is characterized by chronic hyperglycemia and disturbances of carbohydrate, lipid and protein metabolism. We aimed to research association between serum lipid profile and blood glucose, hypothesizing that early detection and treatment of lipid abnormalities can minimize the risk for atherogenic cardiovascular disorder and cerebrovascular accident in patients with type 2 diabetes mellitus.

Methods: This was a hospital-based cross-sectional study that was conducted at Mnazi Mmoja Hospital, Diabetic clinic in Zanzibar. MMH is the main referral hospital in Zanzibar. The hospital is located in the Stone Town, the historic centre of Zanzibar City. The hospital has an outpatient clinic, specialized clinics as well as several wards for in-patient services. Although termed as a referral hospital, basic outpatient services are also provided to the nearby communities. The study populations were those patients who presented themselves DC at Mnazi Mmoja hospital with type 2 diabetes, with the age between 18 to 45 years of age. Fasting blood glucose (FBG), total cholesterol (TC), high density lipoprotein (HDL), low density lipoprotein (LDL) and triglyceride (TG) levels were evaluated. Correlation studies (Pearson's correlation) were performed between the variables of blood glucose and serum lipid profile. Significance was set at $p<0.05$.

Results: Serum lipid and lipoproteins were significantly higher in diabetic patients compared to non diabetic subjects except HLD-C which is significantly lower in diabetic patients compared to non-diabetic subjects. Cholesterol mean level value in diabetic patients was significantly higher than the mean serum of non diabetic subjects ($p=0.001$).

Mean value of triglycerides in diabetic patients was significantly ($p=0.001$) increased compared to mean of non diabetic subjects. LD L-Cholesterol mean value in diabetic patients was statistically significant ($p=0.001$) higher than the mean value of non diabetic subjects.

Same results ($p<0.05$) were found when we compared glucose and lipid profile (TG, TC, LDL and HDL) in subgroups type2 DM and control subjects.

Conclusion: Serum levels of triglyceride, cholesterol, LDL-cholesterol were elevated in diabetic patient compared to non- diabetic subjects. Low level of serum HDL-cholesterol in diabetic patients compared to non diabetic subjects. Also there is a relation between levels of lipids and duration of diabetes. Inversely correlations were found between triglyceride and H D L-cholesterol may be due to dyslipidemia. No gender differences in lipid profile observed in diabetic patients. Patient's healthcare and public awareness is very low and most patients are not controlled and they are unaware of their condition. The majority of diabetic patients are unaware of their healthcare.

Recommendations: Measurement of serum lipid profile should be introduced to the management plan of diabetes. Large size of the samples and a long period is needed to study the effect of duration and gender. Also to establish regional and national training courses for diabetic educators and creation of new evidence based management plan for diabetics in Zanzibar for better healthcare and lastly regular test of glycosylated hemoglobin (Hb A lC) for each diabetic patients.

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LIST OF ABBREVIATIONS

Abbreviations	Name
4-AAP	4-Aminoantipyrine
4CP	4-Chlorophenol
ADP	Adenosine Diphosphate
AHA	American Heart Association
ATP	Adenosine Triphosphate
BMI	Body Mass Index
CE	Cholesterol Esterase
CHD	Coronary Heart Diseases
CO	Cholesterol Oxidase
DM	Diabetic Mellitus
DC	Diabetic Clinic
DHAP	Di Hydroxy Acetone Phosphate
EC	Ethical Clearance
FBG	Fasting Blood Glucose
FFA	Free Fatty Acids
FPG	Fasting Plasma Glucose

FSD	Female Sexual Dysfunction
GK	Glycerol Kinase
GPO	Glycerol-3-Phosphate Oxidase
GDM	Gestational Diabetes Mellitus.
GOD	Glucose Oxidase Dehydrogenises
GPO	Glycerol Phosphate Oxidase
H_2O_2	Hydrogen Peroxide
HBA	Hydroxy Benzoic Acid
HDL-C	High Density Lipoprotein Cholesterol
IR	Insulin Resistance
TYPE 1 DM	Insulin Dependent Diabetes Mellitus
IGT	Impaired Glucose Tolerance
IRAS	Insulin Resistance Atherosclerosis Study
LPL	Lipo Protein Lipase
LDL-C	Low Density Lipoprotein Cholesterol
MI	Myocardial Infarction
MRDM	Malnutrition-Related Diabetes Mellitus
MMH	Mnazi Mmoja Hospital

MMPL	Mnazi Mmoja Pathology Laboratory
MoHZ	Ministry of Health Zanzibar
MUHAS	Muhimbili University of Health and Allied Sciences
NCEP	National Cholesterol Education Program
NTYPE 1 DM	Non - Insulin Dependent Diabetes Mellitus
OGTT	Oral Glucose Tolerance Test
OR	Odd Ratio
PA	Physical Activity
PG	Plasma Glucose
POD	Peroxidase Oxidase Dehydrogenase
SPSS	Statistical Package for Social Sciences
T1DM	Type 1 Diabetes Mellitus
T2DM	Type 2 Diabetes Mellitus
TC	Total Cholesterol
TG	Triglycerides
VLDL-C	Very Low Density Lipoproteins Cholesterol

DEFINITION OF TERMS

Diabetes mellitus type 2 is a long term metabolic disorder that is characterized by high blood sugar, insulin resistance and relative lack of insulin.

Diabetes mellitus type 1 is a chronic condition in which the pancreas produces little or no insulin, a hormone needed to allow sugar (glucose) to enter cells to produce energy.

Insulin resistance (IR) is a pathological condition in which cells fail to respond normally to the hormone insulin.

Lipids defined as biological substances that are generally hydrophobic in nature and in many cases soluble in organic solvents.

Lipid profile or lipid panel is a panel of blood tests that serves as an initial broad medical screening tool for abnormalities in lipids, such as cholesterol and triglycerides

CHAPTER ONE

1.0 INTRODUCTION

1.1 Diabetes Mellitus

Diabetes mellitus (DM) is a multi-factorial disease which is characterized by hyperglycemia, (elevation of blood glucose level caused by a relative or absolute deficiency in insulin) lipoprotein abnormalities and oxidative stress (1) (2). Chronic hyperglycemia is associated with the long-term consequences of diabetes that include damage and dysfunction of the cardiovascular system, eyes, kidney and nerves (3). Diabetes mellitus is characterized by polyuria, polydipsia and weight loss in spite of polyphagia, hyperglycemia, glycosuria, ketosis, acidosis and coma. Furthermore feeling tired or ill, feeling irritable, urinating more than normal, being very thirsty, being very hungry, unexplained weight loss, blurred vision, fever, headache, and dry itchy skin may include symptoms of diabetes(4). There are wide spread biochemical abnormalities but the fundamental defects to which most of the abnormalities can be traced are reduced entry of glucose into various peripheral tissues and increased liberation of into the circulation from the liver. There is therefore an extra cellular glucose excess and in many cells, an intracellular glucose deficiency, there is also decrease in entry of amino acid into muscle and an increase in lipolysis (5).

Diabetic patients are at high risk for dyslipidemia, cardiovascular disease (CVD) and mortality (6)Dietary modification and lipid lowering medication can reduces serum lipid levels and lower the occurrence of (CVD) events (7).

In diabetic patients' lipid profile is characterized by an elevation in both postprandial and fasting plasma triglyceride (TG) and low level of HDL cholesterol (8) (9). Therefore in fact diabetes mellitus is characterized not only by alteration in glucose insulin axis but marked features described as the diabetic dyslipidemia(10). The increased lipid level and total cholesterol synthesis during hyperglycemia may contribute to the acceleration of atherosclerosis in diabetes mellitus (11).

Lipid profile, which is altered in diabetes state(12), is one of the significant factors in development of cardiovascular diseases studies have shown that increased plasma triglyceride and cholesterol levels may be a risk factor for vascular disease(13).

Also oxidative modification of LDL is an important step in the development of atherosclerosis (14). The prevalence of type 2 DM is increasing at dramatic rate, and the economic costs of caring for patients with diabetic complications are high, this increase in is closely associated with the epidemic of obesity in industrialized countries. Reduced physical activity is a contributing factor as sedentary lifestyles become more common. Increased body fat, particularly in the visceral compartment, is a strong risk factor for the development of type 2. Elucidation of such risk factors will lead to interventions that can delay the onset or protect against the development of type 2 DM.

1.2 Classification of Diabetes Meilitus

The World Health Organization has described diabetes under the clinical classes of DM and impaired glucose tolerance (IGT). The major classes of DM include:

- Type 1DM which is formally known as Insulin Dependent Diabetes Mellitus (TYPE 1 DM),
- Type 2 DM which is formally known as Non-Insulin Dependent Diabetes Mellitus (NTYPE 1 DM).

Persons with TYPE 1 DM require insulin treatment for survival, due to pancreatic islet (3-cell destruction and are prone to ketoacidosis.

Non-Insulin Dependent Diabetes Mellitus can progress to the state of requiring insulin treatment, but this progression is not necessarily related to p-cell destruction but rather to deficiency in insulin production or a condition of insulin resistance (a decreased biological response to insulin) (11).

- Gestational Diabetes Mellitus (GDM).
- Other types of diabetes mellitus associated with specific conditions.

1.3 Type 1 Diabetes Mellitus (TYPE 1 DM)

The onset of TYPE 1 DM or type 1diabetes is most common in children or young adults and accounts for around 10% or less of the total number of people with diabetes (15). Type 1 indicates the processes of (3-cells destruction that may ultimately lead to diabetes mellitus in which insulin is required for survival to prevent the development of ketoacidosis (acidosis due to an excess of ketone bodies, which accumulate due to the incomplete metabolism of fatty acids), coma and death. An individual with a type 1 process may be metabolically normal before the disease is clinically manifest, but the process of (3-cells destruction can be detected. Type 1 is usually characterized by the presence of anti-glutamic acid decarboxylase (anti-GAD) antibodies, islet cell or insulin antibodies which identify the autoimmune processes that lead to (3-cells destruction. In some subjects with this clinical form of diabetes, particularly non Caucasians, no evidence of an autoimmune disorder is demonstrable and these are classified idiopathic type l. Etiological classification may be possible in some circumstances and not in others. Thus, the category of type l diabetes can be identified if appropriate antibody determinations are performed(16).

1.4 Type 2 Diabetes Mellitus (NTYPE 2 DM)

The second type of diabetes mellitus is (TYPE 1 DM) or type 2 is more complex in etiology and characterized by a relative insulin deficiency reduce insulin action and insulin resistance of glucose transport in skeletal muscle and adipose tissue. It develops gradually without obvious symptoms and the progression to full diabetes ensues when pancreatic p-cells hyper secretion of insulin fails to compensate for insulin resistance (17). Type 2 DM usually diagnosed by tests that indicate glucose intolerance, it is linked with behavior (life style), environment and social factor such as over weigh and unhealthy dietary habits and obesity. Patients with type 2 DM have two to four fold increase in cardiovascular disease (CVD) and dramatically higher risk of accelerated cerebral and peripheral vascular disease (18). The metabolic alternation observed in NTYPE 1 DM are milder than those described for the insulin-dependent diabetes mellitus form of the disease, and are thought to be due to a combination of two factors dysfunctional P-cells and insulin resistance. The incidence and

prevalence of type 2 diabetes mellitus are rapidly increasing worldwide in both developing and developed nations (19).

1.5 Gestational Diabetes Mellitus

Gestational diabetes is a state of carbohydrate intolerance resulting in hyperglycemia of variable severity, with onset or first recognition during pregnancy. It does not exclude the possibility that the glucose intolerance may antedate pregnancy but has previously gone unrecognized. The definition applies irrespective of whether or not insulin is used for treatment or whether the condition persists after pregnancy.

Women who are known to have diabetes mellitus and who subsequently become pregnant do not have gestational diabetes but have (diabetes mellitus and pregnancy) and should be treated accordingly before, during and after the pregnancy (20). In the early part of pregnancy fasting and postprandial glucose concentrations are normally lower than in normal, non-pregnant women. Elevated fasting or postprandial plasma glucose levels may well reflect the presence of diabetes that antedates pregnancy, but criteria for designating abnormally high glucose concentration at this time in pregnancy have not yet been established. The occurrence of higher than usual plasma glucose levels at this time in pregnancy mandates careful management and may be an indication for carrying out an OGTT. Nevertheless, normal glucose tolerance in the early part of pregnancy does not itself establish that gestational diabetes will not develop later. Individuals at high risk for gestational diabetes include older women, obese, women those with previous history of glucose intolerance, any pregnant woman who has elevated fasting or casual blood glucose levels those with a history of gestational diabetes mellitus those with a history of large for gestational age babies, women from certain high risk ethnic groups and strong family history of diabetes mellitus. It may be appropriate to screen pregnant women belonging to high risk population groups during the first trimester of pregnancy in order to detect previously undiagnosed diabetes mellitus. Women at high risk who screen negatively and average risk women should be tested between 24 and 28 weeks of gestation (21).

1.6 Other Specific Types of Diabetes Mellitus

Other specific types are currently less common causes of diabetes mellitus, but are conditions in which the underlying defect or disease process can be identified in a relatively specific manner they include:

- Sub classed as obese or non obese DM and they are associated conditions and syndromes. Patients with TYPE 1 DM and NTYPE 1 DM are most commonly seen in physical therapy because of the microvascular and macrovascular complications of the disease. They will therefore be discussed in greater detail.
- Genetic defects in P-cells, such as maturity onset diabetes of the young.
- Genetic defects in insulin action, such as Leprechaunism.
- Diseases of the exocrine pancreas, such as cancer of the pancreas, cystic fibrosis and fibrocalculous pancreatopathy (a form of diabetes, which was formerly classified as one type of malnutrition related diabetes mellitus).
- Endocrinopathies, such as cushing syndrome, acromegaly and phaeochromocytoma.
- Drugs or chemicals, such as steroids and thiazides.
- Uncommon forms of immune related diabetes, such as the type associated with insulin receptor antibodies.
- Other rare genetic syndromes associated with diabetes, such as Klinefelter syndrome and Down syndrome (22).
- Malnutrition related diabetes mellitus (MRDM) it is associated with nutritional deficiency and is 'seen in tropical developing countries (23).

1.7 Hyperglycemia

Hyperglycemia is an increase in plasma glucose level due to abnormalities in glucose metabolism that are most commonly measured with threshold criteria for fasting plasma glucose (FPG) or 2-h plasma glucose (24). Major cause of hyperglycemia in diabetes is derangement of the glucostatic function of liver. Liver take up glucose from the bloodstream and stores it as glycogen but because the liver containing glucose 6-phophate it also discharges

glucose into the bloodstream. Hyperglycemia by itself can cause symptoms resulting from the hyperosmolality of the blood (25) .

Hyperglycemia of long duration is associated with structural and functional changes in capillary membranes, blood cells and platelets, nephrons and neurons. Many of these changes are brought about by the accumulation of compounds, the depletion of compounds, or the nonenzymatic linking of glucose and proteins or other macromolecules (26). Improved glycemic control has been reported to result in an improvement or slowed progression of the microvascular complications associated with DM (12).

1.8 Hypoglycemia

Hypoglycemia in diabetic patients is an abnormally low concentration of glucose in the blood caused by insufficient food intake excessive exercise or over dosage with oral hypoglycemic agents or insulin. The development of hypoglycemia is an ever present possibility in all patients with diabetes treated with insulin or oral hypoglycemic medications. Hypoglycemia symptoms are usually accompanied by feel nervous, shaky, weak, or sweaty. They may have a headache, blurred vision and be very hungry.

In more serious instances they may become unconscious. Taking small amounts of sugar or glucose containing juice or food will usually help the person feel better within 10-15 minutes (27).

The serious consequences of hypoglycemia relate to its effects on the brain, including loss of cognitive function seizure and coma. Prolonged or repeated episodes of hypoglycemia may produce permanent brain damage and the adrenergic response to the condition may be dangerous in people with cardiovascular disease.

The risk of hypoglycemia is particularly high when tight glycaemic control is sought. In the diabetes control and complications there was a threefold increase in the risk of severe hypoglycemia, including coma and/or seizures, when intensive insulin therapy was used. These episodes may occur with disproportionate frequency at night. Patients with autonomic neuropathy may have greater difficulty in detecting symptoms of hypoglycemia and/or recovering from it. (3-adrenoreceptor blockers may also impair detection of symptoms and/or

recovery and alcohol consumption may aggravate the risk of hypoglycemia and impair recovery. Delayed or missed meals and increased physical activity increase the risk of hypoglycemia in addition to oral hypoglycemic agents, particularly sulfonylurea, may also induce hypoglycemia (26).

1.9 Normal lipids Metabolism

Lipids defined as biological substances that are generally hydrophobic in nature and in many cases soluble in organic solvents (25). These chemical properties cover a broad range of molecules, such as fatty acids, phospholipids, sterols, sphingolipids, terpenes, and others (28). Lipid classes are fats, oils, waxes, and complex lipids involved in various biological processes such as sterols, phospholipids, glycolipids, lipoproteins and sphingolipids (29).

Lipids are first absorbed from the small intestine and emulsified by bile salts which are synthesized from cholesterol in the liver, stored in the gallbladder and secreted following the ingestion of fat. As an emulsion dietary fats are accessible to pancreatic lipase. The products of pancreatic lipase, i.e. free fatty acids (FFA) and a mixture of monoacylglycerols (MG) and diacyl glycerols (DG) from dietary TG diffuse into the intestinal epithelial cells where the resynthesis of triacyglycerols occurs.

Lipids are insoluble in plasma, thus their transport is mediated by lipoproteins which differ in particle size, composition and density. These are chylomicrons (CYM), very low density lipoproteins (VLDL), low density lipoproteins (LDL) and high density lipoproteins (HDL). All of them have a hydrophobic core containing TG and cholesteryl ester (CE) and a polar periphery with phospholipids (PL),cholesteryl (C) and apolipoproteins (30).

1.10 Diabetes Mellitus and Lipids

In DM changes in lipid levels and consequent disorders of lipid metabolism and stress have been observed (12). Such as increases in circulating levels of free fatty acids (FFA), triglycerides and dense low-density lipoprotein cholesterol particles together with reduced levels of high-density lipoprotein cholesterol levels (31). It is play an important role in pancreatic cell responses (32). FFA provided exogenously or produced in the cell are essential

to maintain proper nutrient induced insulin secretion. Acutely FFA generates an increase in glucose induced insulin secretion, whereas chronic exposure to elevated lipids results in cell exhaustion, impaired secretory response to glucose, and eventually, induction of cell apoptosis (32).

The principles abnormal of lipid metabolism in diabetes are acceleration of lipid catabolism, with increased formation of ketone bodies and decreased synthesis of fatty acid and triglycerides. The manifestations of the disordered lipid metabolism are so prominent the diabetes has been called more a disease of lipid than of carbohydrate metabolism. Fifty percent of an ingested glucose load is norm ally burned to CO_2 and H_2O 5% is converted to glycogen and 30-40% converted to fat in fat depots.

In diabetes less than 5% converted to fat even though the amount burned to CO_2 and H_2O is also decreased and the amount converted glycogen is not increased. Therefore, glucose accumulates in the bloodstream and spills over into the urine (25)

Recent study reported that insulin increases the number of LDL receptor so chronic insulin deficiency might be associated with a diminished level of LDL receptor. These cases the increase in LDL particles and result in increase in LDL cholesterol value in diabetes mellitus (33).

1.11 Ketoacidodis

Diabetic ketoacidosis remains a potentially lethal condition with mortality as high as 10%-15% however, at least 50% of cases are avoidable. M any new patients with type l DM present with ketoacidosis, so early recognition and diagnosis are clearly of importance. Ketoacidosis occurs when the body breaks down fatty acids and produces ketones, which are acidic. Some of the ketone bodies are lost through the urine, but those that remain will build up in the blood and lead to ketoacidosis. Signs of ketoacidosis include: nausea, vomiting, dry skin and mouth deep, rapid breathing, low blood pressure.

If the person is not given fluids and insulin right away ketoacidosis can lead to death. It is crucial to educate patients and health care personnel about precipitating factors and actions to be taken to avoid ketoacidosis.

Major precipitating factors include infection and other acute illnesses. In such situations insulin requirements are likely to increase. Omission or insufficient insulin intake is a major cause of diabetic ketoacidosis in some parts of the world. With proper instruction on monitoring of blood glucose and urine ketones, insulin dose adjustment and maintenance of fluid intake, many potential cases of diabetic ketoacidosis can be prevented; if vomiting occurs early referral for intravenous therapy is required.

It is rare for people with type 2 diabetes mellitus to develop ketoacidosis. It is much more common for them to develop the hyperglycemic hyperosmolar state in the face of severe infection or other major intercurrent illness. They usually present with dehydration, circulatory compromise and a change in mental state. Acidosis is uncommon, except when related to lactic acidosis due to hypoperfusion.

Serum ketones and electrolytes need to be monitored. Bicarbonate administration for type l diabetes is not recommended except in severe acidosis (pH <7.1) (33).

1.12 Cholesterol

Cholesterol is an unsaturated steroid alcohol containing 4 rings (A, B, C and D) it has single C-H side chain tail similar to fatty acid in the physical properties. It is oriented in lipid layers, and can be exist in an esterified form called cholesterol ester (CE).

Cholesterol has three types low-density lipoprotein (LDL-C) often called “bad” cholesterol because it carries cholesterol to the tissues of the arteries, causing plaque to build up and the blood vessels to narrow, high-density lipoprotein (HDL-C) it called “good” cholesterol because it helps to keep cholesterol from building up inside your blood vessels and keeps them from getting blocked higher levels of HDL can reduce the risk of cardiovascular disease and very-low density lipoprotein (VLDL-C) this form contains the highest amount of triglyceride like LDL, this is considered “bad cholesterol.” A value less than 32 mg/dl is desirable. VLDL is usually not measured directly and it can be calculated from the other lipoprotein concentrations (34).

In diabetes mellitus the plasma cholesterol level is usually elevated and this plays a role in the accelerated development of the atherosclerotic vascular disease that is a major long term

complication of diabetes in human. The rise in plasma cholesterol level is due to an increase in plasma concentration of VLDL and LDL, which may be due to increase hepatic production of VLDL or decrease removal of VLDL and form the circulation (35).

Hypercholesterolemia in diabetic patients is characterized by high levels of triglycerides (hypertriglycerides), high levels of small LDL particles and low levels of HDL. So dietary intake appears to be one of the most important factors to control level of lipid (33). In addition to Physical activity, it decreases both BMI and central fat accumulation (36) and can partly counterbalance the negative age related changes in lipid spectrum and increase in BMI by diminution of HDL decrease. The changes in lipids due to physical activity are largely independent of changes in body weight (28).

1.13 Triglycerides

Triglycerides is the most common type of lipid formed in animals it contain three fatty acid molecules attached to one molecule of glycerol by ester bond and containing saturated fatty acid which' do not have kinks in their structure, pack together more closely and tend to be solid at room temperature. In contrast triglycerides containing cis unsaturated fatty acid with bends in their structure, typically from oils at room temperature (34). Triacylglycerol (TG) is stored in lipid droplets in the cytoplasm of skeletal muscle. They can be mobilized by catecholamine, exercise and electrical stimulation the exercise induced decrease of TG can be reduced by Beta-adrenergic blockade. The effect of catecholamine on intramuscular TG is compatible with a role of hormone sensitive lipase (HSL) in muscle. A value below 150 mg/dl indicates no increased risk, 150 -200 indicates a slight risk, and over 200 mg/dl is a high risk.

Recent studies have demonstrated that in diabetic patients TG levels is a risk factor for CVD independent of HDL-C level and despite glycemic control, the incidence of macrovascular disease is increased two to five-fold in diabetics as compared to non diabetic patients. This is attributed mainly to diabetic dyslipidemia (30).

1.14 Diabetes Mellitus and Dyslipidemia

Dyslipidaemia in diabetic patients characterized by elevated triglyceride levels and decreased HDL cholesterol levels triglycerides are considered to have atherogenic properties. HDL is considered a protective lipoprotein because it contributes to reverse cholesterol transport (3). Dyslipidemia is com m on in diabetes and may contribute significantly to the excess risk of cardiovascular disease (CVD) among patients with type 2 diabetes (34). Type 2 diabetic patients typically have a preponderance of small, dense LDL particles, which possibly increases atherogenicity by a greater susceptibility to oxidation even if the absolute concentration of LDL cholesterol is not significantly increased. Hypertriglyceridem ia often is rather modest. As in non-diabetic individuals, lipid levels may be affected by factors unrelated to hyperglycemia or insulin resistance, such as renal disease, hypothyroidism and genetically determined lipoprotein disorders. Abuse of alcohol and estrogen replacement therapy may also contribute to hypertriglyceridemia. In well controlled patients with type 1diabetes there is only a small difference in plasma lipid levels compared with non-diabetic subjects. However, noticeable abnormalities in lipoprotein com position are observed in these patients despite good glycaemic control and near normal plasma lipid levels (33).

1.15 Conceptual Frame Work

A conceptual framework on lipid profiles among type 2 diabetes mellitus for young adult patients, based on the literature review provides an overview of the associated factors and its influence in development of dyslipidemia.

Therefore, having the associated factors like age, sex, smoking, insufficient education, sedentary life style, poor dietary intake and lack of exercise will lead to obesity, high cholesterol level and hypertension.

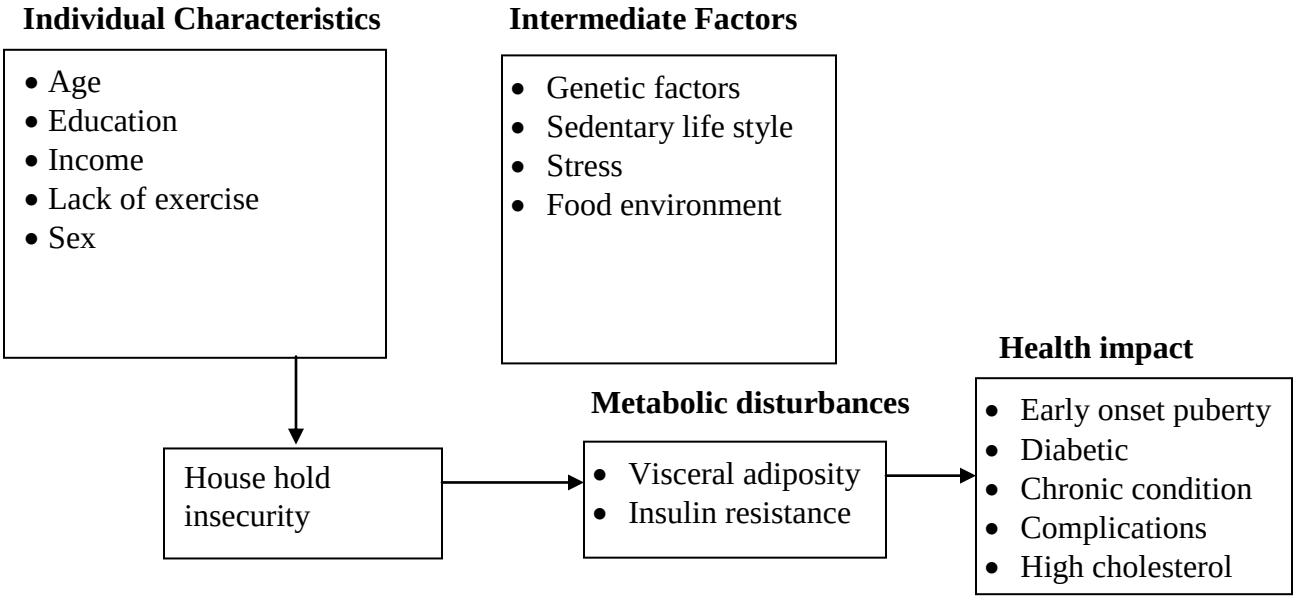

Figure 1: Presents a simplified overview of the concepts on how high cholesterol can be developed.

1.16 Statement of the Problem

Diabetes mellitus is the major health problem in this country because Zanzibar has had contact with middle-East Mediterranean civilization since ancient times. Zanzibar has many contacts with West Africa and the Eastern part have maintained close links of country undergone ethnic absorption of immigrant Arabs during times of Islamizing and culturally became arabised. About 50% of Zanzibar population who live in Unguja Island, town part of country, 20% of populations are south settlers and 30% live in north part. Regular internal migration in different part of Zanzibar has taken place from rural areas and small towns to big cities, particularly to the capital Zanzibar town. This has been compounded by displacement of large proportion of population from drought and famine prone areas in Zanzibar town. In recent years permanent external migration has also occurred. These cultural changes have lead to considerable progress in educational and health establishment as well as improvement in the standards of living. These social and economic advances were accompanied by change to modem life style characterized by higher caloric intake and less physical activity and the emergence of non communicable diseases such as diabetes mellitus a major health problem causing high morbidity and mortality. It can be estimated from the hospital record that the number of diabetic patients is increasing in all socioeconomic class. Type 2 DM accounts for almost 75% of all diabetic patients attending the Mnazi Mmoja Hospital diabetic clinic in Zanzibar.

NTYPE 1 DM is a common disease with sever clinical course and that most patient are poorly controlled and exhibit a high prevalence of acute and chronic complications (Elmahdi *et al.*, 1991; 1989).

Young adults with diabetes were poorly controlled, and received a minimum of diabetes care, long-term complications were common and associated with a high mortality rates among young adults patients. Poor metabolic control of Zanzibar diabetic patients was attributed to poor compliance and poor knowledge of diabetes and problem associated with injection and drug availability.

The ability of patients with diabetes to understand and manage their diseases in ordinary daily life is a most important for successful therapy. Despite the above studies, there is still a

paucity of information on diabetes in Zanzibar available knowledge has prompted us to conduct the current diabetes research, with the goal of contributing to the overall improvement of diabetes care in Zanzibar.

1.17 Rationale of the Study

The rationale of this study was to detect the lipid profiles abnormality in type 2 diabetic mellitus patients.

1.18 Research Question

1. What are the patterns of hyperlipidemia in patients with type 2 diabetes mellitus?
2. **What are the lipid derangements in patients with type 2 diabetes mellitus in Zanzibar?**
3. What is the level of knowledge among patients with type 2 DM?

1.19 Objectives

General objectives:

1. To evaluate serum lipids in Zanzibar type 2 diabetic mellitus patients.

Specific objectives:

1. To measure serum level of triglycerides, total cholesterol, low density and high density lipoprotein in Zanzibaris diabetic mellitus patients.
2. To assess the lipid derangement in patients with type 2 diabetic mellitus with respect to disease duration.
3. To assess level of knowledge among patients with type 2 DM in Zanzibaris.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Diabetes Mellitus and Etiology

Worldwide prevalence of diabetes is alarmingly high because diabetes mellitus is an important cause of morbidity and a major risk factor for cardiovascular disease, specially the increasing prevalence of type 2 diabetes is associated with the aging population, a significant rise in the prevalence of a sedentary lifestyle (3).

Body composition, obesity habitual physical activity (PA) levels, diet and smoking are factors that are at least partly etiology determined, and all are known to exert their own substantial and independent effects on insulin resistance and type 2 diabetes. Etiological factors clearly must play substantial role in determining type 2 diabetes prevalence, because type 2 diabetes has become dramatically more common in the last few decades. During this same time, factors such as habitual PA levels and body composition have changed substantially while negligible genetic alterations could have occurred over this time frame (14).

Dietary intake is a potentially modifiable risk factor. Indeed 60 to 90% of type 2 diabetes cases appear to be related to obesity or weight gain and smoking (9). In addition to moderate increases in physical activity and a w eight loss of 5% of initial body weight can reduce the risk of developing type 2 diabetes by 58% (37).

As WHO reported life style plays important role in DM prevention because lifestyle changes aimed at weight control and increased physical activity are important objectives in the prevention of type 2 diabetes mellitus. The benefits of reducing body w eight and increasing physical activity are not confined to type 2 diabetes they also play a role in reducing heart disease and high blood pressure. Lifestyle is the key to reversing these trends (5).

Diabetes mellitus (DM) defined as a metabolic disorder of multiple etiologies, characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both (1).

Chronic hyperglycemia is associated with the long-term consequences of diabetes that include dam age and dysfunction of the cardiovascular system, eyes, kidneys and nerves. The complications of diabetes are often divided into two groups: microvascular (retinopathy, nephropathy, and neuropathy) and macrovascular (ischaemic heart disease, stroke, peripheral vascular disease). These estimates relate to the direct burden of diabetes as a proximate cause and do not include the attributable burden of diabetes to renal failure and cardiovascular disease (38).

DM classified either the absence of insulin that is Insulin-Dependent Diabetes Mellitus TYPE 1 DM or type 1or which is insensitive to the insulin that is Non-Insulin Dependent Diabetes Mellitus NTYPE 1 DM or type 2 the most common form is effecting ever younger age groups striking young adults and even adolescents(39).

Most of the studies agreed that diabetes mellitus is an epidemic diseases in most countries it has become almost universal killer, it was announced that sugar has become the fourth largest diseases leading to death in the world, World Health Organization (WHO) estimated that the number of people with diabetes worldwide in year 2000 was 177 million, this increase to at least 336 million by the year 2030, with prevalence around 5.4% to major concern are that much of this increase will be in the developing countries (approximately 75% of all persons) (40).

DM is chronic illness that requires continuous medical care and educating patients on self management to achieve normal or near normal blood glucose levels in patients with diabetes and this will prevent acute complications and reduces the risk of long term complications(15).

DM include damage and dysfunctions for many organs and system s lipid abnormalities one of the diabetes dysfunctions, it commonly occurs in type 2, so that analysis of serum lipid has become an important health management, (American Diabetes Association) reported that lipid profile test to determine levels of serum total cholesterol, triglycerides, HDL cholesterol (HDL-C), and LDL cholesterol(LDLC).

Nevertheless, lipid testing rates among individuals with diabetes have been far less than ideal (A.D.A), and can be broadly categorized into two groups: those that are common to the general population, for example elevated total and LDL cholesterol and additional diabetes related abnormalities for example elevated triglycerides and reduced HDL cholesterol (24).

One study has shown 95% of all diabetic patients attending diabetes clinic were classified as having TYPE 1 DM however 75% were treated with insulin (Bani and Anokute., 1994).
The prevalence of sex dysfunction in diabetes mellitus population in Sudan has not sufficient attention yet. Currently no data reported on the relation between diabetes mellitus and sex dysfunction. But international study showed that diabetes has long been considered a major cause of impaired sexual function. Diabetic m en have substantially increased risk of erectile dysfunction (ED), it defined as a consistent inability to have an erection firm enough for sexual intercourse (13).

Although sexual dysfunction in women with diabetes have lagged behind those in men, likely due to several factors, including a lack of standardized definitions of sexual dysfunction in women, absence of well-validated scales, and societal taboos regarding female sexuality (11).

2.2 Diagnosis of Diabetes Mellitus

Diabetes is a silent disease so the diagnosis of it in an asymptomatic individual should never be made on the basis of a single abnormal glucose value, verification of the diagnosis with repeat testing is required, unless an individual presents with unequivocal hyperglycemia long with its classic symptoms. Diabetes often has no symptoms or warning signs. The only way to be sure is to have your blood tested for glucose (blood sugar). Many other metabolic abnormalities occur notably an increase in ketone bodies in the blood when there is severe lack of insulin (41).

The World Health Organization diagnosis diabetes mellitus is a fasting blood glucose > 7.0 mmol/1 (126 mg/dl) or plasma glucose concentration >11.1 mmol/1 (200 mg/dl) are clearly diagnostic of diabetes (22).

Glycosuria usually occurs when blood glucose values are greater than 180 mg/dl but this threshold varies considerably between individuals and increase with age.

For reliable result a glucose tolerance test should be performed in morning after an overnight fast with the patient sitting quietly. It is also important that he should have had normal meal for the last three days and should not have been dieting. False results may also occur if the patient has been ill recently or has had prolonged bed rest (42).

Blood glucose concentration are measured fasting and then every half an hour (For two hours) after drink of 75 g of glucose in 250-350 ml water (in children 1-75 g/kg to a maximum of 75 g), urine tests should be performed before the glucose drink and at one and two hours. (The oral glucose tolerance test (OGTT) (42).

In diabetes, glucose piles up in the bloodstream, especially after meals. If glucose load is given to a diabetic, the plasma glucose rises higher and returns to the base line more slowly than it does in normal individuals. The response to a standard oral test dose of glucose, the oral glucose tolerance test, is used in the clinical diagnosis of diabetes. Impaired glucose tolerance in diabetes is due in part to reduced entry of glucose in to cells (decreased peripheral utilization) in the absence of insulin, the entry of glucose in to skeletal, cardiac, and smooth muscle and other tissues is decreased (35).

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study Design and Study Site

This is a hospital-based cross-sectional study that was conducted at Mnazi Mmoja Hospital, Diabetic clinic in Zanzibar. MMH is the main referral hospital in Zanzibar. The hospital is located in the Stone Town, the historic centre of Zanzibar City. The hospital has an outpatient clinic, specialized clinics as well as several wards for in-patient services. Although termed as a referral hospital, basic outpatient services are also provided to the nearby communities.

3.2 Study Population

The study populations are those patients who presented themselves DC at Mnazi Mmoja hospital with type 2 diabetes, with the age between 18 to 45 years of age.

3.3 Samples Size Calculation

The sample size was calculated using the formula for a single proportion. The following assumptions were made to allow sample size calculation.

Prevalence of 16.5% study done in Sudan by **Abdelmarouf** CC *et al*

Confidence limit of 95% (z=1.96)

Margin of error (ε) of 5%:

$$n = \frac{Z^2 p(100-p)}{\varepsilon^2}$$

$$= \frac{1.96^2 \times 16.5\ (100-16.5)}{5^2}$$

Sample size = 211 was used in this study.

3.4 Inclusion Criteria

1. Patients with Type 2 diabetes aged between 18 to 45 years of age
2. Who consented to participate in the study

3.5 Exclusion Criteria

1. Patient with T1DM
2. Patients with pregnancy
3. Patients with known malignancy
4. Patients had undergone any invasive procedure or surgery in the last three months.
5. Patients with communicable diseases.

3.6 Data Collection and Sampling Procedure

Convenient sampling was done in which all patients with T2DM were enrolled. All patients who presented themselves with history of Type 2 diabetes were screened first to confirm their status. Patients who met inclusion criteria and gave consent to participate were enrolled. Patients were asked some important questions containing socio-demographic information . Blood samples were collected from every patient who consented for blood drawn.

3.7 Sample Collection

Approximately 4.0 ml of venous blood was collected aseptically by a staff nurse and I in empty sterile tube. The collected blood was centrifuged and serum obtained was stored at -20°C. All samples were transported in a cool box to (PLMMH), laboratory for analysis using MINDRAY BS 200 Chemistry Analyzer.

3.8 Laboratory Procedures

All patients with Type 2 diabetes were screened for Lipid profiles including (TG, TC, LDL, HDL) and CK-MB using MINDRAY BS 200 Chemistry Analyzer machine was conducted at PLMMH.

3.9 Triglycerides -TG

Triglycerides are enzymatically hydrolyzed by lipase to free fatty acids and glycerol. The glycerol is phosphorylated by adenosine triphosphate (ATP) with glycerol kinase (GK) to produce glycerol-3-phosphate and adenosine diphosphate (ADP). Glycerol-3-phosphate oxidase (GPO) producing hydrogen peroxide (H_2O_2). In a color reaction catalyzed by peroxidase, H_2O_2 reacts with 4-aminoantipyrine (4-AAP) and 4-chlorophenol (4-CP) to produce a red colored dye. The absorbance of this dye is proportional to the concentration of triglyceride present in the sample.

3.9.1 Total Cholesterol (TC)

Cholesterol esters are enzymatically hydrolyzed by cholesterol esterase to cholesterol and free fatty acids. Free cholesterol, including that originally present, is then oxidized by cholesterol oxidase to cholest-4-ene-3-one and hydrogen peroxide. The hydrogen peroxide combines with hydroxybenzoic acid (HBA) and 4-aminoantiprine to form a chromophore (quinoneimine dye) which is quantitated at 500nm.

3.9.2 Low Density Lipoprotein (LDL)

LDL Cholesterol is calculated using the Friedewald as follows:

LDL cholesterol = Total cholesterol – HDL cholesterol – Total triglyceride ÷ 2.2

3.9.3 High Density Lipoprotein (HDL)

The method uses two reagent formats and depends on the properties of a unique detergent. The method is based on accelerating the reaction of cholesterol oxidase (CO) with non HDL unesterified cholesterol and dissolving HDL cholesterol selectively using a specific detergent. In the first reagent, non-HDL unesterified cholesterol is subject to an enzyme reaction and the peroxide generated is consumed by a peroxide reaction with DSBmT yielding a colorless product. The second reagent consists of a detergent (capable of solubilizing HDL cholesterol), cholesterol esterase (CE) and chromogenic coupler to develop color for the quantitative determination of HDL cholesterol.

3.10 Data Management and Analysis

Data entered cleaned and analyzed using SPSS version 21. Frequencies were calculated. Logistic regression was analyzed using results obtained as a dependent variable and the socio-demographic characteristics as independent variables. Odd ratios and 95% confidence interval was calculated and $P < 0.05$ was considered to be statistically significant.

3.11 Ethical Issues

Ethical clearance was obtained from the MUHAS Senate Research and Publication Committee and research permission from Ethical Committee of the Ministry of Health Zanzibar. All patients were fully informed about the study and assured that all information related to this study would be kept confidential. Sample collection and interview of the patients were done after obtaining written informed consent.

During the study, all study samples were unlinked anonymously. Patients' information was protected and nobody other than the principle investigator was allowed to access. All patients who were diagnosed abnormal treated according to hospital treatment guidelines. Counseling and health education was provided to all participants whose samples diagnosed elevated in significant rates.

CHAPTER FOUR

4.0 RESULTS

Two hundred and eleven (211) subjects composed of 161 diabetic subjects and 50 healthy controls were enrolled in the study. Of the diabetic patients 113 (53.5%) were females and 98 (46.5%) were males, even though 29 (58%) of healthy control subjects were females and 21 (42%) were males.

Table 4.1: Socio demographic characteristic of the study respondents

Characteristics	Response	Tot no (%)	Female	Male
Educational level	No Formal Education	7 (3.3%)	4 (57.1%)	3 (42.9%)
	Did not Complete Primary	8 (3.8%)	6 (75%)	2 (25%)
	Primary Education	17 (8.0%)	8 (47%)	9 (53%)
	Secondary Education	153 (72.5%)	62 (40.6%)	91 (59.4%)
	Tertiary Education	26 (12.3%)	12 (46.1%)	14 (53.9)

Table (4.2). Represents the mean age, height, weight and body mass index. Patients and control subjects were both overweight. Plasma glucose level and Serum lipid profile triglyceride (TG), (total cholesterol (TC), Low -density lipoprotein cholesterol (LDL-C), High-density lipoprotein cholesterol (HDL-C) were measured. The mean and standard deviation (SD) of all parameters were reported.

Table 4.2:Essential Physical Data of Diabetic Patients and Control Subjects (Mean ± SD)

Characteristic	Diabetic patients	Control subjects	P-values
Age (YR)	51.20 ± 11.203	45.72±11.169	0.002
Weight (Kg)	60.02± 13.429	61.02± 13.181	0.711
Height (Cm)	165.82 ±8.573	167.28±9.450	0.360
BMI (Kg/m^2)	25.5915±4.05637	25.3248±3.90677	0.698

4.1. Lipid Profile: TC, TG, LDL, HDL and VLDL Concentrations

All serum lipid and lipoproteins were significantly higher in diabetic patients compared to non diabetic subjects except HLD-C which is significantly lower in diabetic patients compared to non-diabetic subjects. Cholesterol mean level value in diabetic patients was significantly higher than the mean serum of non diabetic subjects (p=0.001).

Mean value of triglycerides in diabetic patients was significantly (p=0.001) increased compared to mean of non diabetic subjects. LD L-Cholesterol mean value in diabetic patients was statistically significant (p=0.001) higher than the mean value of non diabetic subjects.

Serum HDL-Cholesterol mean value was significantly (p= 0.001) lower in diabetic patients compared to the mean of non diabetic subjects. As shown in table (3.2). Same results ($p<0.05$) were found when we compared glucose and lipid profile (TG, TC, LDL and HDL) in subgroups type2 and control subjects. As shown in figures (3.1)

Table 4.3: Levels of Glucose and Serum Lipid Profile in Diabetic Patients and Control Subjects.

Measurement (mg/dL)	**Diabetic patients (Mean SD)**	**Non-Diabetic subjects (Mean ±SD)**	**p- value**
GL	159.000±63.9692	81.00±16.247	0.001
TG	137.915±59.0534	111.040±29.8395	0.001
TC	176.807±36.0918	144.912±34.1804	0.001
LDL	151.224±64.0362	177.714±26.2476	0.001
HDL	44.80±15.7758	51.894±10.5376	0.001

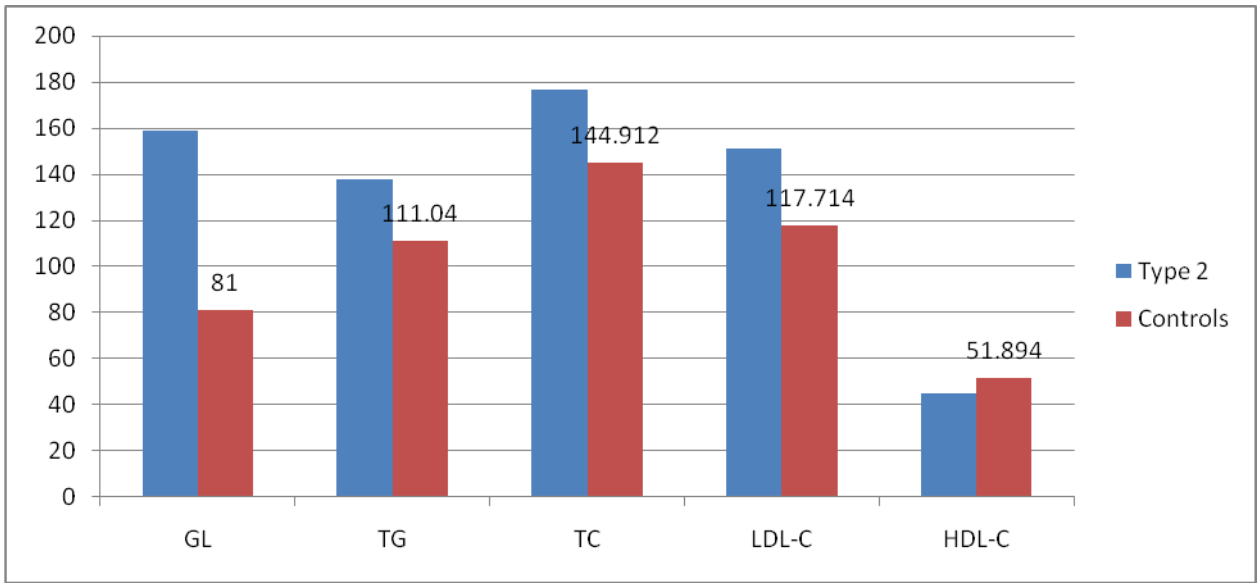

Figure 2.1: Mean values of glucose and lipid profile (TG, TC, LDL, HDL. mg/dl) of type2 diabetic patients and non diabetic subjects.

4.2. Gender and Diabetic Patients

Among diabetic patients, males had higher level of glucose, triglycerides, LDL, HDL and lower level of cholesterol as compared to females. This differences were statistically not significant ($p>0.05$). As shown in table (3.3).

Table 4.4: Levels of Glucose and Lipid Profile in Males and Females Diabetic Patients.

Measurement mg/dl	**Female diabetic patients (Mean ± SD)**	**Male diabetic patients (Mean ± SD)**	**p-value**
GL	153.720±59.2818	164.280±68.530	0.412
TG	133.250±46.6038	142.580±69.4943	0.433
TC	180.118±38.4228	173.496±33.6621	0.362
LDL	142.966±65.2019	159.482±62.4058	0.199
HDL	43.746±15.1988	45.856±16.4182	0.506

CHAPTER FIVE

5.0 DISCUSSION

5.1. Prevalence of Diabetes Mellitus

The incidence of diabetes mellitus and its complications is markedly increasing in different part of the world according to the WHO and researches took place in Sudan (4).

All these reasons lead to increase of diabetes mellitus complications. Up normal levels of lipids profile one of the complications. In the present study we determined the prevalence of lipid profile, healthcare standards and patients' knowledge among Zanzibar diabetic patients

5.2. Glucose Level

Diabetic patients are characterized by abnormalities in glucose metabolism in several organs, skeletal muscle glucose disposal is reduced, hepatic glucose production is increased and type 2 glucose uptake into the lens and neural tissue are increased (43). Although the actual mechanisms of insulin resistance in type2 diabetes remain unknown, several steps in the uptake and intracellular handling of glucose are probably affected (28). Measuring blood glucose is one way of monitoring diabetes.

In this study diabetic patients have abnormal level in blood glucose compared with non diabetic subjects. Significant difference was observed ($p=0.001$), the same result ($p=0.\ 0.001$) was found between diabetic subgroups type2 and control subjects. High levels of blood glucose of diabetic patients due to lack of or resistance to insulin, same results were found by (39). In their studies of diabetic population in which they conclude that, the fasting blood glucose level is also elevated and this indicates poor control of DM. In fact diabetes mellitus is characterized by hyperglycemia together with biochemical alterations of glucose (27).

5.3. Lipid Profile

Lipid and lipoprotein abnormalities are common in the diabetic population due to the effects of insulin deficiency and insulin resistance on key metabolic enzymes (Decode study group., 1999). Glucose tolerance, insulin resistance and plasma insulin levels have been implicated in

abnormal plasma lipoprotein levels and hyperinsulinaemia has been linked with the development of atherosclerotic vascular complications in diabetic patients (44).

The result of this study showed significant increased levels of total cholesterol (p=0.001) in diabetic patients compared to non-diabetic subjects, this increase it may be due to an increase in the plasma concentration of V LD L and LDL, which may be due to increase hepatic production of VLDL or decreased removal of VLDL and LDL from the circulation (35).

The study suggest significant increased level of LDL (p=0.001) in diabetic patients due to insulin increases the number of LDL receptor; the deficiency might be associated with a diminished level of LDL receptor. This causes the increase in LDL particles and result in the increase in LDL-cholesterol value in diabetes mellitus (33). So that patients with small, dense LDL-C will also typically have lower HDL-C and elevated TG blood levels, which may further increase risk of atherosclerosis (12).

Significant higher level of triglycerides (p= 0.001) in Zanzibar diabetic patients may due to overproduction or increased plasma levels of triglyceride which, via an exchange process mediated by cholesterol ester transfer protein (CETP), result in lower levels of high density lipoprotein HDL-cholesterol, also may be due to insulin deficiency which results faulty glucose utilization causes hyperglycemia and mobilization of fatty acids from adipose tissue. In diabetes blood glucose is not utilized by tissue resulting in hyperglycemia. The fatty acids from adipose tissue are mobilized for energy purpose and excess fatty acid is accumulated in the liver, which are converted to triglyceride (30). The most frequent alterations of lipid profile were combination of elevated TGs, decreased clearance of TG rich lipoproteins and decreased high-density lipoproteins HDL-C (37).

An increased percent body fat was identified with higher levels of TC and decreased HDL-C due to decrease in hepatic lipase activity resulting in metabolic abnormalities characterizing metabolic syndrome (15).

Significant lower level of HDL ($p=0.001$) in diabetic patients compared to non diabetic subjects. Lower HDL cholesterol level is attributed to triglyceride enrichment by cholesterol ester transfer protein and increased hepatic triglyceride lipase activity (24). Although HDL particles are produced by the liver, a significant portion of them are formed from remnant particles of TG-rich lipoproteins as they are metabolized. This metabolism is often defective in diabetes, reducing the production of HDL-C from this source, a protein called cholesterol ester transport protein (CETP) transports cholesterol ester away from HDL particles in exchange for TG from VLD L particles. This transport lowers HDL-C in the blood, which also promotes for small, dense LDL particles (12).

The same results ($p<0.05$) were found between subgroups Type2 diabetic patients they compared to non diabetic subjects. Elevated lipid and lipoprotein level in diabetic patients may be due to insulin resistance because impaired insulin action increase free fatty acid release from intra-abdominal adipose tissue promoting lipoprotein lipase activity results in reduced triglyceride clearance (35). The same findings were reported in other studies (45) Lipid levels effected with glucose levels because carbohydrates and lipid metabolism are interrelated to each other if there is any disorder in carbohydrate metabolism will lead disorder in lipid metabolism so there is high concentration of cholesterol and triglycerides and due to reduction in HDL cholesterol levels because insulin resistance with or without hyperglycemia is associated with qualitative changes in the lipid profile (24).

Similar findings were obtained by other researchers (6)

5.4. Gender and Diabetes Mellitus

Both male and female diabetic patients were overweight and females had significantly higher BMI than males ($p=0.001$). But no significant difference ($p>0.05$) were found between them in levels of GL, TG, TC, LDL-C and HDL-C. It might be related to different degrees of insulin resistance between the two sexes or to a direct effect of the hormonal status on one or more enzymes implicated in lipoprotein metabolism (46).

In addition, many variables may have different effects such as age at onset of disease, duration of diabetes and H bA lc and drug compliance (20) . Dietary compositions seem to affect the lipid profile (39). Also physical activities, obesity, hypertension, smoking, contraceptive use, environment, occupation and level of education and certain genetic predisposing factors of the population(6). Higher levels of fat in the cells prevent the action of insulin, and so produce insulin resistance and type2 DM development. The high prevalence of obesity has largely been attributed to the dietary habits, which include high intake of fatty and sweet foods and dates, lack of physical activity (41). Same results were reported by other researches (15).

5.5. Correlation between Glucose and Lipid Profile

There was a significant positive linear correlation between elevated blood glucose and triglycerides, total cholesterol, LDL and negative correlation between glucose and HDL -C. This is an important finding which shows that hyperglycemia is closely associated with hypercholesterolemia, hypertriglyceridemia, elevated LDL, and reduced HDL which was all documented as risk factors for CHD.

Therefore diabetic patients with lack of diabetic control (high FBS) have higher lipids, less HDL cholesterol. This also points to the significance of control of blood glucose in diabetic patients.

In addition, correlation studies within the lipid groups also showed interesting results. As cholesterol increased, it was accompanied with increase in triglyceride, LDL while HDL decreased. Similar findings with triglyceride levels, which correlated positively with LDL but negatively with HDL. These results stress the need for control of plasma cholesterol and triglyceride levels in order to have lower LDL levels and elevated HDL levels. These latter two parameters (Low LDL and high HDL) are also protective against CHD. This shows that the various lipids and lipoproteins are closely correlated with each other, and control of one influences the others.

This is in agreement with the reports of (17). That long-standing hyperglycemia rather than blood glucose level is broadly related to the diabetic complications seen in the diabetics.

The correlation analysis carried out in this study showed that increases in the duration of diabetes, glucose and lipid values were significantly increased. This increase may due to poor glycemic control and age-related pathology with duration of diabetes were thought to accelerate degenerative changes in a cooperative manner (7). This finding was in agreement with (47).

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Serum levels of triglyceride, cholesterol, LDL-cholesterol were elevated in diabetic patient compared to non- diabetic subjects. Low level of serum HDL-cholesterol in diabetic patients compared to non diabetic subjects. Also there is a relation between levels of lipids and duration of diabetes. Inversely correlations were found between triglyceride and H D L-cholesterol may be due to dyslipidemia. No gender differences in lipid profile observed in diabetic patients. Patient's healthcare and public awareness is very low and most patients are not controlled and they are unaware of their condition. The majority of diabetic patients are unaware of their healthcare.

6.2 Recommendations

Measurement of serum lipid profile should be introduced to the management plan of diabetes. Large size of the samples and a long period is needed to study the effect of duration and gender. Also to establish regional and national training courses for diabetic educators and creation of new evidence based management plan for diabetics in Zanzibar for better healthcare and lastly regular test of glycosylated hemoglobin (Hb A lC) for each diabetic patients.

6.3 Conflict of Interests

The author declares that there was no conflict of interests in writing this paper.

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APPENDICES

Appendix I: Data Collection Tool

Demographic information

First name Middle name Last name

Male Female

Age Weight Height

Address Duration of living with diabetes

Level of Education

- ☐ Non formal education
- ☐ Primary level
- ☐ Secondary level
- ☐ Higher secondary
- ☐ University levels

Investigation required (CORONARY HEART DISEASE)

Lipid profiles

- ☐ Total cholesterol
- ☐ LDL
- ☐ HDL
- ☐ Triglyceride

Sample type ……

Date collected---------- Time collected…….

Collected by……

LABORATORY RESULTS

Total cholesterol----------

LDL----------

HDL----------

Triglyceride----------

Signature----------

Appendix II: Dodoso

Taarifa za awali

Jina la kwanza | Jina la kati | Jina la Ukoo

Jinsia Mme ☐ Mke ☐

Umri ☐ Uzito ☐ Urefu ☐

Anwani ☐ Muda wa kuishi na Kisukari ☐

Kiwango cha Elimu

- ☐ Isiyo rasmi
- ☐ Shule ya msingi
- ☐ Sekondari
- ☐ Sekondari ya juu
- ☐ Elimu ya Chuo Kikuu

Vipimo vinavyohitajika (Magonjwa ya Moyo)

Lipid profiles

- ☐ Kiwango cha mafuta kwa ujumla
- ☐ Mafuta ya uzito mwepesi
- ☐ Mafuta ya uzito mkubwa
- ☐ Triglyceride

Aina ya sampuli ……

Tarehe…….. Muda …….

Mkusanyaji ……

Majibu ya Mahabara

Kiwango cha mafuta kwa ujumla ----------

Mafuta ya uzito mwepesi ----------

Mafuta ya uzito mkubwa----------

Triglyceride----------

Sahihi----------

Appendix III: Data interpretation tool

In my study for coronary heart diseases was determined the levels of lipoprotein panels and Creatine Kinase.

A lipoprotein panel is a blood test that can help to show whether there are associated risks for coronary heart disease (CHD). This test looks at substances in the blood that carry cholesterol.

A lipoprotein panel gives information about:

Triglycerides (TG), Total cholesterol consists of HDL cholesterol and LDL cholesterol. Levels are reported in either mg/dL or µmol/L.

TG is a type of fat in the blood. The normal value is up to 1.75 mmol/L. Above this amount was considered as high amount.

The American Heart Association defines normal total cholesterol as <=5.2 mmol/L. (160-189 mg/dL). Above this limit was considered as high amount of cholesterol.

HDL ("good") cholesterol. This type of cholesterol helps decrease blockages in the arteries. The normal amount is up to <=0.9 mmol/L. above this amount was considered as high value.

LDL ("bad") cholesterol. This is the main source of cholesterol buildup and blockages in the arteries. The normal values are between <=2.59 mmol/L, above this limit was considered as high value.

A lipoprotein panel measures the levels of LDL and HDL cholesterol and triglycerides in the blood. Abnormal LDL and HDL levels may be signs of increased risk for CHD.

Appendix IV: Informed Consent Form (English Version)

ID.NO						

Consent to Participate in ……..

Hello! My name is Mr/Miss … ……. and I am a nurse working on this research project with the objective of investigating the Lipid profiles from diabetes patient among patients at MM/Hospital Zanzibar.

Purpose of the study

We are determining the lipid profiles among Type 2 diabetic patients using a method called Spectrophotometric technique. Participating in this research will bring the patient to know their cardiovascular complication after laboratory investigation and the appropriate management of the case.

What Participation Involves

If you agree to join the study you will be required to give some blood specimen, answer questions, be examined and interviewed.

Confidentiality

All information we collect on forms will be entered into computers with only the study identification number.

Risks

We do not expect that any harm will happen to you because of joining this study, sometimes minor bruise and pain may occur during withdrawal of blood sample.

Rights to withdraw and Alternatives

Taking part in this study is completely your choice. If you choose not to participate in the study or you decide to stop participating in the study you will continue receive all services you would normally get from this hospital. You can stop participating in this study at any time

even if you have already given your consent. Refusal to participate or withdrawal from the study will not involve penalty or loss of any benefits to which you are otherwise entitled.

Benefits

If you agree to participate in this study, you will understand your cardiovascular complication caused by your diabetes status. However, like all participants you will benefit from seeing a physician accordingly and being followed closely by our nurses to make sure you are getting the best available treatment.

In case of Injury

We do not anticipate that any injury will occur to you as a result of participation in this study. However, if any physical injury resulting from participation in this research occurs, we will provide you medical treatment according to the current standard of care in Zanzibar. There will be no additional compensations to you.

Who to Contact

If it happens to have any question about this study, you should contact the study coordinator or the Principal Investigator Mr Juma, Mohammed Saleh, Muhimbili University of Health and Allied Sciences, P.O.Box 65001, Dar es Salaam. If you have any question about your rights as a participant, you may call Prof. ……., Chairman of the Senate Research and Publications Committee, P.O.Box 65001, Dar es Salaam. Tel: **Signature:**

Do you agree?

Participant agree…… Participant not agree…….

I, …….have read the contents in this form. My questions have been answered. I agree to participate in this study.

Signature of participants…….

Appendix V: Informed Consent Form (Swahili Version)

CHUO KIKUU CHA AFYA YA TIBA MUHIMBILI
KITIVO CHA SAYANSI YA AFYA
KARATASI YA USHIRIKI

Nambari ya utambuzi | | | | | | |

Uthibitisho wa kushiriki ……..

Habari! Jina langu naitwa Bw/Bibi … ……. Ni muuguzi nafanya kazi katika utafiti huu ambao lengo lake ni kuangalia uwepo wa mafuta mazuri na mabaya yanayotokana na ugonjwa wa kisukari katika hospital ya Mnazi Mmoja Zanzibar.

Lengo la utafiti huu

Utafiti huu utaangalia uwepo wa mafuta mazuri na mabaya yanayopatikana kutokana na ugonjwa wa kisukari kwa kutumia njia mpya na ya kisasa ijulikanayo kama fotometrik System. Ushiriki wako katika utafiti huu utapelekea kujua kiwango cha mafuta mwilini yatokanayo na ugonjwa wa kisukari ambao upo katika mzunguko wako wa damu baada ya kuchunguza damu yako Maabara, na pia itasaidia ni aina gani ya utabibu utumike katika kukuondoshea matatizo husika.

Mchango tarajiwa kutoka kwa mshiriki

Iwapo umekubaliana na ushiriki katika utafiti huu utatakiwa usaidie kiwango kidogo cha damu, uchunguzwe afya yako na utusaidie katika kujibu maswali machache ambayo tutakuuliza.

Usiri wa taarifa katika utafiti huu

Taarifa zote zitakazokusanywa zitaingizwa katika computer pamoja na nambari ambayo mshiriki atapatiwa, majina yatabakia kuwa katika makaratasi ambayo yatahifadhiwa kwa usiri mkubwa na mtafiti mkuu.

Mazingira hatarishi

Hatutarajii kupatwa na tatizo lolote kutokana na ushiriki wako, kama itatokea ni maumivu hafifu wakati wa kuchukua damu kutoka kwa mshiriki.

Haki ya kujiondoa katika utafiti huu

Kushiriki katika utafiti huu ni jambo la hiari. Kama utaamua kutoshiriki katika utafiti huu au kujiondoa katika utafiti bado utaendelea kupata haki zote za msingi amabazo kikawaida ulipaswa kupatiwa. Unaweza kujiondoa mda wowote hata kama ulishatia saini katika hati ya makubaliano. Kukataa kushiriki au hutotozwa gharama yoyote na haki zako zote utapata kama inavyostahiki.

Faida

Kama utachagua kushiriki katika utafiti huu, utapata kueleweka ni tatizo la moyo linalotokana na ugonjwa wa kisukari. Cha Zaidi na muhimu ni kupata fursa ya kuonekana na daktari na kufatiliwa kwa ukaribu na muuguzi wetu ili kuhakikisha unapata tiba sahihi.

Kama itatokezea ajali

Kama tulivyosema mwanzoni kwamba hatutarajii kupatwa na tatizo lolote kutokana na ushiriki wako. Lakini iwapo ajali itatokeazea kwako kutokana na kushiriki kwako katika utafiti huu, uongozi unakuhakikishia kukupatia tiba kwa kuzingatia viwango vya tiba vitolewavyo Zanzibar. Hakutokua na marejesho ya ziada kutokana na kupata ajali baada ya kutibiwa.

Kwa mawasiliano

Kwa maswali ya aina yoyote kuhusu utafiti huu, utatakiwa uwasiliane na Mratibu wa Utafiti au Mtafiti mkuu Mr Juma, Mohammed Saleh. Chuo Kikuu cha Sayansi za Afya-Muhimbili, S.L.B 65001, Dar es Salaam. Ukiwa na swali lolote kuhusu haki zako kama mshiriki, unaweza kumpigia Prof……. ……., Mwenyekiti wa Kamati ya Seneti ya Utafiti na Machapisho, S.L.B 65001, Dar es Salaam. Simu…….:

Sahihi:

Je umekubali kushiriki?

Mshiriki amekubali…… Mshiriki kama amekataa…….

Mimi, …….nimesoma karatasi ya uthibitisho wa kushiriki. Maswali yangu yote yamejibiwa. Nakubali kushiriki katika utafiti huu.

Sahihi ya mshiriki……Sahihi ya mwakilishi wake…….……

Sahihi ya msaidizi mtafiti……..Tarehe ya makubaliano……