



Sudan University of Science and Technology (SUST)

College of Graduate Studies



Assessment of Plasma Total Cholesterol, High Density Lipoprotein and Low Density Lipoprotein Levels among Metabolic Syndrome Patients in Khartoum State

تقييم مستويات الكوليسترول الكلي والبروتين الدهني مرتفع الكثافة والبروتين الدهني منخفض الكثافة في بلازما المرضى بالمتلازمة الأيضية في ولاية الخرطوم

(A desertation submitted in partial fulfillment for the requirement of the Master degree in Medical Laboratory Sciences (Clinical Chemistry))

By:

Reem Abdelgadir Abakker Abadalla

B.Sc in Clinical Chemistry – College of Medical Laboratory Sciences (University of Medical Sciences and Technology) (UMST) (2013)

Supervisor:

Dr. Nuha Eljaili Abubaker

College of Medical Laboratory Sciences (Clinical Chemistry)

December 2018

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

قال تعالى:

(تَبَارَكَ الَّذِي بِيَدِهِ الْمُلْكُ وَهُوَ عَلَىٰ كُلِّ شَيْءٍ

قَدِيرٌ)

صدق الله

العظيم

سورة الملك

الايه (1)

Dedication

To the best man in the world who support, encourage me and thought me that the life is a nice moment and I must be thankful for everything good in my life, my

DAD

To purple flower MAM

To the gentle man who thought me the meaning of the life my brother Mohandis. Mohammed

Abdelgadir

To the amazing brother and my sister who fulfill's my life my brother and my sister

Ahmed and Faeza Abdelgadir

To my love my sister son's

To my family and friends.....

To all Who support me during this research.....

Acknowledgment

All and first thanks to the almighty ALLAH. Then I would like to express my gratitude and ever last appreciation to my supervisor **Dr. Nuha Eljaili Abubaker** for this guidance, helpful suggestions for solving problems, valuable supervision as well as precious advice, support continues assistance through the whole process of this research.

Also special thanks to all members of Sudan university of science and technology (SUST) Collage of graduate studies specially to staff members of clinical chemistry, I am really do not find the words that express my thanks and gratitude to him .

Finally, I am grateful to thank all patients participate in this study.

Abstract

Metabolic Syndrome is a serious medical condition with increase incidence of multiple cancers risk , has effects on the life quality and it is a problem found all over the world including Sudan and it is fatal unless controlled and treated properly.

This is comparative cross sectional study was conducted to assess plasma cholesterol, high density lipoprotein and low density lipoprotein levels in patients with metabolic syndrome. Hundred blood samples (50 controls and 50 cases, ages and genders were matched between two groups) were collected during period from August to September 2018, selected randomly from Zenam Medical Center and Samir Medical Center in Khartoum state, and 50 apparently healthy individuals serves as control group. Enzymatic methods were used to estimate serum T. cholesterol, HDL-C and LDL-C levels, and Spectrophotometer (semi automation instrument), and results were analyzed using statistical package for social science (SPSS version 20) computer program.

The study results showed that, increased Mean of Body Mass Index ,Waist Circumference , T. cholesterol , LDL-C and decreased in HDL-C in case versus control group. (30.2 ± 7.0 versus 22.7 ± 1.2 Kg/m²), (102.2 ± 15.2 versus 79.2 ± 2.7 cm), (152.6 ± 23 versus 127.2 ± 9.5 mg/dl), (47.6 ± 6.7 versus 73 ± 6.8 mg/dl), (78 ± 9.6 versus 42.6 ± 6.9 mg/dl) respectively.

Also the findings of This study showed that , there was weak negative correlation between T. cholesterol and and duration of disease ($r = -0.364$, P-value = 0.009), while there were no correlation between (HDL-C and LDL-C) and duration of disease, ($r = -0.022$, P-value = 0.881), ($r = -0.048$, P-value = 0.741) respectively. And no correlations between (T. cholesterol, HDL-C and LDL-C) and age . ($r = -0.151$, P-value = 0.294), ($r = -0.025$, P-value = 0.864), ($r = -0.258$, P-value = 0.07) respectively. Also there were no correlations between (T. cholesterol, HDL-C and LDL-C) and Body Mass Index ,Waist Circumference ($r = 0.098$, P-value = 0.50), ($r = -0.089$, P-value = 0.537), ($r = -0.082$, P-value = 0.573), ($r = 0.145$, P-value = 0.316), ($r = -0.136$, P-value = 0.347), ($r = -0.027$, P-value = 0.852) respectively.

It is concluded that: the plasma T. cholesterol and LDL-C are increased while HDL-C is decreased in metabolic syndrome patients .

المستخلص

المتلازمة الأيضية هي حالة طبية خطيرة مع زيادة حدوث مخاطر الإصابة بالسرطان المتعدد، ولها تأثيرات على جودة الحياة. وهي مشكلة وجدت في جميع أنحاء العالم والسودان. وهو مميت ما لم يتم التحكم فيه و معالجته بشكل صحيح.

وقد أجريت هذه الدراسة لتقييم الكوليسترول في البلازما، البروتين الدهني عالي الكثافة و البروتين الدهني منخفض الكثافة في مصل المرضى بالمتلازمة الأيضية. تم جمع مائة عينة دم (50 عنصرتحكم و 50 حالة) خلال الفترة من أغسطس إلى سبتمبر 2018، تم اختيارها بشكل عشوائي من مركز زينام الطبي ومركز سمير الطبي في ولاية الخرطوم، و 50 فرد على ما يبدو يتمتعون بصحة جيدة كمجموعة مراقبة.

تم قياس مستوى الكوليسترول في البلازما، البروتين الدهني عالي الكثافة و البروتين الدهني منخفض الكثافة باستخدام جهاز اسبكتروفوتومتر (شبه كامله الآلية)، وتم تحليل النتائج باستخدام حزمة إحصائية لبرنامج العلوم الاجتماعية (SPSS).

وأيضاً أظهرت الدراسة أن زيادة مؤشر كتلة الجسم، الكوليسترول الكلي، والبروتين الدهني منخفض الكثافة ونقصان البروتين الدهني عالي الكثافة في المرضى مقابل مجموعة السيطرة. ، (30.2 ± 7.0 مقابل 22.7 ± 1.2 كغ / م²) ، (102.2 ± 15.2 مقابل 79.2 ± 2.7 سم) ، (152.6 ± 23 مقابل 127.2 ± 9.5 ملغم / ديسيلتر) ، (47.6 ± 6.7 مقابل 73 ± 6.8) ، (78 ± 9.6 مقابل 42.6 ± 6.9 ملغم / ديسيلتر). على التوالي.

كما أظهرت نتائج الدراسة وجود ارتباط سلبي ضعيف بين الكوليسترول الكلي ومدة المرض. (معامل بيرسون = -0.364، ومستوى المعنوية=0.009)، ولا يوجد ارتباط بين (البروتين الدهني عالي الكثافة و البروتين الدهني منخفض الكثافة) ومدة المرض. (معامل بيرسون = -0.022 ومستوى المعنوية=0.881)، (معامل بيرسون = -0.048 ومستوى المعنوية= 0.741) علي التوالي. ولا يوجد ارتباط بين (الكوليسترول الكلي، البروتين الدهني عالي الكثافة و البروتين الدهني منخفض الكثافة) والعمر. (معامل بيرسون = -0.151 ومستوى المعنوية= 0.294) ، (معامل بيرسون = 0.025 ومستوى المعنوية= 0.864) ، (معامل بيرسون = -0.258 ومستوى المعنوية= 0.07) على التوالي.

أيضاً أظهرت عدم وجود ارتباط بين (الكوليسترول الكلي، البروتين الدهني عالي الكثافة و البروتين الدهني منخفض الكثافة) ومؤشر كتلة الجسم ، محيط الخصر. (معامل بيرسون = 0.098 ومستوى المعنوية=0.50) ، (معامل بيرسون = 0.089 ومستوى المعنوية= 0.537) ، (معامل بيرسون = 0.082 ومستوى المعنوية= 0.573) ، (معامل بيرسون = 0.145 ومستوى المعنوية= 0.316) ، (معامل بيرسون = -0.136 ومستوى المعنوية= 0.347) ، (معامل بيرسون = 0.027 ومستوى المعنوية= 0.852) على التوالي.

خلصت الدراسة إلي أنه توجد زيادة ملحوظة في الكوليسترول الكلي و البروتين الدهني منخفض الكثافة في مرضى المتلازمة الايضية ، وايضا يوجد نقصان في مستوي البروتين الدهني عالي الكثافة في مرضى المتلازمة الايضية مقارنة بالمجموعه الضابطة.

List of contents:

No.	Topic	Page
	Verse from Holly Quran	I
	Dedication	II
	Acknowledgement	III
	English abstract	IV
	Arabic abstract	VI
	List of contents	VIII
	List of figures	X
	List of tables	XI
	List of abbreviations	XII
	Chapter one Introduction, Rational and Objectives	
1.1	Introduction	1
1.2	Rationale	3
1.3	Objectives	4
1.3.1	General objective	4
1.3.2	Specific objectives	4
	Chapter two Literature review	
2.1	Metabolic syndrome	5
2.1.1	Signs and symptoms	5
2.1.2	Diagnosis of metabolic syndrome	5
2.1.3	Causes of metabolic syndrome	6
2.1.4	Prevention and treatment of metabolic syndrome	7
2.1.5	Risk factors of metabolic syndrome	8
2.1.6	Management of metabolic syndrome	9
2.2	Cholesterol	9
2.2.1	High density lipoprotein	9
2.2.2	Low density lipoprotein	10
	Chapter three Materials and methods	
3.1	Materials	12
3.1.1	Study approach	12
3.1.2	Study design :	12
3.1.3	Study area	12
3.1.4	Study population	12
3.1.5	Sample size	12
3.1.6	Inclusion criteria	12
3.1.7	Exclusion criteria	12
3.1.8	Ethical consideration	13
3.1.9	Data collection	13
3.1.10	Sample collection and processing	13
3.2	Methods	13
3.2.1	Estimation of Cholesterol	13
3.2.1.1	Principle of Cholesterol	13

3.2.1.2	Procedure of Cholesterol	13
3.2.2	Estimation of High Density Lipoprotein	14
3.2.2.1	Principle of HDL-C	14
3.2.2.2	Procedure of HDL-C	14
3.2.3	Estimation of Low Density Lipoprotein	14
3.2.3.1	Principle of LDL-C	14
3.2.3.2	Procedure of LDL-C	14
3.2.4	Calculation of BMI	14
3.3	Quality control	14
3.4	statistical analysis	15
	Chapter four	
4	Results	16
	Chapter five	
5.1	Discussion	23
5.2	Conclusions	25
5.3	Recommendations	25
	References	
	References	26
	Appendices	
	Appendix I	28
	Appendix II	29
	Appendix III	30
	Appendix IV	31

List of figures

No.	Title	Page
Figure (4.1)	Age distribution among metabolic syndrome patients group.	21
Figure (4.2)	Gender distribution among metabolic syndrome patients group.	22

List of tables

.	Title	Page
Table (4.1)	Mean concentrations and values of T. Cholesterol, HDL-C, LDL-C, BMI and Waist circumference in case and control group.	18
Table (4.2)	Comparison of total T. cholesterol, HDL-C and LDL-C between males and females among MetS group.	19
Table (4.3)	Correlations between age, BMI, waist circumference , duration of disease and T. cholesterol, HDL-C and LDL-C.	20

List of abbreviations

BMI	Body Mass Index
CC	Case Control
Cm	Centimeter
CHD	Coronary heart disease
HDL-C	High density lipoprotein cholesterol
LDL-C	Low density lipoprotein cholesterol
Mets	Metabolic syndrome
T. Cholesterol	Total Cholesterol
Y	Years

Chapter one

Introduction

Rationale

Objectives

1.1 Introduction:

Metabolic Syndrome (Mets) defined according to the Criteria proposed by “China Diabetes Society” (CDS) and unified, were three or more of the following risk factors : overweight or obesity , BMI ≥ 25.0 kg/ m² , abdominal obesity was defined as elevated WC ≥ 85 cm in male , ≥ 80 cm in female, hypertension , systolic blood pressure SBP ≥ 140 mmHg , or diastolic blood pressure (DBP) ≥ 90 mmHg , or previous diagnosis of hypertension, dyslipidemia, TG ≥ 1.7 mmol / l (150 mg / dl) or low HDL-C ≤ 0.9 mmol / l in men ≤ 1.0 mmol/l (40 mg /dl) in women. and hyperglycemia , FPG ≥ 6.1 mmol / l (110 mg / dl) or 2 HPP , PG ≥ 7.8 mmol / l (140 mg /dl). Or previous diagnosis with hyperglycemia. (Alberti *et al.*, 2006; Shuang *et al.*, 2016; Krithika *et al.* , 2016).

Elevated plasma concentration of lipids, particularly cholesterol, are causally related to the pathogenesis of atherosclerosis, the process responsible for the majority of cardiovascular disease (coronary, Cerebrovascular and peripheral vascular disease).

(William *et al.* , 2010).

Lipids and lipoproteins, which are central to the energy metabolism of the body, have become increasingly important in clinical practice, primarily because of their association with coronary heart disease (CHD). Numerous epidemiologic studies have demonstrated that, especially in affluent countries with high fat consumption, there is a clear association between the blood lipoproteins lipid levels and the development of atherosclerosis.

The accurate measurement of the various lipid and lipoprotein parameters is critical in the diagnosis and treatment of patients with dyslipidemia. International efforts to reduce the impact of CHD on public health have focused attention on improving the reliability and convenience of the lipid and lipoprotein assays. Expert panels have developed guidelines for detection and treatment of high cholesterol, as well as laboratory performance goals of accuracy and precision for the measurement of the lipid and lipoprotein analytes. (Bishop *et al.* , 2010).

Increased cholesterol is a factor in the cause of atherosclerotic diseases. Windaus described cholesterol in the lesions of atherosclerotic diseased arteries. Numerous studies have established that when the T. cholesterol and LDL-C concentrations are

high, the incidence and prevalence of CHD are also high. In contrast to LDL-C , increased HDL-C concentrations have been shown to be protective for CHD in both epidemiological and clinical trial studies. Because atherosclerosis begins at a n early age and can take decades to clinically manifest itself, the measurement of plasma lipids and lipoproteins is a valuable means to identify individuals at risk for CHD and determine the most appropriate therapy. (Tietz *et al.* , 2008).

Individuals with Mets exhibit a characteristic pattern of abnormalities in serum lipid levels consisting of low levels of HDL-C and elevated levels of LDL-C and triglycerieds. (Chahil *et al.*, 2006)

In the previous study carried by (shung ., 2016) the result showed that , there were increased in mean values of T. cholesterol, LDL-C and HDL-C were decreased in metabolic syndrome patients (p-value=0.000) which indicates those variables are closely related to Mets and considered as Mets components.

1.2. Rationale:

Metabolic Syndrome is a serious medical condition increase incidence of multiple cancers, social community stigma, secological increase incidence of chronic depression and economic effects on the life quality this problem found all over the world and Sudan and its fatal unless controlled and treated properly.

Dyslipidemia contributes to the progression of atherosclerosis, the underlying pathology of cardiovascular disease.

Mets prevalence is about 20-25% of the world's adult population with increased prevalence in advanced ages. (Carr *et al.*, 2004; Alberti *et al.*, 2006).

A cording to our knowledge there was no published study done in Sudan.

1.3 Objectives

1.3.1. General objective:

- To assess the plasma T. cholesterol, HDL-C and LDL-C levels among metabolic syndrome patients.

1.3.2. Specific objectives:

- To measure and compare the mean of T. cholesterol, HDL-C, LDL-C levels and waist circumference in study groups.
- To calculate the BMI in study groups.
- To correlate between T. cholesterol, HDL-C, LDL-C and study variables (body mass index, waist circumference, duration and age).

Chapter two

Literature review

2.1. Metabolic syndrome:

The term "metabolic syndrome" dates back to at least the late 1950s, but came into common usage in the late 1970s. The terms "metabolic syndrome," "insulin resistance, syndrome" syndrome X", Dysmetabolic syndrome X, mixed metabolic syndrome. (Sarafidis *et al* .,2006; Falkner *et al* .,2014).

The metabolic syndrome (visceral obesity, dyslipidaemia, hyperglycaemia, and Hypertension), has become one of the major public-health challenges World wide., the clustering received scant attention until 1988 when Reaven described syndrome X: insulin resistance, hyperglycemia, hypertension, low HDL-cholesterol, and raised VLDL-triglycerides. (George *et al* .,2005).

2.1.1. Signs and symptoms of Mets:

Metabolic syndrome has no symptoms, although a large waist circumference (central obesity) is a visible sign. Blood sugar is very high, might have signs and symptoms of diabetes (including increased thirst and urination, fatigue, and blurred vision.), Impaired fasting glucose, insulin resistance, or prediabetes, high blood pressure, decreased fasting serum HDL cholesterol and elevated fasting serum triglyceride level. (Knowler *et al.*, 2002).

2.1.2. Diagnosis of Mets:

Several organizations have criteria for diagnosing metabolic syndrome. According to guidelines used by the National Institutes of Health, have metabolic syndrome if have three or more of these traits or are taking medication to control them.

(A) Large waist circumference:

A waist line that measures at least 35 inches (89 centimeters) for women and 40 inches (102 centimeters) for men.

(B)High triglyceride level:

150 milligrams per deciliter, (mg/dL), or 1.7 millimoles per liter (mmol/L), or higher of this type of fat found in blood. (Knowler *et al.*, 2002 ;Chiasson *et al.*.,2003; Carr *et al.*.,2004; Krithika *et al.*.,2016).

(C)Reduced high-density lipoprotein (HDL) cholesterol:

Less than 40 mg/dL(1.04 mmol/L) in men or less than 50 mg/dL (1.3 mmol/L) in women of this "good" cholesterol.

(D)Increased blood pressure:

130/85 millimeters of mercury (mm Hg) or higher.

(E)Elevated fasting blood sugar:

100 mg/dL (5.6 mmol/L) or higher. (Knowler *et al.*, 2002; Chiasson *et al.*.,2003; Carr *et al.*.,2004; Krithika *et al.*.,2016).

2.1.3. Causes of Mets:

(A)Stress: Recent research indicates prolonged chronic stress can contribute to the hypothalamic-pituitary-adrenal axis (HPA-axis), high cortisol levels to circulate, which results in raising glucose and insulin levels dyslipidemia and hypertension.

(B)Central obesity: Central obesity is a key feature of the syndrome, being both a symptom and a cause of it in that the increasing adiposity often reflected in high waist circumference both often results from and often contributes to insulin resistance. However, despite the importance of obesity, patients who are of normal weight may also be insulin-resistant and have the syndrome.

(C)Sedentary lifestyle: Many components of metabolic syndrome are associated with a sedentary lifestyle, including increased adipose tissue (predominantly central); reduced HDL cholesterol; and a trend toward increased triglycerides, blood pressure, and glucose in the genetically susceptible. (Know *et al.*, 2002; Chiasson *et al.*., 2003; Carr *et al.*, 2004).

(D)Aging: Metabolic syndrome affects 60% of the U.S. population older than age 50. With respect to that demographic, the percentage of women having the syndrome is higher than that of men. The age dependency of the syndrome's prevalence is seen in most populations around the world. (Know *et al.*, 2002; Chiasson *et al.* , 2003; Carr *et al.*, 2004).

(E)Psychiatric illnesses

(F)Alcohol Abuse (Know *et al.*, 2002; Chiasson *et al.* ,2003;Carr *et al.*,2004)

2.1.4. Prevention and Treatment of Mets:

Various strategies have been proposed to prevent the development of metabolic syndrome.

A healthy lifestyle as:

(A)Eat better: Adopt a diet rich in whole grains, fruits, vegetables, lean meats and fish, and low-fat or fat-free dairy products and avoid processed food, which often contains partially hydrogenated vegetable oils, and is high in salt and added sugar.

(B)Get active: Incorporate at least 150 minutes of moderately vigorous physical activity into weekly routine. Walking is the easiest place to start, but may want to experiment to find something else like to do that gets heart rate up. If needed, break exercise up into several short, 10-minute sessions throughout the day to reach goal. (Know *et al.*, 2002; Chiasson *et al.* , 2003; Carr *et al.*, 2004).

(C)Lose weight: Reduce risk by successfully losing weight and keeping it off. Learn recommended calorie intake, the amount of food calories consuming, and the energy calories burning off with different levels of physical activity. Balance healthy eating with a healthy level of exercise when changes in lifestyle alone do not control the conditions related to metabolic syndrome, health practitioner may prescribe medications to control blood pressure, cholesterol, and other symptoms. Carefully following practitioner's instructions can help prevent many of the long term effects of metabolic syndrome. Every step counts and hard work and

attention to these areas will make a difference in health.. (Know *et al.*, 2002; Chiasson *et al.* , 2003; Carr *et al.*, 2004).

(D)Stopping smoking:

Smoking cigarettes worsens the health consequences of metabolic syndrome. Talk the doctor if you need help quitting.

(E)Managing stress:

Physical activity, meditation, yoga and other programs can help handle stress and improve emotional and physical health. (Know *et al.*, 2002; Chiasson *et al.* , 2003; Carr *et al.*, 2004).

2.1.5. Risk factors of Mets:

Risk increases when more components of metabolic syndrome are present.

The following factors increase chances of having metabolic syndrome:

(A)Age: risk of metabolic syndrome increases with age.

(B)Race: In the United States, Mexican-Americans appear to be at the greatest risk of developing metabolic syndrome.

(C)Obesity: Carrying too much weight, especially in abdomen, increases risk of metabolic syndrome.

(D)Diabetes: more likely to metabolic syndrome if had diabetes during pregnancy (gestational diabetes) or if have a family history of type 2 diabetes.

(E)Other diseases: risk of metabolic syndrome is higher if ever had non-alcoholic fatty liver disease, cardiovascular disease, polycystic ovary syndrome.(Knowler *et al.*, 2002; Krithika *et al.*, 2016).

2.1.6. Management of Mets : Food and Drug administration:

The first line treatment is changing of lifestyle a healthy lifestyle, drug treatment is frequently required.

Diuretics and Angiotensin converting Enzyme inhibitors may be used to treat hypertension.

Cholesterol drugs may be used to lower LDL cholesterol and triglycerides levels, if they are elevated, and to raise HDL cholesterol levels if they are low. Use of drugs that decrease insulin resistance, e.g., metformin and thiazolidinediones. (Knowler *et al.*, 2002 ; Krithika *et al.* ,2016).

2.2. Cholesterol:

The major lipids present in the plasma are fatty acids, triglycerides, cholesterol and phospholipids. Cholesterol is used by the body for such useful functions as facilitating triglyceride transport by lipoproteins, for maintaining the normal structure and integrity of cell membranes, and as a precursor for steroid hormone synthesis, but when in excess, it can lead to cardiovascular disease.

Elevated plasma concentrations of lipids, particularly cholesterol, are causally related to the pathogenesis of atherosclerosis, the process responsible for the majority of cardiovascular disease (coronary, Cerebrovascular and peripheral vascular disease). Cardiovascular disease is the commonest cause of death in the UK: about one-quarter of all deaths are due to CHD. Many of these are in people under the age of 60. Effective management of hypercholesterolaemia and other risk factors is of proven benefit in reducing cardiovascular disease mortality. (William *et al.*, 2010).

2.2.1. High density lipoprotein:

Lipoproteins constitute the body's "petroleum industry." Like the great oil tankers that travel the oceans of the world transporting petroleum for fuel needs. The HDL-C are the cleanup crew, gathering up excess cholesterol for transport back to the liver.

Lipids and lipoproteins, which are central to the energy metabolism of the body, have become increasingly important in clinical practice, primarily because of their association with CHD. Numerous epidemiologic studies have demonstrated that, especially in affluent countries with high fat consumption, there is a clear association between the blood lipoproteins lipid levels and the development of atherosclerosis. Decades of basic research have also contributed to knowledge about the nature of the lipoproteins and their lipid and protein constituents, as well as their role in the pathogenesis of the atherosclerotic process. The accurate measurement of the various lipid and lipoprotein parameters is critical in the diagnosis and treatment of patients with dyslipidemia. International efforts to reduce the impact of CHD on public health have focused attention on improving the reliability and convenience of the lipid and lipoprotein assays. Expert panels have developed guidelines for detection and treatment of high cholesterol, as well as laboratory performance goals of accuracy and precision for the measurement of the lipid and lipoprotein analytes. (Bishop *et al.* , 2010)

HDL-C, the smallest and most dense lipoprotein particle, is synthesized by both the liver and intestine. (William *et al.* , 2012).

2.2.2. Low density Lipoprotein:

LDL-C are the principal carriers of cholesterol, mainly in the form of LDL-C cholesteryl esters.

primarily contains apo B-100 and is more cholesterol rich than other apo B-containing lipoproteins form as a consequence of the lipolysis of VLDL-C. LDL-C is readily taken up by cells via the LDL-C receptor in the liver and peripheral cells. In addition, because LDL-C particles are significantly smaller than VLDL-C particles and chylomicrons, they can infiltrate into the extracellular space of the vessel wall, where they can be oxidized and taken up by macrophages through various scavenger receptors. Macrophages that take up too much lipid become filled with intracellular lipid drops and turn into foam cells, which is the predominant cell type of fatty streaks, an early precursor of atherosclerotic plaques. LDL-C particles can exist in various sizes and compositions and have been separated into as many as eight sub classes through density ultracentrifugation or gradient gel electrophoresis. The LDL-C subclasses differ largely in their content of core lipids;

the smaller particles are denser and have relatively more triglyceride than cholesteryl esters. Recently, there has been great interest in measuring LDL-C subfractions, because small, dense, LDL-C particles have been shown to be more proatherogenic and may be a better marker for coronary heart disease risk. (Bishop *et al.* , 2010).

Chapter three

Materials and methods

3.1. Materials:

3.1.1. Study approach:

A quantitative method was used to measure the level of total cholesterol , high density lipoprotein and low density lipoprotein in metabolic syndrome patients during the period from August to September 2018.

3.1.2. Study design:

This is a comparative cross sectional study.

3.1.3. Study area:

The study was conducted in Zenam medical Center and Samir medical center.

3.1.4. Study population:

The study included male and female patients with metabolic syndrome and healthy individuals.

3.1.5. Sample size:

This study included 50 patients with metabolic syndrome as case and 50 healthy individual as control (age and gender will matched).\

3.1.6. Inclusion criteria:

Patients with metabolic syndrome and healthy individual were included.

3.1.7. Exclusion criteria:

Smoking, Alcoholism, renal disease, diagnosed with chronic diseases that significantly contribute to change in metabolic functions including thyroid disorders, chronic hepatitis and liver cirrhosis were excluded.

3.1.8. Ethical consideration:

The study was approved by scientific committee of Clinical Chemistry Department of College of Medical Laboratory Science in Sudan University of Science and Technology, then a verbal informed consent was obtained from each participant and then needed an valuable data were collected by questionnaire.

3.1.9. Data collection:

Data were collected using structural interviewing questionnaire, which was designed to collect and maintain all valuable information concerning each case examined.

3.1.10. Sample collection and processing:

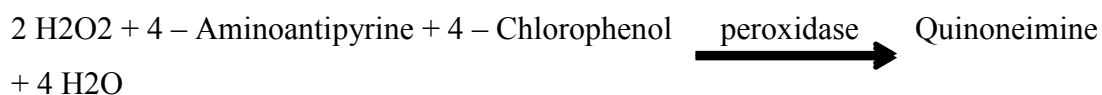
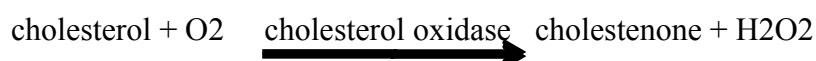
About 3ml of venous blood was collected by safe aseptic procedures.

Used plasma for the assay of T. cholesterol, HDL-C and LDL-C the volume of sample is recommended that at least 2.5ml of whole blood is collected. In plasma sample, blood should be collected in lithium heparin and then centrifugated, and the plasma separated. Plasma sample stored frozen below -20C. Sample should be thawed and mixed before assay.

3.2. Methods:

3.2.1. Estimation of Total cholesterol level :

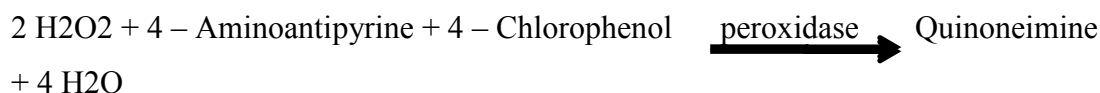
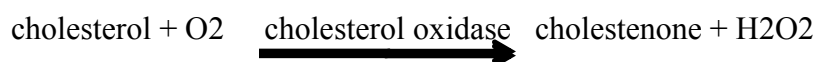
3.2.1.1. Principle of T. cholesterol :



3.2.1.2. Procedure of T. cholesterol : Appendix II

3.2.2. Estimation of High Density Lipoprotein:

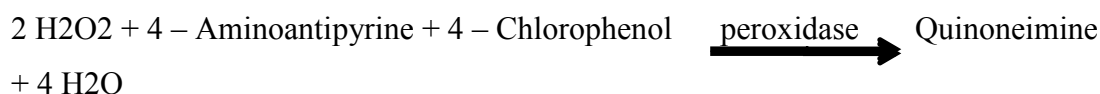
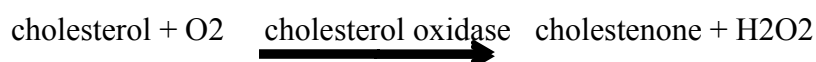
3.2.2.1. Principle of HDL-C:



3.2.2.2. Procedure of. HDL-C: Appendix III

3.2.3. Estimation of Low Density Lipoprotein:

3.2.3.1. Principle of LDL-C:



3.2.3.2. Procedure of. LDL-C: Appendix IV

3.2.4. calculation of Body mass index(BMI):

$$\text{BMI} = \text{Weight (kg)} / \text{Height (m}^2\text{)}$$

3.3. Quality control:

The precision and accuracy of all methods used in this study were checked by commercially prepared control sample before it is application for the measurement of test and control samples.

3.4. Statistical analysis:

Data obtained from this study was analyzed using statistical package for the social science (SPSSversion20). Independent T- test was used for comparison and pearson's correlation test was used for correlation.

Chapter four

Results

4. Results:

figure (4.1): Age distribution among metabolic syndrome patients group.

figure (4.2): Gender distribution among metabolic syndrome patients group.

The results of the biochemical determination of T. cholesterol, HDL-C and LDL-C in metabolic syndrome. Were statistically analyzed and the results were as follows:

Table (4.1): Represents the comparison mean \pm SD of , T. cholesterol ,HDL-C and LDL-C, BMI and wasit Circumference in case versus control group. The result showed (152.6 ± 23 versus 127.2 ± 9.5 mg/dl, p- values=0.000), (47.6 ± 6.7 versus 73 ± 6.8 mg/dl, p- values=0.000), (78 ± 9.6 versus 42.6 ± 6.9 mg/dl, p- values=0.000), (30.2 ± 7.0 versus 22.7 ± 1.2 Kg/m² , p- values=0.000), (102.2 ± 15.2 versus 79.2 ± 2.7 cm, p- values=0.000) . respectively.

Table (4.2): Shows comparison of T. cholesterol, HDL-c and LDL-c between males and females among Mets group. The result showed (T. cholesterol in males and females 149.1 ± 23.1 and 154.4 ± 23.3 mg/dl , p-value = 0.450), (HDL-c in males and females 45.2 ± 6.7 and 48.9 ± 6.4 , p- value = 0.062), (L DL-c in males and females 80.5 ± 10.2 and 76 ± 9.2 , p-value = 0.198).

Table (4.3): Shows correlations between T. cholesterol, HDL-C and LDL-C and age, BMI, wasit Circumference and duration of disease.

Correlations between T. cholesterol level and age ($r = -0.151$, P-value =0.294).
Correlations between T. cholesterol level and BMI ($r = 0.098$, P-value=0.50).
Correlations between T. cholesterol level and waist circumference ($r = 0.145$, P-value=0.316).
Correlations between T. cholesterol level and duration ($r = -0.364$, P-value=0.009).

Correlations between HDL-C level and age ($r = 0.025$, P-value =0.864).
Correlations between HDL-C level and BMI ($r = -0.089$, P-value=0.537).
Correlations between HDL-C level and waist circumference ($r = -0.136$, P-value=0.347).
Correlations between HDL-C level and duration of disease ($r = -0.022$, P-value=0.881).

Correlations between LDL-C level and age ($r= 0.258$, P-value =0.07). Correlations between LDL-C level and BMI ($r= -0.082$, P-value=0.573). Correlations between LDL-C level and waist circumference ($r= 0.027$, P-value=0.852). Correlations between duration and LDL-C level and duration ($r= -0.048$, P-value=0.741).

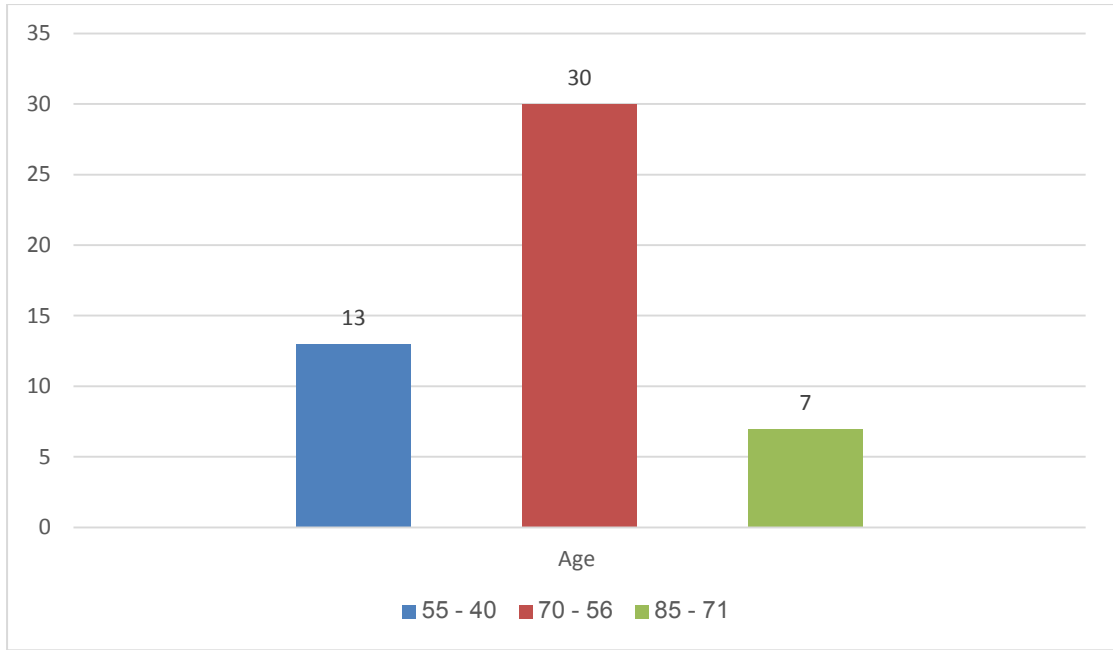


figure (4.1): Age distribution among metabolic syndrome patients group

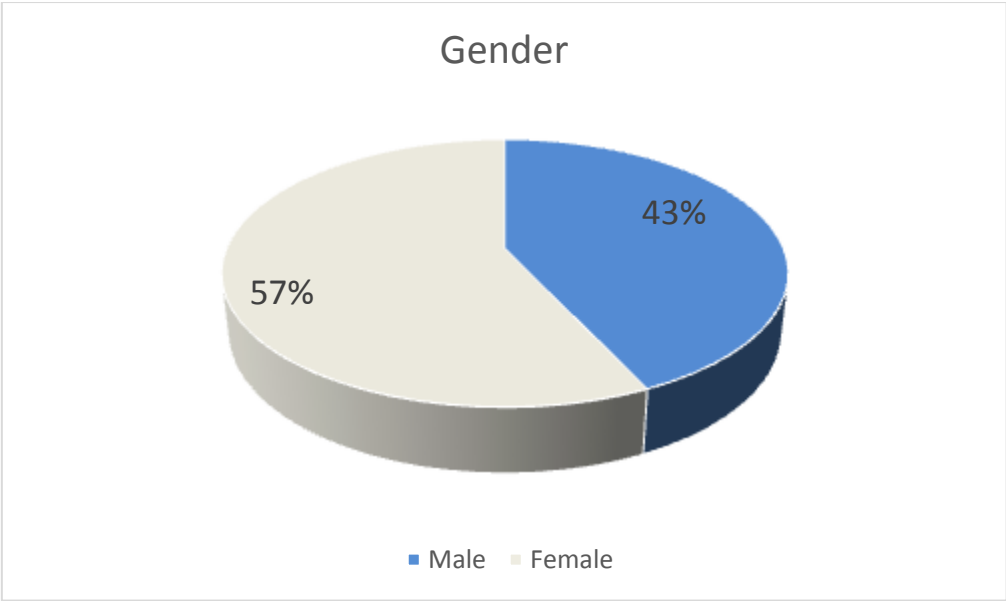


figure (4-2): Gender distribution among metabolic syndrome patients group

Table (4.1): Mean concentrations and values of T. Cholesterol, HDL-C, LDL-C, BMI and in case and control group:

Variable	Case Mean \pm SD	Control Mean \pm SD	P-value
T .Cholesterol (mg/dl)	152.6 \pm 23 (109-199)	127.2 \pm 9.5 (110-145)	0.000
HDL-C (mg/dl)	47.6 \pm 6.7 (32-62)	73 \pm 6.8 (43-82)	0.000
LDL-C(mg/dl)	78 \pm 9.6 (58-100)	42.6 \pm 6.9 (31-73)	0.000
BMI(Kg/m ²)	30.2 \pm 7.0 (21.7-50.0)	22.7 \pm 1.2 (20-24.8)	0.000
Waist circumference (cm)	102.2 \pm 15.2 (80-149)	79.2 \pm 2.7 (74-84)	0.000

Result given in mean \pm SD, p-value \leq 0.05 consider significant.

Independent sample T-test was used for comparison . Range between brackets.

Table (4.2): Comparison of T. cholesterol, HDL-C and LDL-C between males and females among MetS group.

Variables	Males Mean+SD	Females Mean+SD	<i>P.</i> value
T. Cholesterol (mg/dl)	149.1 ± 23.1	154.4 ± 23.3	0.450
HDL-C (mg/dl)	45.2 ± 6.7	48.9 ± 6.4	0.062
LDL-C (mg/dl)	80.5 ± 10.2	76 ± 9.2	0.198

Result given in mean ± SD, p-value ≤ 0.05 consider significant.

Independent sample T-test was used for comparison .

Table (4.3): Correlations between total cholesterol, HDL-C and LDL-C and study variable (Age, BMI, waist circumference and duration of disease)

Variables	Coefficient	T. Cholesterol	HDL	LDL
Age	R	- 0.151	0.025	- 0.258
	P	0.294	0.864	0.07
BMI	R	0.098	- 0.089	- 0.082
	P	0.50	0.537	0.573
waist circumference	R	0.145	- 0.136	0.027
	P	0.316	0.347	0.852
Duration of disease	R	- 0.364	- 0.022	- 0.048
	P	0.009	0.881	0.741

Pearson's correlation test was used

R: Is the strength of the correlation.

P: Is the significance of the correlation (values considered significant if ≤ 0.05).

Chapter five

Discussion, Conclusion and Recommendations

5.1 Discussion:

Metabolic Syndrome is a serious medical condition with increase incidence of multiple cancers risk, has effects on the life quality.

This study conducted to asses plasma levels of T. Cholesterol, HDL-C and LDL-C, among metabolic syndrome patients in Khartoum state.

In the present study; the plasma T. cholesterol and LDL-C are significantly higher in metabolic syndrome patients compared to control group, and the HDL-C is significantly lower in metabolic syndrome patients when compared to control group.

The findings of this study showed that Mets most common among age between (56–70) years. The findings obtained from especially designed questionnaire revealed that, (57%) of patients were females and (43%) were males. this finding agreed with another study carried by (Chen J *et al.*, 2017 ; Maleki, A *et al.* , 2015). Which showed that, Mets patients most abundant in females than males.

The findings of the study showed, there were increased in mean values of T. cholesterol, LDL-C and HDL-C were decreased in metabolic syndrome patients compared to control group (p-value=0.000), this finding agreed with another study carried by (shung ., 2016), that indicates those variables are closely related to Mets and considered as mets components. The findings of the study showed that, there were insignificant difference in T. cholesterol, HDL-C and LDL-C according to gender (p value 0.45, 0.062 and 0.198) respectively .

Also the findings of the study showed that there was weak negative correlation between T. Cholesterol and duration of disease ($r = -0.364$, P-value = 0.009), while there were no correlation between(HDL-C and LDL-C) and duration of disease. ($r = -0.022$, P-value = 0.881), ($r = -0.048$, P-value = 0.741) respectively. And no correlations between (T. cholesterol, HDL-C and LDL-C) and age. ($r = -0.151$, P-value = 0.294), ($r = -0.025$, P-value =0.864), ($r = -0.258$, P-value = 0.07) respectively. Also showed, there were no correlations between (T. cholesterol, HDL-C and LDL-C) and BMI. ($r = 0.098$, P-value = 0.50), ($r = -0.089$, P-value = 0.537), ($r = -0.082$, P-value = 0.573) respectively.

Also there were no correlations between (T. cholesterol, HDL-C and LDL-C) and WC. ($r= 0.145$, P-value = 0.316), ($r=-0.136$, P-value =0.347), ($r= -0.027$, P-value = 0.852) respectively. This finding agreed with another studies carried by (Singh *et al.*, 2015).Which showed that, low level of HDL-C due to decreased clearance of lipoprotein from the circulation and elevated levels of LDL-C are due to reduction of therapy.

5.2 Conclusion:

Patients with metabolic syndrome had T. cholesterol and LDL-C are increased and HDL-C is decreased in metabolic syndrome patients.

5.3 Recommendations:

From the findings of this study it is recommended that:

- 1- Life style modifications program such as exercise, healthy diets, low calories intake, and physical activities to be implemented in whole community specially females to reduce the susceptibility to metabolic syndrome.
- 2- High sensitive C- reactive protein should be done in metabolic syndrome patients.
- 3- Evaluation of other predictive markers of atherosclerosis.

References

References

Alberti, K. G., Zimmet, P., Shaw, J. (2006).Metabolic syndrome-a new world-wide definition.A Consensus Statement from the International Diabetes Federation.*Diabet Med*; **23**(5):469-80.

Bishop,m.l., Edward,P.F., Larry,E.S.(2010).Clinical Chemistery Principles, Techniques and Correlation. Ed. Philadelphia: Lippincott Williams and Wilkins. **6th ed** chapter 14:328-333.

Bishop, m.l., Edward, P. F., Larry, E.S.(2013).Clinical Chemistery. Principles, Techniques and Correlation.**7th ed**:133-245.

Chahil T.J., Ginsberg H.N.(2006).Diabetic dyslipidemia. Endocrinal Metab Clin North Am.35:491-510.

Chiasson, J.L., Josse, R.G., Gomis, R.(2003).STOP-NIDDM Trial Research Group. Acarbose treatment and the risk of cardiovascular disease and hypertension in patients with impaired glucose tolerance: the STOP-NIDDM trial. *JAMA*; **290**(4):486-94.

Chen, J., Kong, X., Jia, X., Li, W., Wang, Z., Cui, M., Xu, D.(2017). Association between metabolic syndrome and chronic kidney disease in Chinese urban population , *Clinica Chimica Acta*; 470:103-108

Falkner, B., Cossrow, N.D. (2014).Prevalence of metabolic syndrome and obesity – associated hypertension in the racial ethnic minorities of the United States.*Current Hypertension Reports*.**16** (7):449.

George, K., Alberti. Paul, Z.t., Jonathan ,S . (2005). The metabolic syndrome a new worldwide definition, *the lancet*. **366** :(9491);1059–1062.

Knowler, W.C. (2002).Reduction in the incidence of Type 2 diabetes with life style intervention or metformin.*New England journal of medicine* ;**346**(6):393-403.

Krithika, S., Andrew, F., Haresh, V., Joseph, S., Komal ,S.(2016).Systematic Review of Metabolic Syndrome Biomarkers.*International Journal of Medical Sciences*; **13**(1): 25-38.

Maleki, A., Montazeri, M., Rashidi, N., Montazeri, M., Yousefi, A.E. (2015). Metabolic Syndrome and its components associated with chronic kidney disease. *Journal of research in medical sciences : the official Journal of Isfahan University of medical sciences*, 20(5), pp. 465-9.

Sarafidis, S., panteleimon,A., Nilsson., Peter ,M.(2006). The metabolic syndrome: a glance at its history .*Journal of Hypertension*; **24**(4):621-626

Shauna, C., Anderson., Susan,C.(2015).Clinical Chemistery Concepts and Applications. **Revised ed**:121-163.

Shuang, C., Xiaofan, G., Shasha, Y., Ying, Z., Zhao, L., Yingxian ,S.(2016). Metabolic Syndrome and Serum Liver Enzymes in the General Chinese Population. *Int J Environ Res Public Health.* ; **13**(2): 223.

Singh O, Gupta M., Khajuria V.(2015).lipid profile in metabolic syndrome . *Natl J physiol pharm pharmacol*;5:134-137.

William, J.M., Stephen, K.B.(2010).Clinical Chemistry.**6th ed**:77-123.

William, J.M., Stephen, K.B.(2012).Clinical Chemistry.**7th ed** chapter 14:354 -358.

Tietz, Carl A. Burtis., Edward R. Ashwood., David E Brun.(2008).Fundamental of Clinical Chemistry.**6th ed** chapter 23:415 -416.

Appendices



Sudan University of Science and Technology

Master Degree



Estimation of T. cholesterol, HDL-C and LDL-C in Mets patients

Name:

Gender: male Female

Age:.....years

Height:cm Weight:kg

BMI:.....kg/m²

Wasit circumferenc:.....cm

TEL:.....

Other chronic diseases.....

Sample: heparinized plasma

Parameters:

T. Cholestrol :.....mg / dl

HDL-C:mg /dL

LDL-C:mg /dL

Number ()