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Effect of Rotating Shift on Biomarkers of Metabolic Syndrome and Inflammation among Health Personnel in Gaza Governorate

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Effect of Rotating Shift on Biomarkers of Metabolic Syndrome and Inflammation among Health Personnel in Gaza Governorate

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Dedication

I dedicate this thesis

To my great Parents who have given me endless love, support, durable patience, and faith through the years,

To my sister Samah, and my brother Jawad for their encourage and love,

To my great family and friends,

To the souls of all martyrs who sacrificed themselves for the sake of Palestine to give us the freedom we deserve,

To everyone who made this work possible

To all of them I dedicate this work

Heba Mohammed Arafat

Declaration

I certify that this thesis submitted for the degree of Master, is the result of my own research, except where otherwise acknowledged, and this study (or any part of the same) has not been submitted for a higher degree to any other university or institution.

Signed:

Heba Mohammed Arafat

…./…./…

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Abstract

Shift work has been hypothesized to associate with increase the risk of metabolic syndrome (MetS). It is a complicated syndrome that demonstrated as a common precursor for developing cardiovascular diseases and/or type 2 diabetes mellitus. The study was conducted to estimate the prevalence of MetS among health personnel and to examine the effect of rotating shift work schedule on biomarkers of MetS and inflammation. A comparative analytical cross sectional study was conducted on a sample of 310 health care personnel, 100 current daytime workers compared with 210 rotating shift workers. A questionnaire on socio-demographic (sex, age, marital status, income, job, governorate), past medical history, health-related behaviors such as (smoking and physical activity) and occupational history about shift work, health examination including anthropometric and arterial blood pressure measurements, and laboratory investigations. We used the Adult Treatment Protocol III National cholesterol Education Programme of America (ATPIII) indicators for diagnosis and determination of MetS. The syndrome was met if an individual had three or more of the following criteria: waist circumference >102cm in men and >88cm in women, fasting plasma glucose ≥110mg/dl, blood pressure ≥130/85mmHg, serum triglycerides ≥150mg/dl and serum HDL cholesterol <40mg/dl in male and <50mg/dl in female. Statistical analysis was performed using SPSS version 20. The overall prevalence of MetS among healthcare workers was 8.4% (9.0% among current daytime workers and 8.1% among rotating shift workers) without significant difference between males and females, and shift category. The most frequently altered component among healthcare workers was elevated C- reactive protein (44.5%), followed by high triglyceride (35.5%), increased total cholesterol (24.8%), and elevated BMI>30 (20.6%). The main risk factors for MetS in both sexes among rotating shift workers in descending order were as follow: high Blood pressure (OR = 59.5; 95% CI, 16.4- 215.8),high fasting blood sugar (OR= 43.9; 95% CI, 12.9- 149.1),high triglyceride (OR = 42.3; 95% CI, 5.5- 326.6), obesity (elevated body mass index >30)(OR = 11.8; 95% CI, 4- 34.6), and low level of high density lipoprotein cholesterol (HDL) (OR = 1.6; 95% CI, 0.3- 6.1). MetS was prevalent among health care personnel in Gaza Strip, with a steady increase in its prevalence through age and BMI. There was no direct relationship between shift category and the occurrence of MetS and inflammation, other factors as genetic factors, lifestyle factors , the job itself may have more effects on the occurrence than shift category. From the results we recommended a need for managing hypertensive disorders among current day time and rotating shift workers, and urged that the health conditions of hospital employees should not be overlooked. Also, the attention of ministry of health is needed together with the individual practice of health behaviors to manage the MetS to prevent possible cardiovascular disease among current daytime and rotating shift workers.

Keywords: *Metabolic syndrome, current daytime workers, rotating shift workers, inflammation, risk factors.*

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List of Abbreviations

AACE	American Association of Clinical Endocrinologists
ADA	American Diabetes Association
AHA/NHLBI	American Heart Association/National Heart, Lung, and Blood Institute
ANPH	Al- Nassir Pediatric Hospital
ASH	Al- Shifa Hospital
BMI	Body Mass Index
CBC	Complete Blood Count
CHAOS	Coronary Artery Disease, Hypertension, Atherosclerosis, Obesity, and Stroke
CHD	Coronary Heart Disease
CHE	Cholesterol Esterase
CHO	Cholesterol Oxidase
CHOD	Cholesterol Oxidase
CI	Confidence Interval
CI	Confidence Interval
CNS	Central Nervous System
CRP	C-Reactive Protein
CVD	Cardiovascular Disease
DM	Diabetes Mellitus
EDTA	Ethylene Diamine Tetra Acetic Acid
EGIR	European Group For The Study of Insulin Resistance
FBS	Fasting Blood Sugar
FFA	Free Fatty Acid
GGs	Gaza Governorates
GK	Glycerokinase
GLUT-4	Glucose Transporter Protein-4
GOD	Glucose Oxidase
GOD	Glucose Oxidase
GS	Gaza Strip
HD	Heart Disease
HDL	High Density Lipoprotein
HTN	Hypertension
IDF	International Diabetes Federation

IFG	Impaired Fasting Glucose
IGT	Impaired Glucose Tolerance
IL-6	Interleukin-6
LDL	Low Density Lipoprotein
LPL	lipoprotein lipase
MetS	Metabolic Syndrome
MOH	Ministry of Health
NCDS	Non Communicable Diseases
NCEP/ATP	National Cholesterol Education Program Adult Treatment Panel
NEFAs	Nonesterified Fatty Acids
NGOs	Non-Governmental Organizations
OR	Odds Ratio
PAI-1	Plasminogen Activator Inhibitor-1
PCBS	Palestinian Central Bureau Of Statistics
PHC	Primary Health Care
POD	Glucose Peroxidase
POD	Glucose Peroxidase
RAS	Renin Angiotensin System
RR	Relative Risk
RR	Relative Risk
SD	Standard Deviation
SOPH	School Of Public Health
SPSS	Statistical Package For Social Science
T2DM	Type 2 Diabetes Mellitus
TAG	Triacylglycerol
TC	Total Cholesterol
UNRWA	United Nation Relief And Works Agency for Palestine Refugees in the Near East
VLDL	Very Low Density Lipoprotein
WBC	White Blood Cell
WC	Waist Circumference
WHO	World Health Organization
WHR	Waist Hip Ratio
$\mathbf{x^2}$	Chi Square

Chapter (1)

Introduction

1.1 Introduction

Metabolic syndrome (MetS) is multifaceted syndrome that usually occurs in general population, mainly in adults over 50 years of age (Timer et al., 2000). This syndrome has been described as a ‘‘clustering’’ of multiple risk factors for cardiovascular disease (CVD) (Buckland et al., 2007; Yasein et al., 2010) such as hypertension (HTN), dyslipidemia [specifically high triglycerides (TG), low levels of high-density lipoprotein (HDL), and increased small dense low-density lipoprotein (LDL)], obesity (particularly central or abdominal obesity), insulin resistance, and impaired glucose tolerance (IGT) or diabetes mellitus (DM) (Michael et al., 2007; Erem et al., 2008; Longo-Mbenza et al., 2010). MetS was also known as syndrome X, cardio metabolic syndrome, insulin resistance syndrome, Reaven’s syndrome, CHAOS (an abbreviation for coronary artery disease, hypertension, atherosclerosis, obesity, and stroke) (Kaplan, 1989; Schindler, 2007). Patients with MetS have a twofold increased risk of mortality from coronary heart disease (CHD) (Kathleen et al., 2007).

The increased prevalence of MetS has been attributed to changes in lifestyle, particularly with regard to new eating patterns and sedentarism (Cai et al., 2012; Kesse-Guyot, 2013). However, modern life has also brought changes to the work environment. Working hours that occurred during the daytime were extended in the last decades for a large number of services and production areas (Straif et al., 2007).

The vast majority function of the circadian system is the internal cycling of physiological and metabolic events (Murphy & Campbell, 1996). In fact, many physiological processes display day–night rhythms, in addition to lipid and carbohydrate metabolism and blood pressure (BP) are subject to daily variation.

The circadian rhythm and environmental conditions may become asynchronous in rotating shift workers whose night activity is out of leading to desynchronization of the normal phase relationships between biological rhythms within the circadian system (Klerman, 2005).

Recent epidemiological studies have reported an association between inflammation and thrombogenesis as a cause for CVD in patients suffering from the MetS **(**Hansson, 2005).

In addition, several studies have shown a positive relationship between elevated leukocyte count and risk of CHD suggesting that leukocyte count is related with metabolic and hemodynamic diseases typical of the MetS (Targher et al., 1996).

1.2 Research problem

Metabolic syndrome (MetS) is considered a worldwide epidemic problem (Alberti et al., 2009). It is estimated that approximately one fourth of adults worldwide carry the syndrome (Grundy, 2008). Individuals with MetS are at increased risk of developing type 2 diabetes mellitus (T2DM) and CVD (Blaha et al., 2008; Salas-Salvado et al., 2008). People with MetS have a fivefold greater risk to develop T2DM and are in higher risk of morbidity and mortality from CVD, for this a combination of each risk factors which compose MetS interact in a synergic manner to accelerate the development of atherosclerosis (Stern et al., 2004). In USA which is a developed country MetS is about 20%-30% (Aguilar-Salinas et al., 2005), while in some Asian countries like India and Iran higher prevalence rate has been reported (Azizi et al., 2003; Deepa et al., 2007).

In 1999, Knutsson and Boggild reviewed several studies and concluded that there is evidence of a strong association between shift work and CVD, with shift workers having on average 40% excess risk for ischemic heart disease as compared to day workers. Rotating shift work was found to be an independent risk factor for MetS in European men (OR, 1.51; 95% CI, 1.01-2.25) when corrected for age and physical-activity variables (Sookoian et al., 2007). The recent evidences indicate that MetS is highly prevalent in Gaza Strip population, with a steady increase in MetS prevalence through age and BMI. The overall prevalence of MetS in Gaza Strip cohort was 23.0% and 39.5% according to NCEP/ATP III and IDF definitions respectively (Sirdah et al., 2012). Another study done among clinic patients in Gaza showed that the prevalence of MetS was 59.5%, without difference between male and female, the main risk factors for MetS were high BP (78.8% for systolic and 73.8% for diastolic BP), large waist circumference (WC) (67.9%), high TG (78.6%), and high fasting blood sugar (FBS) (86.4%). HDL cholesterol was protective but not statistically significant (Jamee et al., 2013).

1.3 Justification

A number of studies have shown that shift work is related with MetS, a study done by Ye et al., showed that prevalence of MetS for shift worker was 15.3%, and for daytime worker was 2.8% (Ye et al., 2013). Fujino et al. (2006) in their prospective study showed that the rotating-shift workers had a significantly higher risk of death due to ischemic heart disease (RR = 2.32, 95% CI: 1.37, 3.95; $p = 0.002$). Also, a cross sectional study done by Sookoian et al. (2007) demonstrated that the odds ratio for MetS in rotating shift workers compared with day workers was 1.51 (95% CI 1.01–2.25), but the evidence on a causal relationship is limited.

In Gaza, most rotating shift workers at governmental hospitals complain from many health problems such as hypertension, obesity, diabetes, generalized fatigue, and decreased activities from the shift schedule they had.

Because shift work hypothesized to increase the prevalence of MetS, and CVD and diabetes are an established public health issues, this is a field in need of further focus.

According to our best knowledge and published literature there is no studies in Gaza investigated the prevalence of MetS and its biomarkers among healthcare workers and the potential effect of rotating shift work on MetS and inflammation biomarkers.

The study will provide policy makers with evidence that could help them to organize shift working shifts in a more effective way and will provide evidence that could provide policy makers with evidence that could help in improving working conditions for employee who work in the Gaza Strip. Additionally the study will provide MOH with information that could be used to reform the working schedules in order to decrease the likelihood of developing NCDS due to working conditions .

In this thesis, the main aim was to find out the prevalence of MetS among rotating shift workers and to explore the association between shift work and MetS with further emphasizes on inflammation markers.

1.4 General objective

To find out the prevalence of MetS among rotating shift workers and to explore the effect of rotating shift work schedule on biomarkers of MetS and inflammation among Palestinian medical staff working in Gaza-governorate hospitals.

1.5 Specific objectives

1. To determine the prevalence of metabolic syndrome (MetS) among rotating shift workers at Gaza governorate hospitals.
2. To determine the prevalence of metabolic syndrome (MetS) among day workers at Gaza governorate hospitals.
3. To explore if there is difference in prevalence of metabolic syndrome (MetS) in rotating shift workers with day workers.
4. To explore any possible effect of rotating shift work schedule on inflammation markers as white blood cell count and C-reactive protein.
5. To compare any possible change in inflammation markers between rotating shift workers and day worker.
6. To explore the association between MetS and having abnormal inflammation markers.

1.6 Research Questions

1. What is the prevalence of MetS among rotating shift workers at Gaza governorate hospitals?
2. What is the prevalence of MetS among current daytime workers at Gaza governorate hospitals?
3. Is there difference in prevalence of metabolic syndrome (MetS) between rotating shift and day worker?
4. Is there any effect of rotating shift work on acquisition of MetS?
5. Is there any effect of rotating shift work on inflammation markers?
6. Is there association between MetS and having abnormal inflammation markers?

1.7 Study Context

This study was conducted at the governmental hospitals of the Gaza Strip (GS). Services of hospitals are affected by many factors such as: political situation, demography and geography of the Gaza Strip, socioeconomic, and health services in the Gaza Strip.

1.7.1 Demography and Socio-economic Context:

Palestine is situated on the eastern Mediterranean coast between the longitudes 34º 15' and 35º 40' to the east of Grenache. And latitudes 29º 30'' and 33º 15' to the north of equator, and it has a long coast on the Mediterranean sea (224 Km). To the east it shares borders with Jordan and Syria, to the north with Lebanon, and to the south with Egypt (Saleh, 1985).

The total population of Palestine at mid-2015 was about 4.68 million; 2.38 million males and 2.30 million females. The estimated population of West Bank was 2.86 million of which 1.45 million males and 1.41 million females, while the estimated population of the Gaza Strip totaled 1.82 million of which 925 thousand males and 895 thousand females. The percentage of urban population at mid-2015 was 73.9%, while the percentages of population in rural and camps areas were 16.7% and 9.4% respectively. The percentage of individuals aged (0-14) constituted 39.4% of the total population at mid-2015 of which 37.2% in the West Bank and 43.0% in the Gaza Strip. The elderly population aged (65 years and over) constituted 2.9% of the total population of which 3.2% in the West Bank and 2.4% in the Gaza Strip at mid-2015 (PCBS, 2015).

The unemployment rate for Palestine increased to 26.9% in Q2/2016 (25.8% in Q4/2015). The number of unemployed was 358,700 in the 2nd quarter 2016; distributed as 203,600 in Gaza Strip and 155,100 in the West Bank. The unemployment rate in Gaza Strip was 41.7% compared with 18.3% in the West Bank in the 2nd quarter 2016. And the unemployment rate for males in Palestine was 22.1% compared with 44.7% for females in the 2nd quarter 2016. The highest unemployment rate in the 2nd quarter 2016 was 42.6% among youth aged 20-24 years. For years of schooling, the highest unemployment rate among females with 13 years of schooling and more was 50.9% . The highest unemployment rate among youth who have not completed any grade level reached 55%. The unemployment rate among youth graduates was 51% in the 1st quarter of 2016. The highest unemployment rate was 64% for graduates in education and teacher training, while the lowest unemployment rate of 25% was among law graduates (PCBS, 2016).

1.7.2 Political Context:

The West Bank and the Gaza Strip have been under occupation by Israel since 1967. The Palestinian National Authority was established in 1994 following the Oslo agreement. However, there has been ongoing political turmoil and economic decline sparked, in particular, by the second intifada in September 2000 and in 2006, international community withdrew direct financial support for the Palestinian National Authority following the election of Hamas. In February 2007, a National Unity Government was formed but was not widely supported and was short- lived. Factional clashes continued and in Jun 2007 Hamas took over control of the Gaza Strip. The ongoing Israeli blockade, imposed in June 2007 after Hamas take- over control of the Gaza Strip. This action crippled the private sector, driving unprecedented numbers of Palestinian into unemployment and poverty. The situation in the Gaza Strip was further exacerbated as a result of the Israeli military actions during the years 2008, 2012 and 2014. By these wars vital infrastructure was damaged or destroyed, including manufacturing and commercial units, housing and other buildings, electricity, water and sanitation services. Access to health care for ordinary patients was severely restricted during the conflict and continued as a result of Israeli blockade (Saleh, 2012).

It can be concluded from all the above that any attempts to improve health status and solve health problems in this region will be less effective unless root causes of these problems would be addressed by ending the occupation, eliminating siege and rehabilitation of the economy.

1.7.3 Health status context:

The population in Palestine is in epidemiological transition, with the burden of noncommunicable diseases rising. In 2015, heart disease was the leading cause of death in Palestine, causing 27.5% of all reported deaths. Cancers, when combined together, were the second leading cause of death, accounting for 13.8 % of reported deaths, followed by cerebrovascular diseases (9.9%), perinatal period conditions (6.9%), diabetes mellitus (6.8%), respiratory system diseases (6.6%), and injuries (5.1%). This disease burden has contributed to the increase in costs in the health sector and necessitates a greater focus on health prevention and integrated disease management including mental health. In spite of the protracted crisis and – as noted by the Palestinian Ministry of Health − with the support of the international community, achievements have been made in relation to some health indicators in recent years– although they compare negatively to health indicators in Israel. In 2015 the number of live births per 1,000 of population per year is still high compared with other countries. The reported crude birth rate was 28.8/ 1,000 of population, in West Bank was 26.7/ 1,000 and 31.8/ 1,000 was in the Gaza Strip. The crude death rate in Palestine was 2.9 per 1,000 of population; in Gaza Strip 2.7 per 1,000 of population, and in West Bank 3.0 per 1,000 of population and the infant mortality rate in Palestine was10.9 per 1,000 of live births. Vaccination coverage is close to 100% (MOH, 2015).

1.7.4 Health services in Palestine:

The quality of the public health sector needs to be substantively improved. Most public health facilities are unable to provide safe and adequate services and need to be rehabilitated or upgraded. While Israeli authorities permit the access of medical supplies into Gaza, there are frequent breakdowns of medical equipment resulting from power interruptions and water impurities, among other factors. For this and other reasons, many patients are forced to seek treatment outside Gaza for a wide range of medical problems, which is difficult due to movement restrictions imposed by the blockade (UNRWA Operational Response, 2013).

The Ministry of Health provides health services to Palestinians under its jurisdiction in accordance with the Palestinian Basic Law, which serves as the interim constitution, and the Public Health Law. The Ministry of Health has a network of 472 primary health care centers (418 in the West Bank and 54 in the Gaza Strip), and 26 hospitals (13 in the West Bank and 13 in the Gaza Strip) (MOH, 2015).

The Ministry of Health is the main provider of secondary healthcare services (hospitals) in Palestine. It provides and oversees 3259 hospital beds which are distributed among 26 hospitals in all governorates of the country. There are a total of 80 hospitals operating in Palestine with 5939 beds. These include 50 hospitals in the governorates of the West Bank, with 3502 beds (59% of the total). The remaining hospital beds are in the governorates of the Gaza Strip. A total of 809 beds at Ministry of Health hospitals are set aside for internal medicine and related disciplines, accounting for 24.8% of beds at Ministry of Health hospitals. These include 437 beds in the West Bank and 372 in the Gaza Strip. The Ministry of Health has also set aside 890 beds for general surgery and other surgery sub-specializations, accounting for 27.3% of the beds provided at the Ministry of Health hospitals. These include 444 beds in the West Bank and 446 beds in the Gaza Strip. The Ministry of Health is the only institution in Palestine that makes beds available for the treatment of mental and psychological disorders. Two hospitals have such beds: one in the Gaza Strip, with 25 beds, and the other in the West Bank, with 180 beds (WHO, 2016).

Nongovernmental organizations play an important role in service delivery, especially in providing tertiary, ambulatory and rehabilitative care services. In 2014, nongovernmental organizations operated 137 primary health care centers (129 in the West Bank and 8 in the Gaza Strip) and 34 hospitals (20 in the West Bank and 14 in the Gaza Strip), supplying about one-third of bed availability in Palestine. They are important providers especially for mental health counseling, physical therapy and rehabilitation. UNRWA provides services − mainly through fixed and mobile primary health care clinics as well as contracted hospitals − to registered refugees: to 727 471 people in the West Bank through 42 primary health centers and one hospital, and to 1 167 572 people in the Gaza Strip through 22 primary health centers. About 74% of eligible refugees utilized UNRWA's health services in 2014. (WHO, 2015).

1.8 Operational definitions

Metabolic syndrome

The metabolic syndrome is a cluster of risk factors for cardiovascular disease and diabetes that includes: abdominal obesity, glucose intolerance, hypertension and dyslipidemia (Anderson et al., 2001; Nesto, 2003; Carr et al., 2004; Yasein et al., 2010).

Shift work

In this study shift work defined as job schedule in which employees work hours than the standard hours of 7:30 am to 2:30 p.m.

Circadian rhythms

Any biological process that displays an endogenous, entrainable alternation of about 24 hours. These 24-hour rhythms are driven by a circadian clock, and they have been widely observed in plants, animals, fungi, and cyanobacteria (Edgar et al., 2012).

Chapter (2)

Literature Review

In this chapter the researcher demonstrates the study's conceptual framework and describes the most common factors (independent factors) background characteristics of respondents, characteristics of facilities, then a comprehensive review of the study literature is presented regarding shift work and MetS that included HTN, dyslipidemia, obesity (particularly central or abdominal obesity), insulin resistance, and IGT.

2.1 Conceptual Framework:

Shift work can elevate the risk of MetS by various mechanisms. Physiological and biological mechanisms are essential, they are often related to activation of the autonomic nervous system, changed lipid, carbohydrate and other metabolic parameters. These factors may lead to increase risk for T2DM, CHD and inflammation. MetS disturbances have some joint cause that unphysiologic timing of physical activity in relation to circadian rhythms is a possible explanation for the negative impact on the cardiovascular system and T2DM.

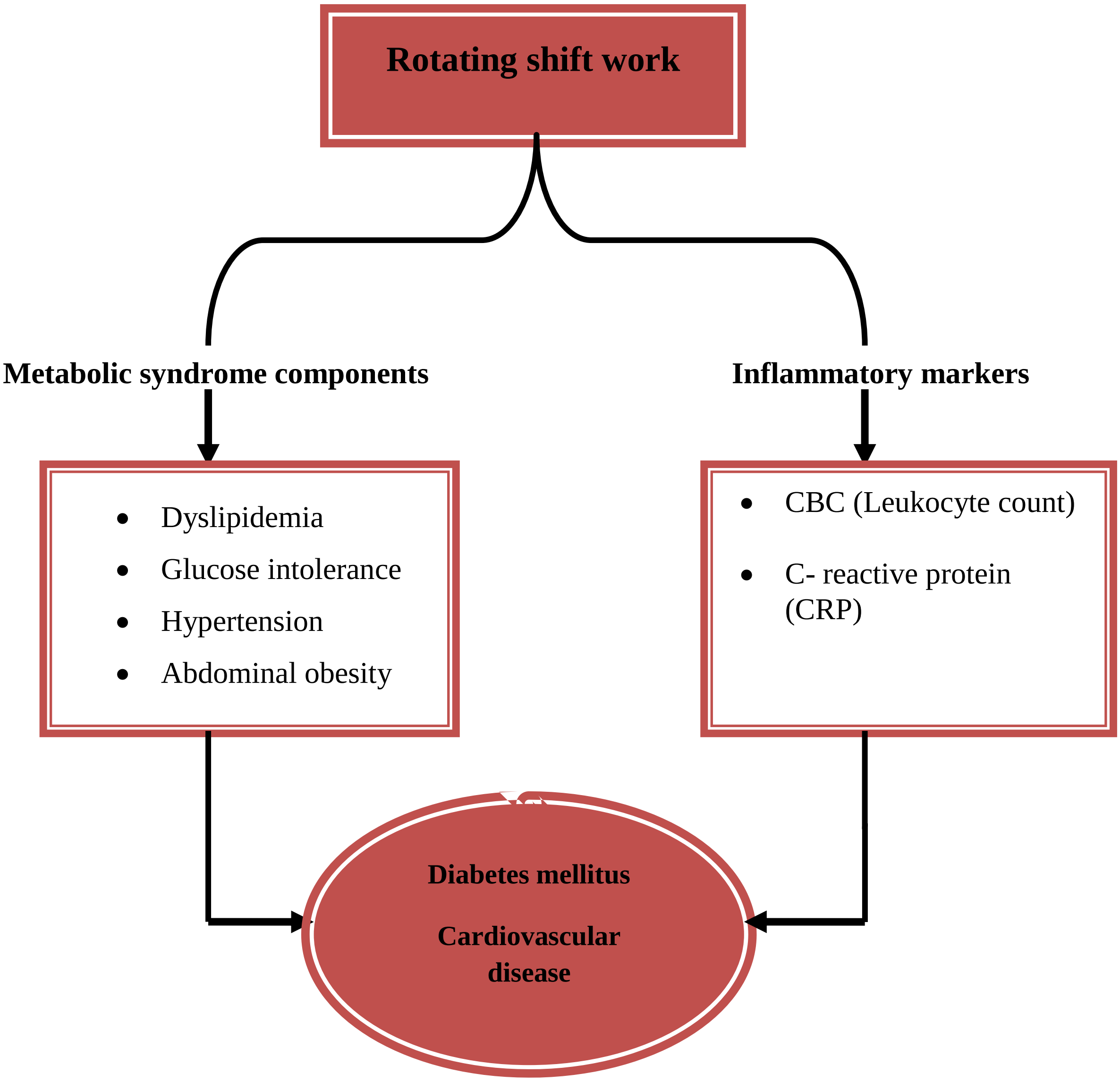


Figure (2.1): Conceptual Framework: Effect of rotating shiftwork on biomarkers of metabolic syndrome and inflammation in Governmental hospitals in Gaza Strip

As demonstrated in figure (2.1), the conceptual frame work for this study includes the following elements:

2.1.1 Rotating shift work

Shift work is associated with several health problems, possibly due to an impairment of biological rhythm specifically, MetS induces an almost twice increased risk for CHD (Aykan et al., 2013), a two to threefold increased risk for ischemic stroke (Yusuf et al., 2004; Kurl et al., 2006) and an even greater risk for diabetes (Hanley et al., 2005).

2.1.2 Metabolic syndrome components and inflammatory markers

- **Atherogenic dyslipidemia**: This is characterized in routine lipoprotein by increased triglycerides and low concentrations of HDL cholesterol. Further detailed analysis often reveals other abnormalities, including small, dense LDL particles, small HDL particles, and increased levels of apolipoprotein B, all of which have independent atherogenic potential.

- **Glucose intolerance**: The majority of patients with MetS exhibit evidence of insulin resistance, that characterized by glucose intolerance. Despite the strong association between insulin resistance, glucose intolerance, and other metabolic risk factors, mechanisms underlying the link to CHD risk factors are obvious. When glucose intolerance evolves into hyperglycemia that is sufficient to diagnose T2DM, this is considered to be a major independent CHD risk factor.

- **Hypertension**: It is frequently associated with the several metabolic abnormalities, of which obesity, glucose intolerance, and dyslipidemia are the most common (Ferrannini & Natali, 1991). Studies demonstrated that both hyperglycemia and hyperinsulinemia activate the Renin angiotensin system (RAS) by increasing the expression of angiotensinogen, Angiotensin II, and the AT1 receptor, which, in concert, may contribute to the development of HTN in patients with insulin resistance (Malhotra et al., 2001).

- Abdominal obesity: it is characterized clinically as increased WC; abdominal or visceral obesity and it is most strongly associated with MetS and considered as risk of CHD.

-Elevated CRP and increased leukocyte count: The high levels of CRP and leukocyte count are associated with an increased WC (Soto González et al., 2006), insulin resistance (Deepa et al., 2006), BMI (Guldiken et al., 2007), and hyperglycemia and are increased with the number of the MetS components. It is more likely to be elevated in obese insulin-resistant (McLaughlin et al., 2002). Furthermore, it has been demonstrated that CRP levels independently predicted the occurrence of future CVD (Ridker et al., 2003).

2.1.3 Diabetes Mellitus and Cardiovascular diseases

Cardiovascular disease is the main outcome of MetS (Isomaa et al., 2001; Mottillo et al., 2010). However, T2DM is also a major outcome of MetS. Accordingly, there is vigorous evidence correlating shift work and T2DM derives from epidemiological studies which show that shift workers are at increased risk for getting T2DM (Kroenke et al., 2006; Pan et al., 2011). In addition a various prospective and retrospective studies, reported that shift workers were found to have a 40% CVD risk increase (Bøggild & Knutsson, 1999).

2.2 Metabolic syndrome (MetS)

2.2.1 History of metabolic syndrome

The provenance of metabolic syndrome (MetS) began in 1920 when Kylin, a Swedish physician, demonstrated the association of high BP, high blood glucose, and gout (Kylin, 1923). Vague described in 1947, that the visceral obesity was related to metabolic abnormalities found in CVD and T2DM (Vague, 1947). Later, in 1965, Yalow and Berson developed insulin assay and correlated insulin levels and glucose lowering effects in resistant and non-resistant individuals. In 1988 lecture performed at the American Diabetes Association (ADA) meeting by Reaven coined the term Syndrome X and brought into focus the clustering of characteristics of MetS. Reaven now prefers the name, Insulin-Resistance Syndrome feels insulin resistance is the common denominator for MetS. In 1989, Kaplan renamed it “The Deadly Quartet” and others then modeled the term "Insulin Resistance Syndrome" (Haffner et al., 1992). The first criteria for definition was made by a World Health Organization (WHO) diabetes group in 1998 (WHO, 1999). Followed by the European Group for the study of Insulin Resistance (EGIR) that modify WHO definition in 1999 (Balkau & Charles, 1999). In 2001, the National Cholesterol Education Program Adult Treatment Panel (NCEP/ATP) submitted its definition (Cleeman, 2001), subsequently, in 2003 the American Association of Clinical Endocrinologists (AACE) offered its definition of the syndrome (Einhorn et al., 2003). After that in April 2005 the International Diabetes Federation (IDF) proposed a new definition of the MetS.

2.2.2 General definition of the metabolic syndrome

The metabolic syndrome is a cluster of risk factors for cardiovascular disease and diabetes mellitus that includes: abdominal obesity, glucose intolerance, hypertension and dyslipidaemia (Anderson et al., 2001; Nesto, 2003; Carr et al., 2004; Yasein et al., 2010).

Cai et al. define the MetS as a group of metabolic abnormalities including elevated blood pressure, increased triglycerides, decreased high-density lipoprotein, abdominal obesity, and changes in blood glucose (Cai et al., 2012), which are associated with an elevated risk of developing T2DM and CVD as well as increased mortality (Wu et al., 2010).

2.2.3 Current definitions of the metabolic syndrome

Just as there are many synonyms for MetS that have evolved over time, there are also several definitions of MetS started with the World Health Organization (WHO) was the first organization to publish the definition of MetS in 1998 (Alberti & Zimmet, 1998) and subsequently modified the definition in 1999 (WHO 1999). The WHO definition required three main criteria for the diagnosis of MetS. The compulsory criteria were the presence of impaired glucose regulation or diabetes and/or insulin resistance along with two of the four other risk factors: HTN, dyslipidemia, abdominal obesity, and microalbuminuria, as shown in table 2.1.

The European Group for Study of Insulin Resistance (EGIR) published their definition in 1999 (Balkau & Charles, 1999). The EGIR definition applies only to non-diabetics and the major criteria focused on the presence of hyperinsulinemia along with two of four other risk factors (hyperglycemia, HTN, dyslipidemia, central obesity), as shown in table 2.1. The National Cholesterol Education Program Adult Treatment Panel III (ATP III) published their criteria to diagnose MetS in 2001 (NCEP 2001). The presence of three of five risk factors: increased WC, low HDL cholesterol, high TG, high BP, and impaired fasting glucose (IFG), achieve the criteria for the diagnosis of MetS.

American Association of Clinical Endocrinologists (AACE) put forth their definition in 2003 and called it the "Insulin Resistance Syndrome" (Einhorn et al., 2003). The diagnosis depended on clinical judgment based on risk factors, irrespective of the number of risk factors present, and this definition was to be used only in non-diabetics. The American Heart Association/National Heart, Lung and Blood Institute (AHA/NHLBI) made slight modifications to this definition in 2005, as shown in table 2.1 (Genuth et al., 2003; Grundy et al., 2005). The changes include TG, HDL, and HTN related therapies as equivalents of the metabolic factor's involvement and update in Insulin Fasting Glucose to>100 mg/dl. The most recent definition of MetS is from the International Diabetes Federation (IDF) in 2005, as shown in table 2.1.

Table 2.1 summarizes the criteria of the various definitions and highlights the differences. Different measures of obesity and insulin resistance are used by the various definitions. The most distinguished difference is that the EGIR and AACE definitions are limited to non-diabetics, while the others include diabetics. The ATP III and EGIR have emphasized the presence of visceral obesity as a major risk factor, while in the IDF definitions it is a required criterion, without which the diagnosis of MetS cannot be made. All the definitions agree on the following essence components of MetS: obesity, abnormal glucose levels, dyslipidemia, and HTN.

Table (2.1): Comparison of the different definitions for the Metabolic Syndrome (Alberti et al., 2005).

MetS Component	WHO1998	EGIR1999	ATP III2001	AACE2003	AHA/NHLBI2005	IDF2005
MetS, Criteria for diagnosis	low insulin sensitivity or IGF/IGT or Type 2 DM plus tow of other four following:	Hyperinsulinemia Plus two of the four following	Three or more of the following five risk factors:	Depend up on clinical judgment irrespective of number of risk factors present:	Central obesity plus two of other four following:	Central obesity and any of the following below:
Obesity	Men: waist. hip ratio >0.90 in	Men: waist circumference >94 cm	Men: waist circumference >102 cm	BMI >25 kg/m2	Men: waist circumference>102 cm	WC Ethnic specific
	Women: waist. hip ratio> 0.85inand/or BMI > 30 kg/m2	Women: waist circumference >80 cm	Women: waist circumference > 88 cm	BMI >25 kg/m2	Women: waist circumference >88 cm	WC Ethnic specific
Blood pressure (mmHg)	≥140/90	≥140/90	≥130/85	≥130/85	≥130/85	≥130/85
plasma glucose mg\dl	IFG(Fast>110) mg/dl	IFG(Fast>110) mg/dl	IFG(Fast>110) mg/dl	IFG(Fast>110) mg/dl	IFG(Fast>110) mg/dl	IFG(Fast>100)mg/dl. If FPG > 100 mg/dL, OGTT Glucose tolerance test is strongly recommended but is not necessary to define presence of the Syndrome.
	IGT(2H>140)	IGT(2H>140)	………………	IGT(2H >140)	…………..	…………..
	Type 2 DM	……………	Type 2 DM	………….	Type 2 DM	Type 2 DM
Triglycerides(mg/dl)	≥150	≥150	≥150	≥150	≥150	≥150
HDL (mg/dl)	**Men** ≤35	≤39	≤ 40	≤ 40	≤ 40	≤40
	Women ≤39	≤39	≤50	≤50	≤50	≤50
Other/ unique Features	Microalbuminuria	Used only in non-diabetics	………………	Other conditions Used only in non-diabetics	Update of ATP	Ethnic specific WC

2.3 Prevalence of metabolic syndrome

The prevalence of the MetS is directly depend upon the definition used to describe the syndrome (Scott, 2003). Without a unifying definition, reports of prevalence have a varied in the USA and Europe (Rantala et al., 1999). The estimated current global prevalence of the MetS is nearly 16% (95% CI 10-23) (Wild et al., 2004). 44% of the U.S. population older than age 20 affects by MetS. A higher percentage of women older than age 50 have the syndrome than that of men (Ervin, 2006). Studies from Europe, North America, and Australia report the prevalence of the MetS to be between 12% and 25% (Sattaret al., 2003 ;Villegas et al., 2003 ; Cameron et al., 2003). While studies in Asia have mostly found a reduced prevalence of 5% (Holloszy et al., 1986; Lee et al., 2004). Using the 2005 version of NCEP-ATP III the prevalence of MetS in China, Taiwan Hong Kong and Thailand (Lohsoonthorn et al., 2006) was ranging from 10-15% (Feng et al., 2006). Otherwise, the rates in the Koreans were higher than the Chinese and Thai's even though their BMI was similar to other East Asia countries.

The metabolic syndrome is common among Arab populations in Mediterranean countries (Abdul-Rahim et al., 2001; Al-Lawati et al., 2003) and among Arab Americans (Jaber et al., 2004). Using the ATP III diagnostic criteria, the prevalence of the MetS in Jordan was 36.3% (28.7% among men and 40.9% among women). The authors found that low HDL cholesterol was the most common abnormality in men (62.7%), and abdominal obesity was the most common abnormality in women (69.1%). Men had significantly higher prevalence of hypertriglyceridemia and lower prevalence of abdominal obesity than women. This study exposed that all other metabolic abnormalities did not significantly differ by gender (Khader et al., 2005).

A study performed in Qatar showed that the prevalence of MetS was 26.5% and 33.7% according to NCEP ATP III and IDF respectively. The prevalence of MetS by ATP III and IDF increased with age and BMI. In addition to that the prevalence of MetS was more common in women. Multivariate logistic regression analysis (ATP III and IDF) showed that age and BMI were significant contributors for MetS, Both definitions strongly confirmed age and obesity as associated factors for MetS (Bener et al., 2009).

A study conducted among patients with CVDs in Gaza estimated that the prevalence of MetS was 59.5%, without difference between male and female. The main risk factors for MetS were large WC (67.9%), high TG (78.6%), high FBS (86.4%), and high BP (78.8% for systolic and 73.8% for diastolic BP) (Jamee et al., 2013).

Another study set up to evaluate the reliabilities of NCEP/ATP III and IDF definitions in diagnosing MetS among Gaza Strip Palestinians, The overall prevalence was 23.0% and 39.5% according to NCEP/ATP III and IDF respectively ($p < 0.001$), the results showed there is no significant differences in the number of MetS components in individuals having MetS by either definition (mean 3.42 ± 0.63 vs 3.52 ± 0.69 respectively, $p = 0.865$). Both IDF and NCEP/ATP III showed an increased prevalence of MetS with age, and BMI, however they revealed different prevalence trends with sex. Except for BMI, there were no significant differences in the general and metabolic related characteristics between people with MetS of IDF and NCEP/ATP III definitions (Sirdah et al., 2012).

The prevalence of the MetS using the IDF criteria in study done for people aged ≥ 40 years living in Tunis, Tunisia was 45.5%; 55.8% in women and 30.0% in men (P <0.001), greater than the rates of 28.7% (WHO) and 24.3% (NECP ATPIII) using the previous definitions. All definitions agreed that the prevalence was higher in women than in men because of significant differences in central obesity and HDL- cholesterol (Harzallah et al., 2006).
The metabolic syndrome was present in 4.6%, 22.4%, and 59.6% of normal-weight, overweight, and obese men, respectively, and a similar distribution was observed in women (Park et al., 2003). MetS was correlated positively with marital status, cessation of cigarette smoking, and negatively with the level of education, alcohol consumption, current cigarette use, household income, and physical activity. In their study, HTN was found to be the most common MetS component as (57.4%). In decreasing order were abdominal obesity (40.9%), low HDL-C (31.8%), hypertriglyceridemia (30.7%), and high fasting blood glucose levels (9.2%), where men had significantly higher prevalence of hypertriglyceridemia (36.2%) than women. The frequencies of abdominal obesity (57.6%) and low HDL (33.6%) concentration were higher in women than men (Erem et al., 2008).

2.4 Metabolic syndrome components

2.4.1 Abdominal obesity

Obesity, as defined by BMI > 30, is a strong risk factor for MetS (Ford et al., 2002). It has been suggested by many studies that visceral obesity is more importance than somatic obesity. Various methods have been proposed to measure it; anthropometric measurements include the WC, waist-hip ratio (WHR), BMI (Zulfiqar & Ahmed, 2007). Though some criteria uses WC and other use BMI to estimate the excessive deposition of fat in the body. It has been found that WC and BMI are highly correlated and there's no superiority between the two.

The association between weight-gain and rotating shift work has been explored. A systematic review provided strong proof of the correlation between shift work and obesity. In addition to that, behavioral changes that associated with shift work, such as decreased physical activity, may independently lead to weight gain and the development of MetS (Van Drongelenet et al., 2011). A study done by Di Lorenzo et al. showed that obesity was more prevalent in shift workers (20.0%) than in day workers (9.7%). Another hospital based study in Botswana showed that obesity (28.7%) and overweight (27.3%) were the major high risk factors for the MetS among healthcare workers (Kelliny et al., 2007).

2.4.2 Dyslipidemia

Dyslipidemia of the MetS, has been characterized by:

1. Raised TG values (hypertriglyceridemia).
2. Low HDL cholesterol values.
3. Increased small, dense LDL values. (Ginsberg & Huang, 2000).

It is believed that such "atherogenic dyslipidemia" is associated with the MetS and contributes to accelerated atherosclerosis (Grundy, 1998).

2.4.3 Hypertension

Increased blood pressure is highly associates with obesity and commonly occurs in insulin-resistant persons. Hence, HTN commonly listed among metabolic risk factors. However, some investigators believe that HTN is less "metabolic" than other MetS components. Certainly, HTN is multifactorial in origin. Even so, most conference participants favored containment of elevated BP as one component of the MetS (Grundy et al., 2005). HTN have been suggested to correlate with insulin resistance (Wassink et al., 2007; Eckel et al., 2005; Reaven, 1988). When insulin resistance is found, the vasodilatory effect of insulin (Westerbacka et al., 2001) in the endothelium will be suppressed resulting in vasoconstriction (Montagnani & Quon, 2000). Compensative hyperinsulinemia increases the activity of the sympathetic nervous system, where the effect on insulin action is conserved (Egan, 2003). The reabsorption of renal sodium in the kidney is elevated directly by fat tissue (Sharma et al., 2002) and via increased the activation of sympathetic nervous system. Moreover, free fatty acid (FFA) created by adipose tissue may directly facilitated vasoconstriction (Tripathy et al., 2003).

2.4.4 Pathophysiology of metabolic syndrome

The mechanisms in which the MetS is occurred are not fully known (Eckel et al., 2005), and there is debate regarding the initiating factor, which leads to MetS. The sedentary lifestyle has an important role in the development of MetS (Reaven, 1988; Park et al., 2003). In addition, the genetic and environmental components have been implicated in the development of MetS. Among these, obesity and insulin resistance play an important role, and both coexist almost in a patient with MetS (Babu et al., 2005).

2.4.4.1 Obesity and abnormal body fat distribution

According to the criteria of IDF, MetS can also be called central obesity syndrome (Gary, 2006). It is more metabolically active than peripheral fat. Recently, studies suggested that central adiposity is the first component to be developed and that weight reduction at that point could be the best way to prevent it. The WC can be measured to assess individuals for increased risk for insulin resistance related CVD, MetS and T2DM (Steele et al 2005; Pladevall et al., 2006). Although insulin resistance is known to be the major factor for the development of MetS, but it is suggested that obesity provides the connection between the insulin resistant, dyslipidemic and hypertensive factors (Wingard et al., 1996). Adipose tissue can define as a heterogeneous mixture of fat cells, immune cells, stromal preadipocytes, and endothelium (Halberg et al., 2008).

With progressive adipocytes enlargement and obesity, the blood supply to fat cell may be reduced with eventual decreased oxygen supply (Cinti et al., 2005). Hypoxia can be considers as spectacular etiology of necrosis and macrophage infiltration into adipose tissue that leads to an increased production of active metabolites known as adipocytokines that involved FFA, glycerol proinflammatory mediators (plasminogen activator inhibitor-1 (PAI-1), tumor necrosis factor alpha (TNFα) and interleukin-6 (IL-6)), and CRP (Lau et al., 2005). All of this will lead to localized inflammation in adipose tissue that proliferate all systemic inflammation associated with the development of obesity related comorbidities (Trayhurn & Wood , 2004). Additionally, visceral fat releases their metabolic products into portal circulation, which carries blood into the liver. Hence FFAs are poured into the liver and also accumulate in the pancreas, heart and other organs, lead to produce impaired regulation of insulin, blood sugar and cholesterol as well as abnormal heart functions.

The National Cholesterol Education Programme Adult Treatment Panel III suggested cut off of 102 cm (40 in) and 88 cm (35 in) for males and females as a marker of central obesity. Parikh et al. (2006) proposed that Index of central obesity, which is the ratio of WC and height, was a better alternative than the WC. Central obesity is correlated with both insulin resistance and T2DM itself (Gabriely et al., 2002).

2.4.4.2 Insulin resistance and glucose intolerance

Insulin resistance can be defined as an insufficient insulin action in liver, adipose tissue and skeletal muscle (Reaven, 2005). It appears to be the primary mediator of MetS (Lann & LeRoith, 2007). The metabolic effect involves the activation of phosphatidylinositol 3-kinase. In case of Insulin resistance, phosphatidylinositol 3- kinase path is impaired and insulin is no longer antiatherogenic (Wang et al., 2004). Also, insulin resistance triggered the gluconeogenesis in the liver, reduced glucose disposal in the muscle, and increased the release of FFAs from the adipose tissue (Reaven, 2005).

A reason of insulin resistance is related to obesity. Non esterified fatty acids (NEFAs) are released from excess adipose tissues, which increase insulin resistance (Eckel et al., 2005) by inhibiting insulin signaling (Wassink et al., 2007). Insulin prevents lipolysis in adipose tissue and glucose production in the liver (Jensen et al., 1989). Accordingly, when insulin resistance develops, the inhibitory effect of insulin on lipolysis is suppressed

(Eckel et al., 2005). MetS is associated with a high amount of intra-abdominal fat (Salmenniemi et al., 2004).

Other contributors to insulin resistance involve abnormalities in insulin secretion, insulin receptor signaling and impaired glucose disposal (Eckel et al., 2005). Furthermore, there is an increased production of inflammatory cytokines and decreased production of anti-inflammatory adipokines (Ross, 1999; Eckel et al., 2005; Wassink et al., 2007; Cornier et al., 2008). This imbalanced production of inflammatory cytokines favors both the inflammatory state associated with obesity and induces insulin resistance by impairing insulin signaling transduction (Wassink et al., 2007). Study done by Reilly et al. (2004) proposed that insulin resistance or its biomarkers may lead to CVD in people with MetS.

2.4.4.3 Dyslipidemia:

Dyslipidemia in MetS characterized by high TG and low levels of HDL cholesterol. The elevated level of TG in the presence of insulin resistance results from increased circulating FFAs. As insulin resistance increases, the lipolysis inhibitory mechanisms of insulin on adipose tissue decrease and more FFAs are produced. In addition lipoprotein lipase is stimulated and increases the release of TG. Hypertriglyceridemia will cause alterations, both in structure and metabolism of HDL and LDL (Menuet et al., 2005). Obese individuals with MetS and dyslipidemia almost always have low HDL levels (Grundy, 2004). The presence of low HDL cholesterol in MetS is partially due to high TG.

As triglycerides increase, the cholesterol esters of HDL are exchanged for TG through the action of cholesteryl ester protein, causing the HDL particle to become smaller and less dense. Across some mechanisms not well understood, the smaller HDL particle is metabolized at an abnormally high rate resulting in low HDL levels. This shift to smaller particles make them less anti-atherogenic, because the larger they are, the more free cholesterol they can remove from cells and atherosclerotic plaque (Menuet et al., 2005).

Cholesterol of LDL fraction is often normal, but LDL particles are smaller and denser than normal, which is related to increase cardiovascular risk (Reilly & Rader, 2003). Smaller LDLs also increases the ability to penetrate the vascular endothelium and a greater affinity for intimal glycans. The retention in the intima allows for enhanced oxidative transformation, endovascular injury and the accumulation of foam cells (Menuet et al., 2005). In addition to increased numbers of smaller and denser LDL cholesterol particles, there is marked increase in apolipoprotein B. In fact, it appears that once apolipoprotein B concentrations increased, cardiovascular risk can be considered high (Sattar et al., 2004).

2.4.4.4 Other factors

Environmental and genetic factors have been implicated in the development of this syndrome. Older age, sedentary lifestyle, and high-fat diet can increase the prevalence of MetS. In the European Youth Heart Study, physical activity in children was inversely correlated with MetS risk factors (Brage et al., 2004). Similarly in the Amsterdam Growth and Health Longitudinal study, fat, fitness, and lifestyle were important determinants of MetS in young adults (Ferreira et al., 2005).

Decreased physical activity lowers the levels of the glucose transporter protein (GLUT-4) and can lead to high release of NEFA. High-fat diets, (Freire et al., 2005), high carbohydrate intake, (Ford et al., 2004) and empty-calorie eating pattern (Sonnenberg et al., 2005) were related to an increased risk for the development of MetS. In contrast, whole-grain intake, especially cereal fiber, (McKeown et al., 2004) and intake of linoleic acid, (Freire et al., 2005) were associated with a lower prevalence of MetS.

2.5 Clinical manifestation of Metabolic Syndrome

2.5.1 The risk of cardiovascular disease

People with the MetS are at more risk of developing T2DM and CVD (Lakka et al., 2002; Gami et al., 2007; Mottillo et al., 2010). CHD, myocardial infarction and stroke are complications of MetS that consider the leading cause of all deaths in industrialized countries. Lakka et al. showed in a prospective study of Finnish men that CVD-death and all-cause mortality were increased in people with the MetS even in the absence of CVD or diabetes (Lakka et al., 2002). Botnia study on 4,483 middle-aged participants in Finland and Sweden found a marked elevated in cardiovascular mortality in participants with MetS during a 6.9-year follow-up period (12.0 vs 2.2%, $P < 0.001$) (Isomaa et al., 2001).

A meta-analysis on the 87 studies that used NCEP or revised NCEP definitions confirmed that MetS is associated with a twofold increase in cardiovascular outcomes (Mottillo et al., 2010). The relative risk was 2.35 (95% confidence interval [CI] 2.02–2.73) for all CVD, 2.40 (95% CI1.87–3.08) for CVD mortality, 1.99 (95% CI 1.61–2.46) for myocardial infarction and 2.27 (95% CI 1.80–2.85) for stroke.

2.5.2 The risk of diabetes mellitus

Type 2 diabetes consider the most common form of diabetes and is characterized by disturbances of insulin action and insulin secretion, either of which may be the predominant feature (WHO Department of Noncommunicable Disease Surveillance, 1999). The development of T2DM arise from a failure of insulin producing cells to maintain the degree of compensatory hyperinsulinemia that is essential to prevent loss of glucose tolerance in insulin-resistant tissues thus leading to increased plasma levels of glucose (Gerstein, 1997; Stratton et al., 2000; Juutilainen et al., 2005). MetS is common in individuals with DM and significantly more common in patients with T2DM than in those with type 1 diabetes mellitus (Guzder et al., 2006; AlSaraj et al., 2009). Nearly all individuals with T2DM have MetS (Liese et al., 1998).

People with MetS have a fivefold increased risk to develop T2DM and are in higher risk of morbidity and mortality from CVD, for this a combination of each risk factors, the interaction between MetS components occurs in a synergic manner to accelerate the development of atherosclerosis (Stern et al., 2004). Ford et al. showed that the RR is 3.5-5.2 (depending on ethnicity) for incident T2DM in people with the MetS compared to those without it (Ford et al., 2008).

2.6 Shift work

The council Directive in November 1993 concerning certain aspects of the organization of working time (as amended by Directive 2000/34 of 22 June 2000) defines shift work as method that organize work in shifts whereby workers succeed each other at the same work stations according to a certain pattern, including a rotating pattern, and which may be continuous or discontinuous, necessitating the need for workers to work at various times over a given period of days or weeks”.

Shift work have numerous definitions. Most studies assorted shift workers as anyone working outside regular daytime hours. According to this definition, shift workers include all people working evening shift, night shift, rotating shifts, or on-call schedules both during the week and on weekends (Institute for Work and Health, 2003). The working hours of rotating shift workers, that do not harmonize with their daily life rhythms, cause negative effects on the health of rotating shift workers involve CVDs, as myocardial infarction and angina pectoris (Bøggild & Knutsson, 1999; Vyas et al., 2012); cerebrovascular diseases, such as stroke (Brown et al., 2009), arthritis, DM and MetS (De Bacquer et al., 2009).

Many health problems are related to shift work, possibly due to an impairment of biological rhythm. Over the last decades, many countries have become 24-hour societies. As a result, the concerning about the influence of shift work on several health problems has been increasing all the time. Several studies have scrutinized the relationship between MetS and shift work and reporting a fivefold increase in the risk of developing MetS in shift workers compared with daytime workers (Pietroiusti et al., 2010).

2.7 Circadian rhythm

Circadian rhythms are essential physiological processes. They are found in all organisms, these daily rhythms, of period about 24 hours, are associated with periodic changes in hormones controlling sleep/attentiveness, body temperature, BP, heart rate and other physiological variables (Gonze et al., 2002; Leloup & Goldbetter, 2003). It has three main characteristics: it is resistant to sudden changes, endogenous, and adapt slowly to changing conditions. The main synchronizer of the human circadian rhythm is central nervous system (CNS), and coordinates circadian pacemakers in the brain and peripheral tissues through signals generated in the suprachiasmatic nucleus of the hypothalamus that align the circadian period and phase with external stimuli (Garaulet et al., 2010).

We are a diurnal species and thus, we normally sleep at night and active through the daytime. The timing of functions with notable rhythms such as, metabolism, sleep, alertness and performance in a normal environment is such that they are optimal during the most suitable phase of the day. A sudden variation from 'normal' timing of work and sleep can lead to problems, for example sleeping during the day is usually shorter and of worse quality than when taken at night (Akerstedt, 2005; Akerstedt et al., 2008). The circadian rhythm can become desynchronized in rotating shift workers whose night activity is out of phase leading to desynchronization of the normal phase (Klerman, 2005).

The circadian system regulates metabolism (Holzberg & Albrecht, 2003). There is increasing evidence correlates circadian desynchrony to disorders as MetS (central obesity ,insulin resistance, increased BP, reduced HDL cholesterol, high TG (triacylglycerol, TAG) and CVD (Van Cauter et al., 2008). Interestingly, there is evidence that men are more susceptible to metabolic abnormalities than women. TAG considers an independent risk factor for development of heart disease (HD). This may provide a partial explanation for the elevated risk of HD in rotating shift workers. In large surveys, shift workers have increased TAG levels as well as elevated TC than daytime workers (Knutsson & Boggild, 2000; Biggi et al., 2008).

2.8 Shift work and cardiovascular risk

There is a growing concern about coronary artery disease and acute myocardial infarctions and their related with shift work, however, rotating shift work was not associated with all mortality and death (Vyas et al., 2012). A study performed in a public university in Brazil evaluated cardiovascular risk found that cardiovascular risk (28 %) was higher in night workers than in day workers (Pimenta et al., 2012). Another study performed to evaluate the effect of shift work on BP found that the systolic arterial pressure of night workers was 2.5 mmHg ($p < 0.001$) higher than that of day workers (De Gaudemaris et al., 2011).

A various prospective and retrospective studies, reported that shift workers were found to have a 40% CVD risk increase (Bøggild & Knutsson, 1999). Many studies suggest that impaired metabolic regulation due to change lifestyles, circadian rhythms and chronic work stress may partly elucidate the relationship between shift work and increased cardiovascular risk (Knutsson & Bøggild, 2000).

2.9 Shift work and Diabetes mellitus

Type 2 diabetes is a world-wide epidemic disease. It is a significant cause of morbidity and mortality and its consequences are an unbearable encumbrance to the individual and healthcare systems (WHO Department of Non-communicable Disease, 1999). The vigorous evidence correlating shift work and T2DM derives from epidemiological studies which show that shift workers are at increased risk for getting T2DM (Kroenke et al., 2006; Pan et al., 2011). A study done by Suwazono et al. (2009) on male Japanese workers revealed that shift work was an independent risk factor for impaired glucose metabolism.

Also, Mikuni et al. (1983) reported a higher prevalence of DM among shift workers. Morikawa et al. (2005) suggests that shift work is a risk for the onset of DM.

2.10 Shift work and metabolic syndrome

Metabolic syndrome has been variously described (Cornier et al., 2008; Suwazono et al., 2010), and the definition is essential to underlying pathophysiological processes. Higher prevalence of the MetS has been demonstrated among shift workers (Karlson et al., 2001; Esquirol et al., 2009). A study done by Sookoian et al. showed the risk of MetS was 1.5 times higher among shift workers, taking into account age and physical activity (Sookoian et al., 2007). Another study using the new IDF score, which takes into account almost the same parameters but with different weights, the prevalence of the MetS was 37.1% among shift workers and 20.8% among day workers ($P < 0.05$) (Copertaro et al., 2008).

Esquirol et al. show that shift work, regardless of models, was significantly correlated with MetS (De Bacquer et al., 2009). A recent study by De Bacquer et al. demonstrates that the risk of development of the MetS increases independently of the accumulated years of shift work. Rotating shift work has an influence on each component of MetS (Esquirol et al., 2009) and the risk of developing MetS is high in night shift healthcare workers (Pietroiusti et al., 2010).

Table (2.2): Recent epidemiological studies on the relationship between shift work, CVD, DM and MetS

Author	Study design	Population (age)	Outcomes	Main exposure	Main results
Karlsson et al., 2001	Cross-sectional	F: 4632 shift workers, 9857 day workers; M: 3277shift workers,9719 day workers (aged 30, 40, 50,or 60)	Metabolic syndrome	Shift work/day work	F: RR = 1.71 (P < 0.0001); M: RR =1.63 (P< .0001) of having all three components(obesity, hypertension, and high triglycerides)
Nagaya et al., 2002	Cross-sectional	M: 826 shift workers, 2824 day workers (46.7 +/- 7.0 years)	Fasting serum glucose>7.00mmol/l	Shift work/day work	Age group 30–39years OR = 6.75(95% CI 1.31–56.1);agegroup40-49 years OR=1.22(95% CI 0.68–2.10);Agegroup50–59 years OR = 0.93(95%CI0.53–1.55)
Haupt et al., 2008	Cross-sectional	F: 1052unexposed, 192exposed; M: 760unexposed,506 exposed (mean age: 61.5unexposed, 62.3exposed)	Atherosclerosis and MI	Exposed to shift work/unexposed	HR = 1.53 (95%CI 1.06–2.22) of MI at an early age
Esquirol et al., 2009	Cross-sectional	M: 100 shift workers; 98 day workers (mean age: 46.54 shift workers; 48.84 day workers)	Metabolic syndrome(NCEP-ATPIII and IDF definitions)	Rotating shift work/day work	OR = 2.38 (95%CI 1.13–4.98)(NCEP-ATPIII);OR = 0.95 (95%CI 0.51–1.78)(IDF)
Brown et al., 2009	Cohort	F: 28 015 never,36 400(1–14) years,3821 (15–29) years,1187 >30 years mean age: never 54.555.0 (1–14 years), 56.3(15–29 years),60.4 (>30 years)]	Ischemic stroke	Rotating night shift/day time and evenings	HR = 1.04 (95%CI 1.01–1.07)of ischemic stroke per 5 years working rotating night shifts
Pietroiusti et al., 2010	Cohort	F: 244 day workers,278 night workers; M: 92 day workers, 124 night workers (mean age: 38.9 shift workers; 37.9daytime workers)	Metabolic syndrome(updated NCEP definition)	Night shift work or rotating shift work(at least four nights per month during a year)/daytime work	RR = 5.10 (95%CI 2.15–12.11)

2.11 Shift work and inflammation

Shift work has been to contribute to the elevated hazard for sleeping difficulties and other diseases such as CHD and HTN (Hampton et al., 1996; Ha and Park, 2005). Sleep disturbances caused by shift work may play an important role in enhancing inflammation and thus leading to coronary artery disease. CRP observed to be a typical pointer of inflammation (Albert & Ridker, 2004). Brand new studies have reported an association between inflammation and thrombogenesis as potential causes for CVD in patients suffering from the MetS (Hansson, 2005).

Additionally, there is a positive correlation between increased leukocyte count and risk of CHD suggesting that leukocyte count is related with MetS, so it was presumed that increased white blood cell (WBC) may be another component of it (Targher et al., 1996). Furthermore, it has been demonstrated that regardless the presence of the MetS in an individual, CRP levels independently portend the occurrence of CVD (Ridker et al., 2003). Because the MetS has been linked with a greater chance of CVD, CRP levels may be an independent predictor of undesirable outcomes in the MetS (Clearfield, 2005).

Chapter (3)

Methodology

This chapter described the methodology of the study. It is defined as the way in which relevant information is gathered in order to answer the research questions or analyze the research problem including research approach, research design, instrument modifications, recruitment sample, study population, eligibility criteria, pilot study, data collection procedure and plan for data analysis, ethical and administrative approval. Finally it described limitation of the study.

3.1 Study design

This study is quantitative approach; the design is comparative analytical cross sectional that use to determine the prevalence and effect of rotating shift work on biomarkers of MetS and inflammation. A cross sectional study is usually rapid, quick, cheap, and easily undertaken. It is generally carried out at a point of time or over a short period. In addition, it gives more insight into the association between variables in the study. However, it is limited by the fact that it is carried out at one point and gives no indication of the sequence of events whether exposure occurred before, after or during the onset of the disease outcome. This being so, it is impossible to infer causality (Levin, 2006).

3.2 Study setting

This study was conducted in two governmental hospitals, Al-Shifa Hospital (ASH) and Al-Nassir Pediatric Hospital (ANPH). The researcher chose these hospitals for several reasons including the following: the ASH hospital is the largest and general hospital in the Gaza strip, has the largest number of rotating shift health care workers (approximately 714), and is located in the Gaza city. ANPH hospital is one of the main general pediatric hospitals that located in the Gaza city and has nearly 141 rotating shift health care workers.

3.3 Study population

The study population consisted of health care workers who work in these aforementioned selected hospitals in total 1474 healthcare workers (1268 from ASH and 206 from ANPH) including physicians (470 from ASH, 55 from ANPH), nurses (680 from ASH, 120 from ANPH), medical technologists, radiologists, and radiologic technologists (118 from ASH, 31 from ANPH).

3.4 Eligibility criteria

3.4.1 Inclusion criteria

It included rotating night shift and daytime health care workers (male and female) in ASH and ANPH hospitals.

3.4.2 Exclusion criteria

1- Permanent night shift health care workers at the selected hospitals.
2- Health care workers with previous T2DM, CVD, and inflammatory disease.
3- Health care workers with type1 diabetes mellitus.
4- Health care workers with familial hyperlipidemia.

3.5 Period of the study

The study took 10 month in execution; it started in April, 2016 and completed by February 2017. This study was initially proposed in April, 2016. The research proposal has been submitted to and defended in the front of SOPH assigned committee in May 2016. At its development, the research proposal described the entire process and provided information and design of the data collection and data analysis methods and tools. Upon the approval, the researcher prepared the required tools of his study in addition to the demographic question. The researcher has consulted a group of 12 experts at arbitration stage before the finalization of the tool. The arbitration stage lasted for two weeks including refining of tools in the light of reviewers and the academic supervisor's feedback.

In October 2016, the tool was ready to go for data collection. Piloting took place between 2 and 6 October 2016. Actual data collection started on 16 October through 30November 2016. The researcher identified daily work hours to start at 07.15 am through 01.00 pm in order to increase the likelihood of distributing the questionnaires as many participants as possible.

Initial analysis of quantitative data was done between December 2016 - January 2017. The researcher extracted findings, created descriptive tables and performed inferential statistical analysis. The drafted report "thesis" has been frequently enriched and edited by the research supervisor. The final draft for defense was handed on 30March, 2017.

3.6 Sampling

The sampling frame was from the governmental hospitals (Al- Shifa Hospital and Al-Nassir Pediatric Hospital).

Convenient sampling method was proposed because the mentioned hospitals consider the main and largest hospitals and nearly has the largest number of health care workers.

3.7 Sample size and sample process

In order to calculate the required sample, the researcher gathering the needed data, as shown in Annex 10. The researcher used Epi –Info version 7 to calculate the sample size (Annex 1), the number of all healthcare workers (physicians, nurses, radiologists, radiologic technologists and, medical technologists) work at ASH and ANPH are nearly1474. The highest estimate of sample size was when both categories exposed and non-exposed reporting the outcome with 50%, and by considering the confidence interval was 95%, the power was 80, so the sample size was 305 health care workers. To overcome non-respondents, 310 health care workers were including in the study. The sampling of Self-administering questionnaire includes two governmental hospitals in the Gaza Strip (ASH and ANPH), then proportional sample was chosen from each health care workers in the two selected hospitals according to their number (Annex 10).

3.8 Research instrument

In this study the researcher used 2 main types of instruments:

3.8.1 Direct instrument

• Self-administering questionnaire

Self-administering questionnaire administered to health care worker in the selected hospitals. Most questions were the yes/no questions, which offer a dichotomous choice.

The questionnaire includes questions on the personal data (sex, age, occupation, household, income). The questions covered social data, demographic data, medical history to detect the presence of diseases as HTN, CHD, DM and inflammation, life style variables such as (physical activity, and smoking), and the occupational history including questions about shift work (Annex 5).

3.8.2 Laboratory investigations and clinical tests

• Biochemical tests were measured from serum sample using chemistry kits in spectrophotometer including:

1- Triglyceride
2- HDL, LDL, Cholesterol
3- Fasting Blood glucose
4- CRP

• CBC

• Anthropometric measurements including:

- length
- weight

• Blood pressure

3.9 Standardization of measurements:

The researcher used three calibrated and standardized electrical balance (TANITA, Japan), (DETECTO, Japan) from ASH and (DETECTO, Japan) from ANPH. The body weight of each participant dressed in light clothing without shoes was measured, then the height of each individual was measured using vertical measuring rod. BMI was calculated as weight (kg) divided by squared height (m^2). After a 5 minutes rest at minimum, systolic and diastolic arterial BP was measured on the right arm with a standard mercury sphygmomanometer at sitting position (RIESTER, Germany).

3.10 Data and sample collection

Data collection is defined as the precise, systematic gathering of information related to the research purpose or specific objectives, questions, or hypothesis of the study (Burns & Grove, 2003). The health examinations included anthropometric measurements, a questionnaire on health-related behaviors and biochemical determinations, information about the years of work, either shift work or day work duration and past medical history was included. Overnight fasting for at least 10 hours required prior to blood sampling for all participants who agreed to be included in the study. Venous blood samples (5 ml) were collected from the fasting individuals in serum vacutainer tubes without anticoagulant, and EDTA tubes for CBC tesy under quality control and safety procedure. The serum was separated from blood samples by centrifugation at 3500-4000 rpm for 10 min. The separated serum was placed in new plain tubes and sealed for biochemical analysis. Blood in EDTA tube was used to measure leukocyte count and its differential count.

3.10.1 Biochemical analysis

Serum levels of: TC, HDL and LDL cholesterol, TG, fasting glucose, and CRP were measured automatically by (Respons 920 DiaSys, Germany) using commercially analytical kits (DiaSys, Germany).

3.10.1.1 Determination of serum glucose

Serum glucose was determined by glucose oxidase (GOD)/glucose peroxidase (POD) method (Trinder, 1969) using analytical kits (DiaSys, Germany).

Principle:

Glucose oxidase catalyses the oxidation of glucose to gluconic acid. The formed hydrogen peroxide (H2O2) is detected by a chromogenic oxygen acceptor, phenolaminophenazone in the presence of POD.

Â-D-Glucose + $2H_2O + O_2 \xrightarrow{\text{GOD}}$ Gluconic acid + H_2O_2

H_2O_2 + Phenol + 4-Aminophenazone (4-AP) $\xrightarrow{\text{POD}}$ Quinone + H_2O

The intensity of the red color formed is proportional to glucose concentration in the sample.

Reagents Composition

Reagent	Component	Concentration
Reagent 1	TRIS pH 74	92 mmol/L
	Phenol	0.3 mmol/L
	GOD	15000 U/L
	POD	1000 U/L
	4-AP	2.6 mmol/L

Assay procedure:

Wavelength 340 nm, Hg 334 nm, Hg 365 nm

Optical path 1 cm

Temperature 20 – 25 °C

	Blank	Standard or sample
Sample or Standard	--	10µL
Dist. Water	10 Ml	--
Mono-reagent	1000 µL	1000 µL

Measurement Against reagent blank

Mix, incubate 10 min. at 20 – 25 °C. Read absorbance against reagent blank within 30 min.

Calculations:

Glucose (mg\dl) = (Absorbance of sample / Absorbance of standard) x 100 standard

Reference values: Serum or plasma 70-110 mg/dl

3.10.1.2 Determination of serum cholesterol

Serum cholesterol was determined by cholesterol oxidase "CHOD-PAP" method (Meiatlini et al., 1978) using analytical kits (DiaSys, Germany).

Principle:

Determination of cholesterol after enzymatic hydrolysis and oxidation (Artiss & Zak, 1997; Deeg & Ziegenhorn, 1983). The colorimetric indicator is quinoneimine which is generated from 4-aminoantipyrine and phenol by hydrogenperoxide under the catalytic action of POD (Trinder's reaction). (Artiss & Zak, 1997).

Cholesterol ester + H_2O $\xrightarrow{\text{Cholesterol esterase (CHE)}}$ Cholesterol + Fatty acid

Cholesterol + O2 $\xrightarrow{\text{CHO}}$ Cholesterol-3-one + H_2O_2

$2H_2O_2$ + 4-Aminoantipyrine + Phenol $\xrightarrow{\text{POD}}$ Quinoneimine + $4H_2O$

Reagent Composition:

Reagent	Component	Concentration
Reagent 1	Good's buffer pH 6.7 Phenol 4-Aminoantipyrine Cholesterol esterase CHO POD	50 mmol/L 5 mmol/L 0.3 mmol/L > 200 U/L > 50 U/L > 3 kU/L4-AP

Assay Procedure:

Wavelength 500 nm, Hg 546 nm

Optical path 1 cm

Temperature 20 – 25°C

Measurement Against reagent blank

	Blank	Sample or standard
Sample or standard	---	10 µL
Dist. Water	10 Ml	--
Reagent	1000 Ml	1000 µL

Mix, incubate for 20 min. at 20 – 25°C. Read absorbance within 60 min against reagent blank.

Calculations:

Cholesterol (mg\dl) = (Absorbance of sample / Absorbance of standard) x Con. of standard

Reference Range:

Desirable <200 mg/dL

Borderline high risk 200 – 240 mg/dL

High risk > 240 mg/dL

3.10.1.3 Determination of high density lipoproteins (HDL-C)

High density lipoprotein cholesterol was determined by precipitating method (Grove, 1979) using analytical kits (DiaSys, Germany).

Principle

The chylomicrons, very low density lipoprotein, and LDL-C from serum or plasma are precipitated by phosphotungstate in the presence of magnesium ions. After removed by centrifugation the clear supernatant is containing HDL-C and used for the determination of it.

Reagent Composition

Reagent	Component	Concentration
Reagent 1	Phosphotungstic acid Magnesium chloride	14 mmol/L 2 mmol/L

Assay Procedure for Analyzer:

Wavelength 600/700 nm (bichromatic measurement)

Optical path 1 cm

Temperature 37 °C

Measurement Against reagent blank

	Blank	Sample or calibrator
Sample or calibrator	---	2.4 µL
Reagent 1	240 µL	240 µL
Mix, incubate 5 min. at 37°C, read absorbance A1, t hen add:		
Reagent 2	60 Ml	60 µL
Mix, incubate for 5 min. at 37°C, read absorbance A 2.		

Calculation:

HDL Cholesterol (mg/dL) (Absorbance of sample / Absorbance of standard) x Con. of standard

Reference Range

>35 mg/dL

3.10.1.4 Calculation of low density lipoprotein (LDL)

Low density lipoprotein was calculated using the Friedewald equation.

Principle

The ultra-centrifugal measurement of LDL-C is time consuming and expensive and requires special equipment. For this reason, LDL-C is most commonly estimated from quantitative measurements of total and HDL-cholesterol and plasma TG using the empirical relationship of Friedewald (Friedewald et al., 1972).

The equation

LDL-C = Total Cholesterol – (VLDL + HDL-C).

VLDL cholesterol (mg/dl) =T.G/5

Limitation

The Friedewald equation should not be used when chylomicrons are present, and when plasma TG concentration exceeds 400 mg/dl.

3.10.1.5 Determination of serum triglyceride

Serum triglyceride was determined by Colorimetric enzymatic test using glycerol-3-phosphate-oxidase .

Principle

Determination of triglycerides after enzymatic splitting with lipoprotein lipase (LPL). Indicator is quinoneimine which is generated from 4-aminoantipyrine and 4-chlorophenol by hydrogen peroxide under the catalytic action of POD.

Triglycerides $\xrightarrow{\text{LPL}}$ Glycerol + fatty acid

Glycerol + ATP $\xrightarrow{\text{Glycerokinase (GK)}}$ Glycerol-3-phosphate + ADP

Glycerol-3-phosphate+O2 $\xrightarrow{\text{Glycerol-3-phosphate-oxidase}}$ Dihydroxyaceton phosphate + H2O2

2 H2O2 + Aminoantipyrine + 4-Chlorophenol $\xrightarrow{\text{POD}}$ Quinoneimine + HCl + 4 H2O

Reagents Composition:

Reagent	Component	Concentration
Reagent	Good's buffer pH 7.2 4-Chlorophenol ATP Mg2+ GK POD LPL Aminoantipyrine Glycerol-3-phosphate-oxidase	50 mmol/L 4 mmol/L 2 mmol/L 15 mmol/L ≥ 0.4 kU/L ≥ 2 kU/L ≥ 2 kU/L 0.5 mmol/L ≥ 0.5 kU/L
Standard		200 mg/dL

Assay Procedure:

Wavelength 500 nm, Hg 546 nm

Optical path 1 cm

Temperature 20 – 25°C

Measurement Against reagent blank

	Blank	Sample or standard
Sample or standard	---	10 µL
Dist. Water	10 Ml	--
Reagent	1000 µL	1000 µL

Mix, incubate for 20 min. at 20 – 25°C. Read absorbance within 60 min against reagent blank.

Calculation:

Triglyceride (mg\dl) = (Absorbance of sample / Absorbance of standard) x Con. of standard

Reference Range:

Desirable <200 mg/dL

Borderline high risk 200 – 400 mg/dL

Elevated > 400 mg/dL

3.10.1.6 Determination of C-Reactive Protein (CRP)

C- reactive protein was determined by Immunoturbidimetric method using analytical kits (DiaSys, Germany).

Principle:

Determination of CRP concentration by photometric measurement of the antigen-antibody reaction of antibodies to human CRP with CRP present in the sample.

Reagent Composition

Reagent	Component	PH	Concentration
Reagent 1	TRIS	pH 7.5	100 mmol/L
Reagent 2	TRIS	pH 8.0	100 mmol/L

Assay Procedure:

Wavelength 340 nm, Hg 334 nm

Optical path 1 cm

Temperature 37°C

Measurement Against reagent blank

	Blank	**Sample or calibrator**
Sample or calibrator	---	15 µL
Dist. Water	15 µL	--
Reagent 1	250 µL	250 µL
Mix, incubate 5 min. at 37°C, read absorbance A1, then add:		
Reagent 2	50 µL	50 µL
Mix, incubate for 5 min. at 37°C, read absorbance A2.		

Reference Range: Adults < 5 mg/L

3.10.2 Complete Blood Count measurement:

Leukocyte count and its differential counts (neutrophil and lymphocyte) were measured automatically by Orphee mythic 18 equipment, Sweden.

3.11 Diagnostic criteria for the MetS

For the diagnostic criteria of MetS, we used the NCEP/ ATPIII definition . The syndrome was met if an individual had three or more criteria:

1- Waist circumference >102cm in men and >88cm in women

2- Fasting plasma glucose ≥110mg/dl.

3- Blood pressure ≥130/85 mmHg

4-Serum triglycerides ≥ 150mg/dl

5-Serum HDL cholesterol <40mg/dl in male and <50mg/dl in female.

Because the participants refused to measure the WC , we measured the BMI instead of it for obesity, in which the participant considered obese if BMI >30.

3.12 Ethical and administrative consideration

The researcher committed to all ethical considerations required to conduct a research which include:

- An official letter of approval was obtained from public health school at Al Quds University. (Annex 7).
- An official letter of request was obtained from the general director of MOH in Gaza Strip. (Annex 8).
- An official letter of approval to conduct this study was obtained from the Helsinki Committee in the Gaza Strip (Annex 6)
- To guarantee participants rights, a covering letter indicating that the participation is voluntary and the right to refuse was preserved. (Annex 4)
- The confidentiality of the responses from the respondents was assured by explaining how the information shall be recorded and used.

3.13 Pilot study

Before starting the actual data collection process, a pilot study of 20 health care workers outside the selected clinics was done prior to the beginning of data collection to check applicability, identify problems in research questionnaire of data collection for validity and reliability. Pilot study was used to examine the clarity and ambiguity, length and suitability of questions before the data collection process starts (Polit & Beck, 2004).

3.14 Reliability and Validity

3.14.1 Reliability:

Reliability is referred to repeatability or how far the investigator will repeat the same measurement if the investigation are conducted more than one time. Last defined reliability as "the degree of stability exhibited when a measurement is repeated under identical conditions". Reliability refers to the degree to which a measurement procedure can be replicated (last, 1983).

The researcher regarded reliability of the instruments as an important issue and ensured it through filling the whole number of questionnaires; the researcher leaved clear instruction for in data collection. The same tools were used for all respondents and after data collection completion; all filled forms were checked for completeness. Tool and implementation are standardized.

3.14.2 Validity

Validity refers to the degree to which a study accurately reflects or assesses the specific concept that the researcher is attempting to measure. While reliability is concerned with the accuracy of the actual measuring instrument or procedure, validity is concerned with the study's success at measuring what the researchers set out to measure.

3.14.3 Face validity

It is concerned with how a measure or procedure appears. Does it seem like a reasonable way to gain the information the researchers are attempting to obtain? Does it seem well designed? Does it seem as though it will work reliably? Unlike content validity, face validity does not depend on established theories for support (Fink, 1995). The study tools were checked for face validity when the pilot study was conducted. The researcher asked the pilot study respondents to give their opinions about the format, layout, structure and type-writing clarity of study instruments.

3.14.4 Content validity

Content validity is defined as the extent to which a test reflects the variables it seeks to measure (Holm & Liewellyn, 1986). The interviewed questionnaire was sent by the researcher to 12 experts to assess the instrument from clarity, relevancy to the topic and holism point of view. The experts have a good experience in field of medicine, public health, management and research. Those experts were asked to add any suggested modifications that will enrich the research tools. Their suggestions and comments were considered and modifications were introduced. Since instrument measures what is supposed to measure (Polit & Beck, 2004).

3.15 Data entry

After checking and reviewing all filled questionnaires on the same way, data were entered in the computer using SPSS (Statistical Package for Social Science) software version 20 to be analyzed. After finishing the data entry process, check codes were used to avoid double entries. Pretesting of the tools were done to eliminate inconsistencies and made the questions relate to the local settings. Data cleaning were done to account for missing values in a bid to ensure integrity and reliability.

3.16 Data analysis

The collected data were captured and analyzed using SPSS (Statistical Package for Social Sciences) version 20. Frequencies and cross tabulations were used to do the data analysis. First, data cleaning were done to ensure that all data entered accurately and in appropriate way. Data cleaning were conducted through selecting and checking out of a random number of the filled questionnaires, and also through operating frequencies and descriptive statistics for almost all dependent and independent variables. Inferential statistical tests as Chi square, t-test, Fisher-exact x^2 test, and Odds ratio were applied. The level of significance was set at a *P* value of less than 0.05.

3.17 Limitation of the study

1- Lack of resources including budget and facilities.
2- Time limitation because of the nature of researcher work and life condition.
3- The study did not include the NGOs and the private sectors.
4- Matching was not possible due to the fact that the age of healthcare workers who work currently day shift is different from rotating shift.
5- Comparative group was not selected from other places in which we can exclude the fact that employee had work previously in rotating shift which in fact introduce bias to the study.

Chapter (4)

Results and Discussion

This chapter presents the main results of our findings that collected by self- administering questionnaire and laboratory tests. In the descriptive analysis the percentage distribution provides a description of data including socio demographic characteristic, medical history, lifestyle, and natural of work of health care workers. Inferential analysis used to illustrate different determinants affecting MetS. The results were based on 310 self-administering questionnaire, all the respondents consented to the administered questionnaire giving a response rate of 100%.

The results of this study could help the researcher in raising and suggesting the recommendations that could reduce the risk factors of MetS among health care workers (daytime and rotating shift workers).

4.1 Descriptive statistics of Self-administering Questionnaires

4.1.1 Socio-Demographic Characteristics of the Study Population:

The represented sample of the health care workers included in the study was 310 healthcare workers who were distributed in regard to selected hospitals and socio-demographic characteristics including, gender, marital status, age, job, governorate, residence, and monthly income as shown in Table 4.1. The study sample consisted of 310 healthcare workers who work at ASH and ANPH in the Gaza Strip, where (100) were currently day time workers (32.3%), and (210) were rotating shift workers (67.7%). The socio-demographic characteristics of participants were depicted in table (4.1).

Table (4.1): Distribution of the study population by socio demographic characteristics (N= 310)

Variable	Category	Current daytime workers (N=100, 32.3%)		Rotating shift workers (N=210, 67.7%)		Total (N=310, 100%)	
		N	%	N	%	N	%
Gender	Male	56	56.0%	156	74.3%	212	68.4%
	Female	44	44.0%	54	25.7%	98	31.6%
Marital status	Single	19	19.0%	48	22.9%	67	21.6%
	Married	81	81.0%	162	77.1%	243	78.4%
Age	30 years & less	17	17.0%	99	47.1%	116	37.4%
	31-40 years	31	31.0%	68	32.4%	99	31.9%
	41 years & above	52	52.0%	43	20.5%	95	30.6%
Job	physicians	31	31.0%	91	43.3%	122	39.4%
	Practical nursing	51	51.0%	105	50.0%	156	50.3%
	Radiologists, radiologic technologists, and medical technologists	18	18.0%	14	6.7%	32	10.3%
Governorate	North	13	13.0%	30	14.3%	43	13.9%
	Gaza	72	72.0%	147	70.0%	219	70.6%
	Middle zone	14	14.0%	29	13.8%	43	13.9%
	Khan Younis	1	1.0%	3	1.4%	4	1.3%
	Rafah	0	0.0%	1	.5%	1	.3%
Residence	City	74	74.0%	157	74.8%	231	74.5%
	Village	3	3.0%	9	4.3%	12	3.9%
	Camp	23	23.0%	44	21.0%	67	21.6%
Monthly income	Less than 1000 NIS	9	9.0%	28	13.3%	37	11.9%
	1000 - 2000 NIS	22	22.0%	90	42.9%	112	36.1%
	More than 2000 NIS	69	69.0%	92	43.8%	161	51.9%

A total of 310 healthcare workers who work at ASH and ANPH in the Gaza Strip were included in this study, where (100) were currently day time workers (32.3%), and (210) were rotating shift workers (67.7%). The socio-demographic characteristics of participants were depicted in table (4.1).

The majority of day time and rotating shift workers were males and married with percent (56.0%vs.74.3%), (81.0%vs.77.1%) respectively. A greater part of daytime workers were 41 years and above (52.0%), however 47.1% of rotating shift workers were 30 years and less.

According to the profession, 51.0% of daytime workers were practical nursing, 31.0% were physicians, while 18.0% were radiologists, radiologic technologists, and medical technologists, and for the rotating shift workers, 50.0% were practical nursing, 43.3% were physicians, while 6.7%, were radiologists, radiologic technologists, and medical technologists. Most daytime and rotating shift workers lived in city and from Gaza with percent of (72.0% vs.70.0%) respectively, while (13.0% vs.14.3%) respectively from North area, and (14.0% vs. 13.8%) from middles zone respectively. Only (1.0% vs.1.4%) were from Khan Younis.

4.1.2 Occupational history of healthcare workers

Table (4.2): Distribution of the study population by the natural work (N= 310)

Variable	Category	Current daytime workers (N=100, 32.3%)		Rotating shift workers (N=210, 67.7%)		Total (N=310, 100%)	
		N	%	N	%	N	%
Have you ever had any nightshift work previously?	Always	52	52.0%	183	87.1%	235	75.8%
	Sometimes	30	30.0%	22	10.5%	52	16.8%
	No	18	18.0%	5	2.4%	23	7.4%
What departments do you spend most of the nightshifts in?	Children department	24	24.0%	54	25.7%	78	25.2%
	Surgery department	26	26.0%	57	27.1%	83	26.8%
	Intensive care department	11	11.0%	21	10.0%	32	10.3%
	Reception & emergency department	10	10.0%	51	24.3%	61	19.7%
	Maternity department	14	14.0%	15	7.1%	29	9.4%
	Other	15	15.0%	12	5.7%	27	8.7%
Other departments	Radiology	5	35.7	4	33.3	9	34.6%
	Laboratory	9	64.3	7	58.3	16	61.5%
	Burns department	0	-	1	8.3	1	3.8%
How many years did you have nightshifts work ?	not exposed	17	17.0%	5	2.4%	22	7.1%
	1-5 years	21	21.0%	86	41.0%	107	34.5%
	more than 5 years	62	62.0%	119	56.7%	181	58.4%
More than 5 years	6- 10 years	22	35.5%	78	66.1%	100	55.6%
	11- 15 years	28	45.2%	30	25.4%	58	32.2%
	16 years and above	12	19.4%	10	8.5%	22	12.2%
How many shifts do you have monthly?	not exposed	100	100.0 %	11	5.2%	111	35.8%
	1-5 shifts	0	0.0%	139	66.2%	139	44.8%
	More than 5 shifts	0	0.0%	60	28.6%	60	19.4%

Previously in their career (nearly before more than ten years), there were 52.0% of the daytime workers had nightshifts, while 30.0% of them were sometimes got nightshifts, and18.0% had not nightshifts work previously. Currently they haven't nightshifts, Moreover; most of study population spent their nightshift at surgery department, followed by children department, reception & emergency department, intensive care department, maternity department, other departments such as laboratory, radiology and Burns department (26.8%, 25.2%, 19.7%, 10.3 %, 9.4%, and 8.7% respectively).

Our results showed that 62.0% of daytime workers previously had nightshifts for more than 5 years (45.2% of them had a nightshifts for11 to 15 years, 35.5% for 6 to 10 years and 19.4% for 16 years and above), 17.0% had not nightshift work previously, 21.0% had previously nightshifts from one year to 5 years, while 56.7% of the rotating shift workers have nightshifts work for more than 5 years, (66.1% of them have nightshift works for 6 to 10 years, 25.4% for 11 to 15 years and 8.5% for more than16 years), while, 41.0% of them have nightshifts from one year to five years, 2.4% haven't nightshift work currently.

Currently (for more than ten years up to now) the daytime workers haven't rotating shifts, while most of rotating shift workers with 66.2% have 1-5 nightshifts monthly, 28.6% have more than 5 shifts monthly, and 5.2% haven't nightshifts (they have morning and evening only).

4.1.3 Medical history of participants and their families

Table (4.3): Distribution of the study population by health problems and medical history of their families (N= 310)

Variable	Category	Current daytime workers (N=100, 32.3%)		Rotating shift workers (N=210, 67.7%)		Total (N=310, 100%)	
		N	%	N	%	N	%
Diabetes (DM)	Yes	17	17.0%	22	10.5%	39	12.6%
	No	83	83.0%	188	89.5%	271	87.4%
Family history(DM)	Yes	49	49.0%	90	42.9%	139	44.8%
	No	51	51.0%	120	57.1%	171	55.2%
Heart disease (HD)	Yes	6	6.0%	6	2.9%	12	3.9%
	No	94	94.0%	204	97.1%	298	96.1%
Family history (HD)	Yes	23	23.0%	50	23.8%	73	23.5%
	No	77	77.0%	160	76.2%	237	76.5%
T. Cholesterol (TC)	Yes	33	33.0%	44	21.0%	77	24.8%
	No	67	67.0%	166	79.0%	233	75.2%
Family history (TC)	Yes	19	19.0%	56	26.7%	75	24.2%
	No	81	81.0%	154	73.3%	235	75.8%
Triglyceride (TG)	Yes	41	41.0%	69	32.9%	110	35.5%
	No	59	59.0%	141	67.1%	200	64.5%
Family history (TG)	Yes	18	18.0%	45	21.4%	63	20.3%
	No	82	82.0%	165	78.6%	247	79.7%
Hypertension(HTN)	Yes	16	16.0%	23	11.0%	39	12.6%
	No	84	84.0%	187	89.0%	271	87.4%
Family history (HTN)	Yes	53	53.0%	111	52.9%	164	52.9%
	No	47	47.0%	99	47.1%	146	47.1%
Chronic inflammation	Yes	48	48.0%	124	59.0%	172	55.5%
	No	52	52.0%	86	41.0%	138	44.5%
Other health problems	Yes	11	11.0%	19	9.0%	30	9.7%
	No	89	89.0%	191	91.0%	280	90.3%

Table (4.3) described the prevalence of some health problems among healthcare workers after their work either daytime or rotating shift and the medical history of their families. Diabetes mellitus was found in 12.6% of study population with higher percentage in daytime workers than rotating shift workers (17.0% vs. 10.5%, respectively). Among their family members (49.0% vs. 42.9%) respectively had diabetes. Regarding to HD, it was found in 3.9% of study population with higher percentage in daytime workers than rotating shift workers (6.0% vs. 2.9%). Among their family members (23.0% vs. 23.8%) respectively suffered from HD, also 24.8 % of study population had elevated cholesterol with higher percentage in daytime workers than rotating shift workers (33.0% vs. 21.0%) respectively). Among their family members (19.0% vs. 26.7%) respectively had elevated cholesterol. More than third (35.5%) of the study population had high TG, where 41.0% from the daytime workers and 32.9% of the rotating shift workers. There were 18.0% of daytime family members had elevated TG, while 21.4% of rotating shift family members had elevated TG. HTN was found in 12.6% of study population with higher percentage in daytime workers than rotating shift workers (16.0% , 11.0%) respectively. Among their family members (53.0% vs. 52.9%) respectively had HTN . Chronic inflammation was found in 55.5% of healthcare workers with higher percentage in rotating shift than daytime workers (48.0% vs. 59.0%).

4.1.4 Lifestyle of health personnel

In this part we focused on four categories: cigarette smoking, body weight increasing (BMI> 25), use TV or computer for a long times, and exercise especially walking

Table (4.4): Distribution of the study population by their health behaviors (N= 310)

Variable	**Category**	**Current daytime workers (N=100, 32.3%)**		**Rotating shift workers (N=210, 67.7%)**		**Total (N=310, 100%)**	
		N	**%**	**N**	**%**	**N**	**%**
Cigarette smoking	Yes	15	15.0%	49	23.3%	64	20.6%
	Stopped	9	9.0%	12	5.7%	21	6.8%
	No	76	76.0%	149	71.0%	225	72.6%
Body weight status BMI> 25	Yes	36	36.0%	104	49.8%	140	45.3%
	No	64	64.0%	105	50.2%	169	54.7%
Use TV or computer for a long times	Always	4	4.0%	14	6.7%	18	5.8%
	Sometimes	29	29.0%	38	18.2%	67	21.7%
	Rarely	35	35.0%	67	32.1%	102	33.0%
	No	32	32.0%	90	43.1%	122	39.5%
Exercise especially walking	Always	29	29.0%	63	30.0%	92	29.7%
	Sometimes	49	49.0%	90	42.9%	139	44.8%
	Rarely	12	12.0%	37	17.6%	49	15.8%
	No	10	10.0%	20	9.5%	30	9.7%

Table (4.4) described the lifestyle of health personnel of study population. According to our results only 20.6% of study population were smokers. About 45.3 % of the study population had increase in their weight (BMI > 25). Of these, 36.0% were in daytime workers which were lower than what we found in shift workers (49.8%). As shown in table (4.4), there were 43.1% of the rotating shift workers did not use TV or computer for a long times (more than 4 hours) during the shift, while 32.1% rarely use, 18.2% sometimes use and only 6.7% of them always uses TV. The percentage of day workers who using TV or computer for a long times was higher than the percentage of rotating shift workers. However, the prevalence of practice sport especially walking among rotating shift workers was higher than daytime workers. Table (4.4)

4.2 Inferential statistics of self-administering questionnaire

Table (4.5): Anthropometric and metabolic characteristics of study population (N= 310)

	Current daytime workers (N=100, 32.3%)		**Rotating shift workers (N=210, 67.7%)**		**t-test**	***P*-value**
	Mean	**SD**	**Mean**	**SD**		
Age	40.6	11.0	33.2	7.5	6.13	0.001*
Body Mass Index (BMI)	27.5	4.4	26.8	4.0	1.32	0.188
Fasting blood sugar (FBS)	101.6	41.7	94.1	29.6	1.63	0.105
Triglyceride (TG)	147.7	83.2	154.0	117.2	-0.48	0.629
HDL-High density lipoprotein (HDL-C)	48.7	3.7	49.5	2.5	-1.93	0.056
C- Reactive Protein (CRP)	6.4	5.2	5.8	5.1	0.92	0.358
WBC	6.9	1.8	7.5	12.2	-0.436	0.663
Lymphocyte	2.4	2.7	2.5	2.3	-0.550	0.583
Granulocyte	3.9	1.5	3.7	1.3	1.219	0.224

*** Significant at 0.05**

Table (4.5) showed that the mean age of current daytime workers was 40.6 ± 11 years vs. 33.2 ± 7.5 years among rotating shift workers and the difference was statistically significant (*P* value < 0.05). For BMI of current daytime and rotating shift workers, the mean was (27.5 ± 4.4 vs. 26.8 ± 4.0 respectively). For the FBS the mean was 101.6 ± 41.7 vs. 94.1 ± 29.6, respectively and 147.7 ± 83.2 vs. 154.0 ± 117.2 for TG respectively .The mean of HDL-C was (48.7 ± 3.7 vs. 49.5 ± 2.5, respectively) while the mean of CRP was (6.4 ± 5.2 vs. 5.8 ± 5.1, respectively). The mean of WBC and its differential counts (lymphocyte and granulocyte) among daytime and rotating shift workers was (6.9 ± 1.8 vs.7.5 ± 12.2, 2.4 ± 2.7 vs. 2.5 ± 2.3, 3.9 ± 1.5 vs. 3.7 ± 1.3) respectively. For all metabolic and inflammatory risk factors, the difference was not statistically significant between daytime and rotating shift workers (*P* value < 0.05).

our results were in contrast with a study done by Asare-Anane et al. (2015) in which the mean ages for the shift and the non-shift workers were 42.0 and 40.3 years respectively and the difference in age between shift workers and non-shift workers was not statistically significant (*p* = 0.331), BMI of the shift working group was higher than that for the non-shift working group (26.9 ± 4.6 vs 25.2 ± 3.3, respectively) and was statistically significant (*p* = 0.013). The mean FBS, serum TC, low density lipoproteins, TG and were significantly higher in shift workers compared to controls (p < 0.004) Also, the mean hs-CRP was significantly increased in the shift workers group compared to the non-shift workers (2.5 ± 1.1 vs 1.8 ± 1.1, *p* < 0.0001).This may be due to healthy habits such as physical activity and dietary intake of rotating shift workers. A study done by Ye et al. (2013) was inconsistent with our results that the age was statistical significant between the day work group and shift work group (*p* < 0.001), and HDL-C was not statistically different between the two groups (*P*= 0.540).

Table (4.6): Relationship between the different risk factors and shift category among daytime and rotating shift healthcare workers (N=310)

Risk factors	Level	Current daytime workers (N=100, 32.3%)		Rotating shift workers (N=210, 67.7%)		Total (N=310, 100%)		Chi-Square (x^2)	OR	95% CI	*P*-value
		N	%	N	%	N	%				
BMI >30 (Obese)	No	73	73.0%	173	82.4%	245	79.4%	3.64	0.6	0.3-1.0	0.056
	Yes	27	27.0%	37	17.6%	64	20.6%		0.7	0.4-1.2	0.172
Blood pressure (BP) (mmHg)	<130/85	84	84.0%	187	89.0%	271	87.4%	1.57	0.7	0.3-1.3	0.210
	≥130/85	16	16.0%	23	11.0%	39	12.6%		1.6	0.8-3.1	0.210
Fasting blood sugar (FBS) (mg/dl)	<110	83	83.0%	188	89.5%	271	87.4%	2.62	1.8	0.9-3.5	0.105
	≥110	17	17.0%	22	10.5%	39	12.6%		0.6	0.3-1.1	0.105
T. Cholesterol (TC) (mg/dl)	< 200	67	67.0%	166	79.0%	233	75.2%	5.27	0.5	0.3-0.9	0.022*
	≥200	33	33.0%	44	21.0%	77	24.8%		1.9	1.1-3.2	0.022*
Triglyceride (TG) (mg/dl)	Normal	59	59.0%	141	67.1%	200	64.5%	1.96	0.7	0.4-1.2	0.161
	Abnormal	41	41.0%	69	32.9%	110	35.5%		1.4	0.9-2.3	0.161
High density lipoprotein (HDL-C) (mg/dl)	Normal	82	82.0%	193	91.9%	275	88.7%	6.64	0.4	0.2-0.8	0.010*
	Abnormal (decreased)	18	18.0%	17	8.1%	35	11.3%		2.5	1.2-5.1	0.010*
low density lipoprotein (LDL-C) (mg/dl)	Normal	70	70.0%	182	86.7%	252	81.3%	12.37	0.4	0.2-0.6	0.001*
	Abnormal (increased)	30	30.0%	28	13.3%	58	18.7%		2.8	1.6-5.0	0.001*
C- Reactive Protein (CRP)	Normal	48	48.0%	124	59.0%	172	55.5%	3.35	0.6	0.4-1.0	0.067
	Abnormal	52	52.0%	86	41.0%	138	44.5%		1.6	1.0-2.5	0.067
Leukocyte count	Normal	51	100.0%	249	96.1%	300	96.8%	0.99	-	-	0.321
	Increased	0	0.0%	10	3.9%	10	3.2%		-	-	
Neutrophil count	Normal	50	98.0%	253	97.7%	303	97.7%	0.13	-	-	0.719
	Increased	1	2.0%	6	2.3%	7	2.3%		-	-	
Lymphocyte count	Decreased	0	0.0%	1	0.4%	1	0.3%	0.82	-	-	0.365
	Normal	51	100.0%	258	99.6%	309	99.7%		-	-	
Metabolic syndrome	Absent	91	91.0%	193	91.9%	284	91.6%	0.07	0.9	0.4-2.1	0.788
	Present	9	9.0%	17	8.1%	26	8.4%		1.1	0.5-2.6	0.788

*** Significant at 0.05**

Our findings demonstrated that 8.4% of health personnel had MetS with higher prevalence among day worker 9.0% than rotating shift workers 8.1% ,with no statistical relationship ($\mathbf{x}^2$= 0.07, *P*-value>0.05) between MetS and shift category, which mean that daytime and rotating shift workers had the same opportunity to have MetS.

The most common abnormalities among study population in our study were as follow: elevated CRP, high level of TG, elevated level of TC, increased BMI >30, high level of LDL-C, increased FBS and BP, and low HDL-C, increased WBC count, increased neutrophil count, and decreased lymphocyte count with 44.5%, 35.5%, 24.8%, 20.6%, 18.7%, 12.6%, and 11.3%, 3.2%, 2.3%, 0.3% respectively. This study was the first that explored the prevalence and the effect of rotating shift on biomarkers of MetS and inflammation among health personnel in the Mediterranean countries.

The relationship between shift category and the related risk factors were studied. Table (4.6) showed that 27.0% of daytime workers were obese (BMI > 30) vs. 17.6% of rotating shift workers, without statistical relationship ($\mathbf{x}^2$= 3.64, *P*-value> 0.05). For FBS, 17.0% of the daytime workers had elevated FBS vs. 10.5% in rotating shift workers with no statistical relationship ($\mathbf{x}^2$= 2.62, *P*-value>0.05). Also16.0% of the daytime workers had elevated BP vs. 11.0% of rotating shift workers without statistical relationship ($\mathbf{x}^2$= 1.57, *P*-value > 0.05).

Also the study revealed that 33.0% of the daytime workers had elevated cholesterol, while 21.0% from the rotating shift workers had elevated cholesterol, with statistically significant difference, (OR=1.9, 95% CI= 1.1-3.2). For TG, 41.0% of the daytime workers had elevated TG vs. 32.9% of the rotating shift workers with no statistical relationship ($\mathbf{x}^2$= 1.96, *P*-value>0.05). As well as 18.0% of the daytime workers had low level of HDL vs. 8.1% of rotating shift workers, and the difference was statistically significance (*P* = 0.010).

About 30.0% of daytime workers had high LDL while 13.3% of the rotating shift workers had elevated LDL with statistical relationship, (OR= 2.8, 95% CI=1.6-5.0). Finally 52.0% of daytime workers had elevated CRP vs. 41.0% of rotating shift workers without statistical relationship (*P*-value>0.05). Moreover, there were no statistical differences in the CBC results including WBC and its differential counts between daytime and rotating shift workers.

Our results showed that the obesity in daytime workers was higher than in current shift workers. Our findings were consistent with a study that conducted in Korea on 9,989 female nurses, in which obesity for shift workers and non-shift workers were 5.8% and 9.1 respectively (Rhee et al., 2013). But it was not consistent with a cross-sectional study from Australia in which nurses who had shift work were 1.15 times more likely to be overweight or obese than day workers (Zhao et al., 2011). BMI in daytime workers was higher than that in shift workers, which might be influenced by relatively older age of daytime workers, as well as other potential confounding factors.

Regarding to elevate BP, our findings were in accordance with cross-sectional survey of a representative sample of 493 nursing staff of a large general hospital in (Hospital São Vicente de Paulo). Passo Fundo, Brazil. Their results showed that17.7% of the day workers had HTN, while 13.9 and 17% of morning and evening night shift workers had HTN respectively. Their findings indicated that there was no association between shift work and HTN. Another study performed in Iran by Mohebbi et al. (2012) showed a similar results in which 37.4% of day workers had elevated systolic BP > 130 or diastolic BP > 85 mmHg, while 35.8% of shift workers had elevated systolic BP > 130 or diastolic BP > 85 mmHg, with no statistically difference between the two groups ($P = 0.101$, OR= 0.933, 95% CI =0.840–1.036), so the HTN component was not significantly related to shift work ($p > 0.05$).

Some studies identified a trend towards higher BP among shift workers. Ye et al. (2013) showed that shift worker had elevated HTN than day workers (50.3%, 28.2 %) respectively. The researcher clarified this by the old age. 32.2% of shift workers in this study were above 50 years and only 11.3% of day workers were above 50 years.

Regarding fasting glucose, we found the most altered values among day workers, this frequency of altered fasting glucose levels were expected because 88.2% of day workers were above 40 years had elevated FBS, while 45.5% of rotating shift workers were above 40 years had elevated FBS, and the fact that increased levels of blood glucose are associated with increasing age (Kawada et al., 2010; Sumner et al., 2012). Similar results were found in a study performed in Brazil by Canuto, R. et al. (2015) in which their results revealed that elevated FBS was more in day workers than night shift workers (4.9% , 3.8%) respectively. However, a study by Ye et al. (2013) found that FBS was more among shift workers (24.6%) than day workers (4.2%) ($P < 0.001$). This can be explained by that most shift workers were aged between 40-49 years (55%) while most day workers were aged between 18-39 years (64.8%).

Our results showed a significant difference in cholesterol, HDL-C, and LDL-C between shift workers and day workers on the first observation where day workers had increased results (*P* <0.05), but no such difference was observed for TG (*P* > 0.05). A study that conducted by Nazri, et al. (2007) for estimation of HDL- C in day and shift workers showed a consistent result that the day workers had hypo- HDL-C more than shift workers (13.89%, 9.21% respectively). Meanwhile, their result showed no statistically difference relationship between the two groups, our findings were in contrast where we found a significant different between HDL-C level of daytime and shift workers.

In this study the result of HDL-C was statistically significant between the two groups refer to that most daytime workers were older and traditionally HDL levels below the reference value have been associated with increasing age, especially among women (Bello & Mosca, 2004).

The result regarding TG that obtained in this study was similar to a cross sectional study on 12 shift workers and 13 day workers using pre and post test, during a six-month period, that demonstrated the prevalence of TG among day workers and shift workers was (28%, 25% respectively) with no significant difference between the two groups (*P*>0.05) (Knutson et al., 1990). In addition, another study on 58 nurses (30 shift workers and 28 day workers), during a period of 18 months, demonstrated that there was no correlation between TG and shift work between the two groups (Copertaro et al., 2008). However, a study conducted by Sookoian et al. (2007) demonstrated that the mean of TG among shift and day workers was (1.7 ± 0.1, 1.5 ± 0.1 respectively) with statistically difference between the two groups (*P*=0.003). The researcher explained their results that rotating shift workers may do more exercise and more active than day workers because they were younger while the daytime workers were older and less active. Exercise is known to reduce overall metabolic risk factors, improving lipid metabolism and lowering BP (Jennings et al., 1986; Pan et al., 1997).

According to Sookoian et al. leukocyte count was significantly higher in shift workers than in daytime workers (6530 ± 1,216 , 5556 ± 1,123, cells/μL, respectively, *P*= <0.001), Puttonen et al. also reported an increase in hs-CRP in 3-shift workers and an increase in leukocyte count in 2-shift and 3-shift workers, additionally a study done by Lu et al. showed that increased total and differential leukocyte counts (neutrophil, monocyte, and lymphocyte) were associated with shift work ($P < 0.05$), thus disagreeing with our findings. The researcher explained that may be due to the type of job and the age that most day workers were above 40 years and CRP level affected by age.

Our results for this study showed that according to NCEP-ATP Ш criteria, the prevalence of MetS among health personnel who work at ASH and ANPH in Gaza was 8.4% and the prevalence increases as age increases. Studies in Parkistan (Alam et al., 2011) and Lampang hospital (Phengtham, 2011) revealed higher rates of 14.95 and 9.5%, respectively than the prevalence of this study. In another study conducted in Ethiopia (Tran et al., 2011), using the NCEP-ATP III, the overall prevalence of MetS was 12.5 which is higher than our prevalence (8.4%) in this study.

In this study the researcher observed that there were no statistical differences between rotating shift work and the MetS when compared with current day workers. This finding of no association between shift work and MetS we found was consistent with a study performed on male workers with rotating three shift works (Karlsson et al., 2003), and a study done by Shafei et al. (2011) where both studies showed that shift work was not significantly associated with MetS. This could be explained by the positive values that the healthcare workers had such as more exercise, walking during the shift and outside the work as well as fast forward rotation shift schedule practice among rotating shift workers. Fast forward rotation is at this time considered the best in reducing sleep loss and fatigue among shift workers (Katriina et al., 2008), thus reducing other health effects linked with circadian rhythm disruption, also daytime workers were not only involved with their job some of them had administrative job that increased the stress that may involve in the mechanism of MetS. In addition, environmental and genetic factors had been implicated in the development of this syndrome. Older age, sedentary lifestyle, and high-fat diet can increase the prevalence of MetS (Brage et al., 2004).

Table (4.7): Prevalence of metabolic syndrome by gender and work category (N=310)

Work Category	Variable	Category	Metabolic Syndrome						OR	95% CI	*P*-value
			Present		Absent		Total				
			N	%	N	%	N	%			
Daytime workers	Gender	Male	5	55.6%	51	56.0%	56	56.0%	1.0	0.2-3.9	0.978
		Female	4	44.4%	40	44.0%	44	44.0%	1.0	0.3-4.1	0.978
		Total	9	9.0%	91	91.0%	100	100.0%	(Fisher-exact x^2=0.10, *p*-value=0.746)		
Rotating shift workers		Male	14	82.4%	142	73.6%	156	74.3%	1.7	0.5-6.1	0.427
		Female	3	17.6%	51	26.4%	54	25.7%	0.6	0.2-2.2	0.427
		Total	17	8.1%	193	91.9%	210	100.0%	(Fisher-exact x^2=0.25, *p*-value=0.614)		

*** Significant at 0.05**

Most of the medical staff from both groups who had MetS were males with percent equal (55.6% daytime vs. 82.4% rotating shift), while the remaining were females (44.4% daytime vs. 17.6% rotating shift), without major statistical significant relationship (*p*-value> 0.05) between MetS and gender among both groups of medical staff at ASH and ANPH in the Gaza Strip (daytime, rotating shift), which mean that medical staff males and females had the same opportunity to have MetS.

According to our results, the prevalence of MetS was higher in males than females among both work category, which come in steady with study conducted by Cheserek et al. (2014) in which the prevalence was greater in 40-49 years age group among males (25.2%) than among females (16.6%) and the overall MetS prevalence was 6.1%, and was higher in males (5.1%) than females (1.1%). Another study by Sirdah et al. (2012) showed that there were no significant differences in the prevalence of MetS between males and females whether applying the NCEP/ATP III or IDF definition (*P*> 0.05). In a Dutch population, the prevalence of MetS was higher in men 26.7% than in women 22.8% (*P*= 0.02) by ATP III criteria (Cordero et al., 2006). In contrast, among Qatari population, the prevalence of MetS was significantly higher in women by ATP III (61.4% vs. 38.6%, *P* <0.001). Also, in the United Kingdom, the MetS was significantly more frequent in females (24.9% vs. 17.4%, *P* <0.001).

Table (4.8): CRP level according to gender and work category (N=310)

Work category	Variable	Category	CRP (mg/L)						OR	95% CI	*P*-value
			Elevated		Normal		Total				
			N	%	N	%	N	%			
Daytime workers	Gender	Male	28	53.8%	28	58.3%	56	56.0%	0.8	0.4-1.8	0.652
		Female	24	46.2%	20	41.7%	44	44.0%	1.2	0.5-2.6	0.652
		Total	52	52.0%	48	48.0%	100	100.0%	(x^2=0.20, *p*-value= 0.401)		
Rotating shift workers		Male	65	75.6%	91	73.4%	156	74.3%	1.1	0.6-2.1	0.721
		Female	21	24.4%	33	26.6%	54	25.7%	0.9	0.5-1.7	0.721
		Total	86	41.0%	124	59.0%	210	100.0%	(x^2=0.13, *p*-value= 0.751)		

*** Significant at 0.05**

Table (4.8) showed that 52.0% of day workers had elevated level of CRP with higher percentage in males 53.8% than females 46.2%. Also, 41.0% of rotating shift workers had high level of CRP with higher in males 75.6% than females 24.4% without statistically significant difference (*p*-value> 0.05) between level of CRP and gender among both groups.

To date, relatively slight had been written regarding the comparison of gender differences in CRP concentrations among East Asians. Our results supported by Yamada et al. study that performed in a Jichi Medical School, in Japan. The study sample was consisted of 2275 men and 3832 women. The men showed elevated CRP concentrations in comparison to women. Our findings were in agreement with this aforementioned study where men showed higher CRP concentrations compared with women. Controversially, an observational study of Chinese subjects showed no difference in CRP concentrations with respect to gender (Ye et al., 2007).

Table (4.9): Prevalence of MetS by age and work category (N=310)

Work category	variable	Category	Metabolic syndrome						OR	95% CI	*P*-value
			Present		Absent		Total				
			N	%	N	%	N	%			
Daytime workers	Age	30 years & less	0	0.0%	17	18.7%	17	17.0%	-	-	-
		31-40 years	3	33.3%	28	30.8%	31	31.0%	1.1	0.3-4.8	0.874
		41 years & above	6	66.7%	46	50.5%	52	52.0%	2.0	0.5-8.3	0.356
		Total	9	9.0%	91	91.0%	100	100.0%	(Fisher-exact x^2=1.78, *p*-value=0.512)		
Rotating shift workers	Age	31 years & less	1	5.9%	98	50.8%	99	47.1%	0.1	0-0.5	0.001*
		31-40 years	8	47.1%	60	31.1%	68	32.4%	2.4	0.8-62	0.117
		41 years & above	8	47.1%	35	18.1%	43	20.5%	4.5	1.6-12.9	0.002*
		Total	17	8.1%	193	91.9%	210	100.0%	(Fisher-exact x^2=15.53, *p*-value=0.001*)		

*** Significant at 0.05**

According to our results, in the daytime workers and shift workers, respectively, MetS increased from 0% and 5.9% within less than 30 year-old group to 66.7% and 47.1% in the participants of more than 41 years of age. There was a statistical significant relationship (*p*-value<0.05) between MetS and age (30 years & less, 31- 40 years, 41 years & above) among rotating shift workers. In addition, for rotating shift workers the result showed that the ratio of having MetS for 41 years and above equals 4.5 times of other age groups and their percent of susceptible ranging between 1.6 to 12.9 times. Our result regarding age and MetS among rotating shift workers come in agreement with two previous studies on shift workers where both studies also reported that age was directly associated with MetS (Moreira et al., 1996; Esquirol et al., 2009; Kaduka et al., 2012).

The prevalence rate of the MetS in South Korean adults increases with age (Korean centers for disease control and prevention, 2007). Our findings were in agreement with another study that done by Hui Ye et al. (2013) which showed that for the age brackets of under 40, 40–49 years old, and 50 and above, BP was 26.5%, 44.5%, and 61.2%, respectively; fasting blood glucose was 7.4%, 16.0%, and 35.8%; WC was 7.4%, 5.0%, and 9.0%; TG levels were 10.3%, 13.4%, and 29.9%; low high-density lipoprotein cholesterolemia was 22.1%, 21.0%, and 40.3%; and the prevalence of the MetS was 7.4%, 7.6%, and 23.9%, respectively. These results showed signs of an increase in the prevalence of the MetS and abnormalities of each MetS component as the age brackets increased (Ye et al., 2013).

Table (4.10): Prevalence of MetS according to job and work category (N=310)

Work category	variable	Category	Metabolic syndrome						OR	95% CI	*P*-value
			Present		Absent		Total				
			N	%	N	%	N	%			
Daytime workers	Job	Physicians	2	22.2%	29	31.9%	31	31.0%	0.6	0.1-3.1	0.550
		Practical nursing	5	55.6%	46	50.5%	51	51.0%	1.2	0.3-4.8	0.774
		Radiologists, radiologic technologists, and medical technologists	2	22.2%	16	17.6%	18	18.0%	1.3	0.3-7.1	0.730
		Total	9	9.0%	91	91.0%	100	100.0 %	(Fisher-exact x^2=0.54, *p* value=0.810)		
Rotating shift workers	Job	Physicians	12	70.6%	79	40.9%	91	43.3%	3.5	1.2-10.2	0.018*
		Practical nursing	5	29.4%	100	51.8%	105	50.0%	0.4	0.1-1.1	0.077
		Radiologists, radiologic technologists, and medical technologists	0	0.0%	14	7.3%	14	6.7%	-	-	-
		Total	17	8.1%	193	91.9%	210	100.0 %	(Fisher-exact x^2=4.98, *p* value= 0.076)		

*** Significant at 0.05**

According to our results regarding daytime workers, the most prevalent of MetS was found among practical nursing (55.6%), and the difference did not reach the statistical significance (*P*=0.774), while among rotating shift workers the most prevalent of MetS was found among physicians with 70.6% and the difference reached a statistical significant difference in comparison to other jobs (*P*-value= 0.018) table 4.10. Yet, this was the first study that performed among healthcare workers in Gaza strip, and most studies that we found in the literature were performed only among nurses (Pietroiusti et al., 2010; Ahmad et al., 2011).

Table (4.11): Relationship between metabolic syndrome and previously exposed night shifts among both groups (N=310)

Work category	Variable	Category	Metabolic syndrome						OR	95% CI	*P*-value
			Present		Absent		Total				
			N	%	N	%	N	%			
Daytime workers	Years	not exposed	1	11.1%	16	17.6%	17	17.0%	0.6	0.1-5.0	0.622
		1-5 years	2	22.2%	19	20.9%	21	21.0%	1.1	0.2-5.6	0.925
		more than 5 years	6	66.7%	56	61.5%	62	62.0%	1.3	0.3-5.3	0.762
		Total	9	100.0%	91	100.0%	100	100.0%	(Fisher-exact x^2=0.25, *p*-value=0.999)		
Rotating shift workers	Years	not exposed	0	0.0%	5	2.6%	5	2.4%	-	-	-
		1-5 years	3	17.6%	83	43.0%	86	41.0%	0.3	0.1-1.0	0.042*
		more than 5 years	14	82.4%	105	54.4%	119	56.7%	3.9	1.1-14.0	0.026*
		Total	17	100.0%	193	100.0%	210	100.0%	((Fisher-exact x^2=4.57, *p*-value=0.099)		

*** Significant at 0.05**

Table (4.11) showed that 66.7% of the daytime workers who have MetS had been exposed to night shifts previously for more than 5 years without statistical significant relationship vs. 82.4% in the rotating shift workers with statistical significant relationship (*P*-value= 0.026 OR= 3.9, 95% CI= 1.1-14), this mean that rotating shift workers who have night shifts more than 5 years have four times to have MetS than workers who had night shifts less than 5 years, while 22.2% of daytime workers who have MetS had been exposed to night shifts previously from one year to five years without statistical relationship vs. 17.6% in the rotating shift workers and the difference was statistical significance (*P*- value= 0.042) between MetS and the exposed night shifts among rotating shift workers. Our results come in consistent with a study done by Guo et al. which suggested that the ORs for MetS increased with the extension of shift work duration. Every 10 years increase of shift work was related to 17% increase of OR in the unadjusted model (Guo et al., 2015). Also, another study that conducted by Shafei et al. (2011) supported our results and showed that nurses who worked 10 years more than others were two times more likely to have MetS. Moreover, another study in Turkey found that MetS was significantly higher among workers who had been working for more than 10 years (Demiral et al., 2006). This result implies that nurses who had longer duration of employment were more senior and they had a longer duration of exposure to physical inactivity, thus increased their risk towards MetS.

Table (4.12): Relationship between elevated CRP and previously exposed night shifts among day and shift workers (N=310)

Work category	Variable	Category	CRP Elevated N	CRP Elevated %	CRP Normal N	CRP Normal %	CRP Total N	CRP Total %	OR	95% CI	*P*-value
Daytime workers	Years	not exposed	5	9.6%	12	25.0%	17	17.0%	0.3	0.1-1.0	0.040*
		1-5 years	8	15.4%	13	27.1%	21	21.0%	0.5	0.2-1.3	0.151
		more than 5 years	39	75.0%	23	47.9%	62	62.0%	3.26	1.4-7.6	0.005*
		Total	52	100.0%	48	100.0%	100	100.0%	(Fisher-exact x^2=7.95,*p*-value=0.018*)		
Rotating shift workers	Years	not exposed	1	1.2%	4	3.2%	5	2.4%	0.4	0-3.2	0.335
		1-5 years	34	39.5%	52	41.9%	86	41.0%	0.9	0.5-1.6	0.728
		more than 5 years	51	59.3%	68	54.8%	119	56.7%	1.2	0.7-2.1	0.572
		Total	86	100.0%	124	100.0%	210	100.0%	(Fisher-exact x^2=1.01,*p*-value=0.598)		

*** Significant at 0.05**

According to the results presented in table (4.12), most of daytime and rotating shift workers who have elevated CRP had been exposed to night shifts for more than 5 years (75.0%, and 59.3%) respectively, with statistically significant relationship among day workers (OR=3.26, 95% CI =1.4-7.6), but the differences did not reach the statistical significance among rotating shift workers (*P* =0.572), this may related to their ages (mean of their age was 33.2) and we know that CRP affected by age after 40 years.

Table (4.13): The prevalence of metabolic syndrome by currently exposed night shifts per month (N=210)

Work category	Category	Metabolic syndrome						OR	95% CI	*P*- value
		Present		Absent		Total				
		N	%	N	%	N	%			
Rotating shift workers	not exposed	2	11.8%	9	4.7%	11	5.2%	2.7	0.5-13.8	0.208
	1-5 night shifts	4	23.5%	56	29.0%	60	28.6%	0.8	0.2-2.4	0.631
	more than 5 night shifts	11	64.7%	128	66.3%	139	66.2%	0.9	0.3-2.6	0.892
	Total	17	100.0%	193	100.0%	210	100.0%	(Fisher-exact x^2=1.95, *p*-value=0.345)		

*** Significant at 0.05**

The highest prevalence of MetS was found in workers who have more than five nightshifts monthly with percent 64.7%, and the lowest prevalence was among those who not exposed to night shifts with percent 11.8%. There was no statistically significant relationship (*p*-value>0.05) between MetS and currently exposed night shift per month table (4.13).

Table (4.14): The prevalence of CRP level by currently exposed night shifts per month (N=210)

Work category	Category	CRP						OR	95% CI	P-value
		Elevated		Normal		Total				
		N	%	N	%	N	%			
Rotating shift workers	not exposed	3	3.5%	8	6.5%	11	5.2%	0.5	0.1-2.0	0.343
	1-5 night shifts	58	67.4%	81	65.3%	139	66.2%	1.1	0.6-2.0	0.750
	more than 5 night shifts	25	29.1%	35	28.2%	60	28.6%	1.0	0.6-1.9	0.894
	Total	86	100.0%	124	100.0%	210	100.0%	(Fisher-exact X^2=0.83,*p*-value=0.735)		

*** Significant at 0.05**

Table (4.14) showed that 29.1% of the night shift workers who have elevated CRP had night shifts duties more than 5 night shifts monthly, 67.4% who have from one to five night shifts monthly had elevated CRP, and 3.5% among of them not exposed to night shift had elevated CRP. And the difference didn't show statistical significance (*P*> 0.05).

Table (4.15): Prevalence of different factors that define metabolic syndrome (According to ATPШ definition) and inflammation among current daytime workers (N= 100)

Components of MetS	Level	Metabolic syndrome						OR	95% CI	*P*- value
		Present		Absent		Total				
		N	MetS%	N	%	N	%			
FBS (mg/dl)	≥110	5	55.6%	12	13.2%	17	17.0%	8.2	1.9-35.0	0.001*
	<110	4	44.4%	79	86.8%	83	83.0%	0.1	0-0.5	0.001*
BP (mmHg)	≥130/85	6	66.7%	10	11.0%	16	16.0%	16.2	3.5-75.1	0.001*
	<130/85	3	33.3%	81	89.0%	84	84.0%	0.1	0-0.3	0.001*
Obesity (BMI > 30)	Yes	6	66.7%	21	23.1%	27	27.0%	6.7	1.5-29.0	0.005*
	No	3	33.3%	70	76.9%	73	73.0%	0.2	0-0.7	0.005*
TG (mg/dl)	≥150	8	88.9%	33	36.3%	41	41.0%	14.1	1.7-117.4	0.002*
	<150	1	11.1%	58	63.7%	59	59.0%	0.1	0-0.6	0.002*
HDL-C (mg/dl)	<50 for women < 40 for men (Abnormal)	4	44.4%	14	15.4%	18	18.0%	4.4	1.1-18.4	0.030*
	> 50 for women > 40 for men (Normal)	5	55.6%	77	84.6%	82	82.0%	0.2	0.1-1.0	0.030*
CRP (mg/L)	Abnormal	4	44.4%	48	52.7%	52	52.0%	0.7	0.2-2.8	0.634
	Normal	5	55.6%	43	47.3%	48	48.0%	1.4	0.4-5.5	0.634

*** Significant at 0.05**

From table (4.15) the researcher computed the odds ratio and the confidence interval of daytime workers with MetS, by comparing the measurement of each component of the MetS for the normal and the abnormal level. In our study, 55.6% of participants with high-level of FBS had MetS vs. 44.4% with normal FBS, this difference was statistically significant (OR = 8.2, 95% CI =1.9-35.0). For Bp, 66.7% of daytime workers who had high Bp had MetS vs. 33.3% with normal Bp and the difference was statistically significant, (OR= 16.2, 95% CI = 3.5-75.1).

Moreover, 66.7% of daytime workers with BMI>30 had MetS vs. 33.3% with BMI <30 and the difference was statistically significant OR 6.7 CI 95% (1.5-29.0), then the study showed that 88.9% of daytime workers with high TG had MetS vs. 11.1% with normal level of TG OR (95% CI) 14.1 (1.7-117.4). Additionally, 44.4% with low level of HDL cholesterol had MetS vs. 55.6% with normal level, and the difference reached a statistical significant level (*P*= 0.030). Finally 44.4% of participant with elevated CRP had MetS vs. 55.6% with normal level but the difference didn't reach the statistical significant level (*P*= 0.634).

We concluded that the risk factors of MetS among daytime workers based on value of OR in our sample is in descending order were as follow: high BP, high level of TG , high FBS, elevated BMI >30, and low HDL cholesterol level.

Table (4.16): Prevalence of different factors that define metabolic syndrome (According to ATPШ definition) and inflammation among rotating shift workers (N=210)

Components of MetS	Level	Metabolic syndrome						OR	95% CI	*P*- value
		Present		Absent		Total				
		N	MetS %	N	MetS%	N	%			
FBS (mg/dl)	≥110	12	70.6%	10	5.2%	22	10.5%	43.9	12.9-149.1	0.001*
	<110	5	29.4%	183	94.8%	188	89.5%	0.02	0-0.1	0.001*
BP (mmHg)	≥130/85	13	76.5%	10	5.2%	23	11.0%	59.5	16.4-215.8	0.001*
	<130/85	4	23.5%	183	94.8%	187	89.0%	0.01	0-0.1	0.001*
Obesity (BMI >30)	Yes	11	64.7%	26	13.5%	37	17.6%	11.8	4.0-34.6	0.001*
	No	6	35.3%	167	86.5%	173	82.4%	0.1	0-0.3	0.001*
TG (mg/dl)	≥ 150	16	94.1%	53	27.5%	69	32.9%	42.3	5.5-326.6	0.001*
	<150	1	5.9%	140	72.5%	141	67.1%	0.02	0-0.2	0.001*
HDL-C (mg/dl)	<50 for women < 40 for men (Abnormal)	2	11.8%	15	7.8%	17	8.1%	1.6	0.3-6.1	0.562
	> 50 for women > 40 for men (Normal)	15	88.2%	178	92.2%	193	91.9%	0.6	0.1-3.0	0.562
CRP (mg/L)	Abnormal	10	58.8%	76	39.4%	86	41.0%	2.2	0.8-6.0	0.118
	Normal	7	41.2%	117	60.6%	124	59.0%	0.5	0.2-1.2	0.118

*** Significant at 0.05**

The researcher computed the odds ratio and the confidence interval of rotating shift workers with MetS, by comparing the measurement of each component of the MetS for the normal and the abnormal level table (4.16). In our study 70.6% of participants with high-level of FBS had MetS vs. 29.4% with normal FBS. This difference was found to be statistically significant, (*P*= 0.001, OR = 43.9, 95% CI= 12.9-149.1). For Bp, 76.5% of rotating shift workers who had high Bp had MetS vs. 23.5% with normal Bp had MetS. The difference was statistically significant, (*P*= 0.001, OR=59.5, 95% CI=16.4-215.8). Also, 64.7% of shift workers with BMI>30 had MetS vs. 35.3% with BMI<30 and the difference was statistically significant (*P*= 0.001, OR= 11.8, 95% CI= 4.0-34.6). Then the study showed that 94.1% of shift workers with high TG had MetS vs. only 5.9% with normal level of TG had MetS. Again these differences were statistically significant where (*P*= 0.001, OR= 42.3, 95% CI=5.5-326.6). Moreover, 11.8% of rotating shift workers with low level of HDL cholesterol had MetS vs. 88.2% with normal level, and the difference didn't reach a statistical significant level. Finally, 58.8% of participant with elevated CRP had MetS vs. 41.2% with normal level but the difference didn't reach the statistical significant level (*P*= 0.118).

We concluded that the risk factors of MetS among rotating shift workers based on value of OR in our sample is in descending order were as follow: high BP, high FBS, high level of TG , elevated BMI >30, and low HDL cholesterol level. They were in the order of risk factors in daytime workers except for FBS and TG (Table 4.15& 4.16).

This was the first study that showed the prevalence of MetS and its related risk factors among daytime and rotating shift workers. Nevertheless, a study that conducted by Jamee et al. (2012) explore risk factors of MetS in cardiology clinic in Gaza strip- based on value of OR which come in descending order as follow: high FBS (OR12.9), Large WC (OR 11.6), high BP (OR 8.3), high level of TG (OR 8.3), and low HDL cholesterol level (OR 1.3).While in our study the risk factors among daytime workers were: high BP, high level of TG , high FBS, elevated BMI >30, and low HDL cholesterol level. Among rotating shift workers the risk factors were: high BP, high FBS, high level of TG, elevated BMI >30, and low HDL cholesterol level.

From the results we concluded that increased BP was the main risk factor and this require regular check-up of BP in healthcare workers in order to identify individuals who have a higher risk of developing CVD and MetS.

Chapter (5)

Conclusion and Recommendation

This chapter provides the main conclusions of this study as well as recommendations for decision makers that could help to prevent and reduce the risk factors of MetS among health care workers (daytime and rotating shift).

5.1 Conclusions

This cross sectional study was carried out to explore the prevalence and effect of rotating shift work on biomarkers of metabolic syndrome and inflammation among health care personnel in Gaza governorates to raise recommendations that could be helpful for decision makers to improve gaps if found.

An important finding of this study was the overall prevalence of MetS among health personnel was 8.4% (9% among daytime workers was which was higher than among rotating shift workers 8.1%) without statistical significant difference between the two groups, and the prevalence increases as age increases.

According to the results of the study, MetS was more prevalent among male daytime and rotating shift workers than females. From the study finding the main common abnormalities among study population were as follow: elevated CRP, high level of TG, elevated level of cholesterol, increased BMI >30, high level of LDL-C, increased FBS, BP, and low HDL-C with 44.5%, 35.5%, 24.8%, 20.6%, 18.7%, 12.6%, and 11.3% respectively.

There were 27.0% of daytime workers obese (BMI > 30) vs. 17.6% of rotating shift workers, without statistical relationship ($\mathbf{x}^2$ = 3.64, *P*-value>0.05). For FBS, 17.0% of the daytime workers had elevated FBS vs. 10.5% in rotating shift workers with no statistical relationship ($\mathbf{x}^2$ = 2.62, *P*-value>0.05), also 16.0% of the daytime workers had elevated BP vs. 11.0% of rotating shift workers without statistical relationship ($\mathbf{x}^2$ = 1.57, *P*-value >0.05).

A statistically significant difference (*P*- value= 0.022) appeared between cholesterol level and shift category with higher prevalence among daytime workers. For TG, 41.0% of the daytime workers had elevated TG vs.32.9% of the rotating shift workers with no statistical relationship ($\mathbf{x}^2$ = 1.96, *P*-value>0.05). The researcher observed differences between low level of HDL and high level of LDL and the shift category (*P* value = 0.01, 0.001 respectively). From our results, there were no statistical differences in the CBC results including WBC and its differential count, and the level of CRP between daytime and rotating shift workers (*P*-value>0.05).There were 52.0% of daytime workers had elevated level of CRP with higher percentage in males 53.8% than females 46.2%. Also, 41.0% of rotating shift workers had high level of CRP with higher in males 75.6% than females 24.4%.

According to job among daytime workers, the highest prevalence of MetS was found among practical nursing (55.6%), while among rotating shift workers, the highest prevalence of MetS was found among physicians (70.6%). About 82.4% of rotating shift workers who have MetS had been exposed previously to night shifts for more than 5 years (*P*-value= 0.026). Our results showed that most of daytime and rotating shift workers who had elevated CRP had been exposed to night shifts for more than 5 years (75.0%, and 59.3%) respectively and MetS was found in 64.7% of workers who have more than five shifts monthly, 23.5% among workers who have one to five night shifts, and11.8% among workers who haven't exposed to night shifts (only morning and evening).

The current study also investigates the risk factors that define MetS among currently daytime workers which based on value of OR in descending order were as follow: high BP, high level of TG, high FBS, elevated BMI >30, and low HDL cholesterol level, while the risk factors that define MetS among rotating shift workers which based on value of OR in descending order were as follow: high BP, high FBS, high level of TG, elevated BMI >30, and low HDL cholesterol level. They were in the order of risk factors in daytime workers except for high FBS and elevated TG.

5.2 Recommendations

5.2.1 General Recommendation

1- A national prevention programs need to be implemented to combat hypertension, diabetes, obesity, dyslipidemia, and related co morbidity and change in lifestyle, especially with respect to physical activity and nutrition.
2- The MoH need to develop strategies for screening and early identification of the components of the MetS for all employees
3- As blood pressure was the main risk factor of MetS, conducting regular check-up of BP health settings is very important.
4- As age was one of the main determinant of MetS, MoH need to develop policies to regulate the work schedule of employees, particularly of those who are over 40 .

5.2.2 Recommendation for New Areas of Research

1- Future prospective longitudinal studies should be carried out for identifying the prevalence and the effect of shift work on biomarkers of MetS and inflammation on a large sample to include all healthcare workers in all governmental and private hospitals in the Gaza Strip.
2- Considering the role of environmental interaction, job and behavioral stress, and sleep quality in the association between shift work and metabolic disturbances among healthcare workers.
3- There is a need to conduct other quantitative studies that could study the temporal sequence of developing MetS
4- It is recommended to conduct other studies that involve selection of comparative groups from places other than the hospitals.
5- There is an urgent need to conduct further studies to assess the prevalence of MetS among different professions, separately

References

Abdul-Rahim, H. F., Husseini, A., Bjertness, E., Giacaman, R., Gordon, N. H., and Jervell, J. (2001). The metabolic syndrome in the West Bank population: An urban–rural comparison. *Diabetes Care*, 24 (2).

Aguilar-Salinas, C.A., Rojas, R., Gomez-Perez, F.J., Mehta, R., Franco, A., Olaiz, G. et al., (2005)."The metabolic syndrome: a concept hard to define,". *Archives of medical research*, 36 (3), 223-231.

Ahmad Faris, A., Mohd Nazri, S., and Wan Mohd Zahiruddin, W.M. (2011). Metabolic Syndrome and Occupational Risk Factors among Healthcare Workers in Kelantan. *Health and the Environment Journal*, 2 (2).

Akerstedt, T. (2005). Shift work and sleep disorders, *Sleep*. 28, 9-11.

Akerstedt, T., Ingre, M., Broman, J.E., and Kecklund, G. (2008). Disturbed sleep in shift workers, day workers, and insomniacs. *Chronobiology international*, 25, 333-348.

Alam, M..F, Nasreen, S., Ullah, E., and Hussain, A. (2011). The Awareness and Prevalence of Metabolic Syndrome in Medical Community of Bahawalpur. *Oman Medical Journal*, 26(1), 26-28.

Albert, M.A. and Ridker, P.M. (2004). Inflammatory biomarkers in African Americans: a potential link to accelerated atherosclerosis. *Reviews in cardiovascular medicine*, 5, 22–7.

Alberti, K.G., and Zimmet, P.Z. (1998). Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. 15, 539-553.

Alberti, K.G., Zimmet, P., and Shaw, J. (2005).The metabolic syndrome–a new worldwide definition. 366 (9491), 1059–1062.

Alberti, K.G.M.M., Eckel, R.H., Grundy, S.M., Zimmet, P.Z., Cleeman, J.I., Donato, K.A. et al., (2009). Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation task force on epidemiology and prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the study of obesity. 120, 1640-1645.

Aljeesh, Y., and Alkariri, N. (2010). Patients' Satisfaction with the Quality of Health Services Provided at the Outpatient Department at ASH hospital. *The Islamic University Journal (Series of Natural Studies and Engineering)*,18 (8).

Al-Lawati, J. A., Mohammed, A. J., Al-Hinai, H. Q., and Jousilahti, P. (2003). Prevalence of the metabolic syndrome among Omani adults. *Diabetes Care*, 26 (6), 1781– 1785.

AlSaraj, F., McDermott, J.H., and Cawood, T. (2009). Prevalence of the metabolic syndrome in patients with diabetes mellitus. *Irish journal of medical science*, 178 (3), 309-13.

Al-Shifa Hospital records, (2009). Ministry of Health, Gaza.

Anderso, P. J., Critchley, J. A., Chan, J.N., Cockram, C. S., Lee Z, S. K., Aykan, A.C., Gul, I., Kalaycioglu, E., Gokdeniz, T., Hatem, E., Mentese, U. et al.,(2013). Is metabolic syndrome related with coronary artery disease severity and complexity: An observational study about IDF and AHA/NHLBI metabolic syndrome definitions? *Cardiology journal*, 21(3),245–51.

Artiss, J.D. and Zak, B. (1997).Measurement of cholesterol concentration. In: Rifai N, Warnick GR, Dominiczak MH, eds. Handbook of lipoprotein testing. Washington: AACC Press, 99-114.

Azizi, F., Salehi, P., Etemadi, A., and Zahedi-Asl, S. (2003). "Prevalence of metabolic syndrome in an urban population: Tehran Lipid and Glucose Study". *Diabetes research and clinical practice*, 61 (1), 29-37.

Babu, A.R., Herdegen, J., Fogelfeld, L., Shott, S. and Mazzone, T. (2005). Type 2 diabetes, glycemic control, and continuous positive airway pressure in obstructive sleep apnea. *Archives of internal medicine*, 165(4), 447–452.

Balkau, B., and Charles, M.A.(1999). Comment on the provisional report from the WHO consultation. European Group for the Study of Insulin Resistance (EGIR). *Diabetic medicine*, 16 (5), 442–3.

Barazzoni, R., Silva, V., and Singer, P. (2013). Clinical biomarkers in metabolic syndrome. *Nutrition in clinical practice*, 29 (2), 215-21.

Bello, N., and Mosca, L. (2004). Epidemiology of coronary heart disease in women. Progress in Cardiovascular disease, 46(4), 287-95.

Bener, A., Zirie, M., Musallam, M., Khader, Y. S., and Al-Hamaq, A. (2009). Prevalence of Metabolic Syndrome According to Adult Treatment Panel III and International Diabetes Federation Criteria: A Population-Based Study. Metabolic syndrome and related disorders, 7 (3), 221–9.

Blaha, M., Bansal, S., Rouf, R., Golden, S., Blumenthal, R., and DeFilippis, A. (2008). A practical "ABCDE" approach to the metabolic syndrome. Mayo clinic, 83 (8), 932-943.

Bøggild, H., and Knutsson, A.(1999). Shift work, risk factors and cardiovascular disease. *Scandinavian journal of work environment and health*, 25 (2), 85–99.

Brage, S., Wedderkopp, N., Ekelund, U.,. Franks, P.W., Wareham, N.J., Andersen, L.B. and Froberg, K.(2004). Features of the Metabolic Syndrome Are Associated With Objectively Measured Physical Activity and Fitness in Danish Children: The European Youth Heart Study (EYHS).

Brown, D.L., Feskanich, D., Sa´nchez, B.N., Rexrode, K.M., Schernhammer, E.S., and Lisabeth, L.D. (2009). Rotating night shift work and the risk of ischemic stroke. *American Journal of Epidemiology*, 169 (11), 1370–1377.

Buckland, G., Salvado, J., Roure, E., Bullo, M. and Serra-Majem, L. (2008). Sociodemographic risk factors associated with metabolic syndrome in a Mediterranean population. *Public Health Nutrition*,11(12), 1372–1378.

Burns, N., and Grove, S.K. (2003). Understand nursing research, 3rd ed. Philadelphia: W.B. Saunders.

Cai, H., Huang, J., Xu, G., Yang, Z., Liu, M., Mi, Y. et al., (2012). Prevalence and determinants of metabolic syndrome among women in Chinese rural areas. PLoS One,7(5).

Carr, D.B., Utzschneider, K.M., Hull, R.L., Kodama, K., Retzlaff, B.M., Brunzell, J.D., Shofer, J.B., Fish, B.E., Knopp, R.H. and Kahn, S.E. (2004). Intra-Abdominal Fat Is a Major Determinant of the National Cholesterol Education Program Adult Treatment Panel III Criteria for the Metabolic Syndrome. 53(8), 2087-2094.

Cheserek, M.J., Wu, G.R., Shen, L.Y., Shi, Y.H., and Le, G.W. (2014). Disparities in the Prevalence of Metabolic Syndrome (MS) and its Components Among University Employees by Age, Gender and Occupation. *Journal of clinical and diagnostic research*, 8(2), 65-69.

Cinti, S., Mitchell, G., Barbatelli, G., Murano, I., Ceresi, E., Faloia, E., Wang, S., Fortier, M., Greenberg, A.S., and Obin, M.S. (2005). “Adipocyte death defines macrophage localization and function in adipose tissue of obese mice and humans,” *Journal of Lipid Research*, 46(11), 2347–2355.

Clearfield, M. B.(2005). “C-reactive protein: a new risk assessment tool for cardiovascular disease,” *Journal of the American Osteopathic Association*, 105(9), 409–416.

Cleeman, J. I.(2001). “Executive summary of the third report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (adult treatment panel III),” *Journal of the American Medical Association*, 285(19), 2486–2497.

Copertaro, A., Bracci, M., and Barbaresi, M. (2008). Assessment of plasma homocysteine levels in shift healthcare workers. *Monaldi archives for chest disease,*70(1), 24–8.

Copertaro, A., Bracci, M., Barbaresi, M., and Santarelli, L. (2008).Assessment of cardiovascular risk in shift healthcare workers. *European journal of cardiovascular prevention rehabilitation*, 15 (2), 224—9.

Cordero, A., Alegria, E., and Leon, M. (2006).). Prevalence of Metabolic syndrome. Review Espanola of cardiology supply, 5, 11–15.

Cornier, M.A., Dabelea, D., Hernandez, T.L., Lindstrom, R.C., Steig, A.J., Stob, N.R., Van Pelt, R.E., Wang, H., and Eckel, R.H. (2008). The metabolic syndrome. Endocrinology Reviews. 29, 777-822.

Council Directive 93/104/EC of 23 November 1993 concerning certain aspects of the organization of working time. *Official Journal L 307,* 13/12/1993.

De Bacquer, D., Van Risseghem, M., Clays, E., Kittel, F., De Backer, G., and Braeckman, L. (2009). Rotating shift work and the metabolic syndrome: a prospective study. 38, 848–54.

De Gaudemaris, R., Levant, A., Ehlinger, V., Hérin, F., Lepage, B., Soulat, J.M. et al.,(2011). Blood pressure and working conditions in hospital nurses and nursing assistants. The ORSOSA study. *Archives for cardiovascular disease*,104,97–103.

Deeg, R., and Ziegenhorn, J. (1983). Kinetic enzymatic method for automated determination of total cholesterol in serum. *Clinical chemistry*, 29 (10), 1798-802.

Deepa, M., Farooq, S., Datta, M., Deepa, R., and Mohan, V. (2007). "Prevalence of metabolic syndrome using WHO, ATPIII and IDF definitions in Asian Indians: the Chennai Urban Rural Epidemiology Study (CURES-34). *Diabetes/ Metabolism research and review*, 23 (2), 127-134.

Deepa, R., Velmurugan, K., Arvind, K., Sivaram, P., Sientay, S., Uday, S., and Mohan, V. (2006). "Serum levels of interleukin 6, C-reactive protein, vascular cell adhesion molecule 1, and monocyte chemotactic protein 1 in relation to insulin resistance and glucose intolerance-the Chennai Urban Rural Epidemiology Study (CURES)," *Metabolism*, 55(9), 1232–1238.

Demiral, Y., Soysal, A., Can Bilgin, A., Kilic, B., Unal, B., Ucku, R. et al., (2006). The association of job strain with coronary heart disease and metabolic syndrome in municipal workers in Turkey. *Journal of occupational health*, 48(5), 332-8.

Di Lorenzo, L., De Pergola, G., Zocchetti, C., L'Abbate, N., Basso, A., Pannacciulli, N. et al., (2003). Effect of shift work on body mass index: results of a study performed in 319 glucose-tolerant men working in a Southern Italian industry. *International journal of obesity and related metabolic disorders*, 27 (11), 1353- 8.

Directive 2000/34/ EC of the European Parliament and of the Council of 22 June 2000 amending Council Directive 93/104/ EC concerning certain aspects of the organization of working time to cover sectors and activities excluded from that Directive. Official Journal L 195, 01/08/2000.

Dunstan, D.W., Zimmet, P.Z, Welborn, T.A., De Courten, M.P., Cameron, A.J., Sicree, R.A., Dwyer, T., Colagiuri, S., Jolley, D., Knuiman, M., Atkins, R., and Shaw, J.E. (2002)."The rising prevalence of diabetes and impaired glucose tolerance. The Australian Diabetes, Obesity and Lifestyle Study, "*Diabetes Care*, 25 (5), 829-34.

Eckel, R.H., Grundy, S.M., and Zimmet, P.Z. (2005).The metabolic syndrome. *Lancet*, 365, 1415-1428.

Edgar, R.S., Green, E.W., Zhao, Y., van Ooijen, G., Olmedo, M., Qin, X. et al., (2012). Peroxiredoxins are conserved markers of circadian rhythms. *Nature*, 485 (7399), 459–464.

Egan, B.M. (2003). Insulin resistance and the sympathetic nervous system. Current Hypertension Reports. 5, 247-254.

Einhorn, D., Reaven, G. M., Cobin, R. H., Ford, E., Ganda, O.P., Handelsman, Y., Hellman, R., Jellinger, P.S., Kendall, D., Krauss, R.M., Neufeld, N.D., Petak, S.M., Rodbard, H.W., Seibel, J.A., Smith, D.A., and Wilson, P.W.(2003). "American College of Endocrinology position statement on the insulin resistance syndrome," *Endocrine Practice,* 9 (3), 237–52.

Erem, C., Hacıhasanoglu, A., Deger, O., Topbaş, M., Hosver, I., Onder Ersoz, H., and Can, G. (2008). Prevalence of metabolic syndrome and associated risk factors among Turkish adults: Trabzon MetS study. *Endocrine,* 33(1), 9-20.

Ervin, R.B. (2009). Prevalence of metabolic syndrome among adults 20 years of age and over, by sex, age, race and ethnicity, and body mass index: United States, 2003-2006. National Health Statistics Reports, 5(13), 1-7.

Esquirol, Y., Bongard, V., Mabile, L., Jonnier, B., Soulat, J.M., and Perret, B. (2009). Shift work and metabolic syndrome: respective impacts of job strain, physical activity, and dietary rhythms. *Chronobiology International: The Journal of biological and medical rhythm research,* 26 (3), 544–559.

Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (2001). Executive summary of the third report of the National Cholesterol Education Program (NCEP) expert panel on detection, evaluation, and treatment of high blood cholesterol in adults (adult treatment panel III). *JAMA: The Journal of the American Medical Association,* 25(19), 2486–2497.

Ferrannini, E. and Natali, A. (1991)."Essential hypertension, metabolic disorders, and insulin resistance,". *American heart journal,* 121 (4), 1274–1282.

Feng, Y., Hong, X., Li, Z., Zhang, W., Jin, D., Li, U.X., Zhang, Y., Hu, F.B., Wei, L.J., Zang, T., and Xux, X.(2006). Prevalence of metabolic syndrome & its relation to body composition in a Chinese rural population obesity. *Obesity (Silver Spring),* 14(11), 2089-98.

Ferreira, I., Henry, R.A., Twisk, J.R., Mechelen, W.V. , Kemper, H.G., and Stehouwer, C.A.(2005). The Metabolic Syndrome, Cardiopulmonary Fitness, and Subcutaneous Trunk Fat as Independent Determinants of Arterial Stiffness: The Amsterdam Growth and Health Longitudinal Study. *Archives of internal medicine,* 165(8), 875-882.

Fink, A. (1995). How to measure survey reliability and validity. Seventh ed. Thousand Oaks, CA: Sage.

Ford, E. S., Li, C., and Sattar, N. (2008). Metabolic syndrome and incident diabetes: current state of the evidence. *Diabetes care,* 31(9), 1898-904.

Ford, E.S., Giles, W.H., and Dietz, W.H. (2002). Prevalence of the metabolic syndrome among US adults: Findings from the third National Health and Nutrition Examination Survey. *JAMA : The Journal of the American Medical Association,* 287(3), 356–9.

Ford, E.S., Giles, W.H., and Mokdad, A.H.(2004). Increasing prevalence of the metabolic syndrome among U.S. Adults. *Diabetes care,* 25(10), 2444–2449.

Freire, R.D., Cardoso, M.A., Gimeno, S.G., Ferreira, S.R. and for the Japanese-Brazilian Diabetes Study Group.(2005). Dietary Fat Is Associated With Metabolic Syndrome in Japanese Brazilians. *Diabetes care,* 28(7),1779-1785.

Friedewald, W., Levy, R., and Fredrickson, D. (1972). Estimation of the concentration of low- density lipoprotein cholesterol in plasma with use of the preparative ultracentrifuge.18, 499-502.

Fujino, Y., Iso, H., Tamakoshi, A., Inaba, Y., Koizumi, A., Kubo, T., and Yoshimura, T. (2006). Japanese Collaborative Cohort Study Group. A prospective cohort study of shift work and risk of ischemic heart disease in Japanese male workers. *American journal of epidemiology,* 164(2), 128-35.

Gabriely, I., Ma, X.H., Yang, X.M., Atzmon, G., Rajala, M.W., Berg, A.H et al., (2002). Removal of visceral fat prevents insulin resistance and glucose intolerance of aging: an adipokine-mediated process? *Diabetes,* 51(10), 2951-2958.

Gami, A. S., Witt, B. J., Howard, D. E., Erwin, P. J., Gami, L. A., Somers, V. K. et al., (2007). Metabolic syndrome and risk of incident cardiovascular events and death: a systematic review and meta-analysis of longitudinal studies. *Journal of the American College of Cardiology,* 49, 403-414.

Garaulet, M., Ordovás, J.M., and Madrid, J.A. (2010).The chronobiology, etiology and pathophysiology of obesity. *International Journal of obesity,* 34 (12), 1667–83.

Gary, T.C. (2006). Metabolic Syndrome or Central obesity Syndrome. *Diabetes Care,* 29 (3),752.

Geliebter, A., Gluck, M.E., Tanowitz, M., Aronoff, N.J., and Zammit, G.K. (2000). Work-shift period and weight change. *Nutrition,* 16(1), 27-9.

Genuth, S., Alberti, K.G., Bennett, P., Buse, J., Defronzo, R., Kahn, R., Kitzmiller, J., Knowler, W.C., Lebovitz, H., Lernmark, A. et al., (2003) . Follow-up report on the diagnosis of diabetes mellitus. *Diabetes care,* 26 (11), 3160-7.

Gerstein, H. C. (1997). Glucose: a continuous risk factor for cardiovascular disease. Diabetic Medicine: *The journal of the British Diabetic Association,* 14 Suppl 3, S25-S31.

Ginsberg, H.N., and Huang, L.S.(2000). The insulin resistance syndrome: impact on lipoprotein metabolism and atherothrombosis. *Journal of cardiovascular risk,*7(5), 325–31.

Gonze, D., Halloy, J., and Goldbetter, A.(2002). “Robustness of circadian rhythms with respect to molecular noise” in Proceedings of the National Academy of Sciences of the United States of America, 99 (2), 673-678.

Grosswald, B. (2004). The effects of shift work on family satisfaction. Families in Society. *The Journal of Contemporary Social Services,* 85 (3), 413–23.

Grove, T.H. (1979). Effect of reagent pH on determination of HDL cholesterol by precipitation with sodium phosphotungstate-magnesium. *Clinical Chemistry*, 25(4), 560-4.

Grundy ,S.M.(2004).”Obesity, metabolic syndrome, and cardiovascular disease”. *Journal of Clinical Endocrinology and Metabolism*, 89(6), 2595–2600.

Grundy, S. M.(1998). The role of cholesterol management in coronary disease risk reduction in elderly patients. *Journal of Clinical Endocrinology and Metabolism,* 27(3), 655-675.

Grundy, S.M. (2008). Metabolic syndrome pandemic. *Arteriosclerosis, thrombosis and vascular Biology*, 28 (4), 629-636.

Grundy, S.M., Cleeman, J.I., Daniels, S.R., Donato, K.A., Eckel, R.H., Franklin, B.A. et al., (2005). Diagnosis and management of the metabolic syndrome: an American Heart Association/ National Heart, Lung, and Blood Institute Scientific Statement. *Circulation,* 112 (17), 2735-52.

Guldiken, S., Demir, M., Arikan, E., and Tugrul, A. (2007). “The levels of circulating markers of atherosclerosis and inflammation in subjects with different degrees of body mass index: soluble CD40 ligand and high-sensitivity C-reactive protein”. *Thrombosis Research,* 119 (1), 79–84.

Guo, Y., Rong, Y., Huang, X., Lai, H., Luo, X., Zhang, Z., Liu, Y., He, M., Wu, T., and Chen, W. (2015). Shift Work and the Relationship with Metabolic Syndrome in Chinese Aged Workers. PLoS One,11, 10(3):e0120632.

Guzder, R.N, Gatling, W., Mullee, M.A., and Byrne, C.D. (2006). Impact of metabolic syndrome criteria on cardiovascular disease risk in people with diagnosed type 2 diabetes. *Diabetologia,* 49 (1), 49-55.

Ha, M. and Park, J. (2005). Shift work and metabolic risk factors of cardiovascular disease. *Journal of occupational health,* 47, 89–95.

Haffner, S. M., Valdez, R. A., Hazuda, H. P., Mitchell, B. D., Morales, P. A. and Stern, M. P. (1992). Prospective Analysis of The Insulin-Resistance Syndrome (Syndrome X) *Diabetes,* 41(6), 715-722.

Halberg, N., Wernstedt-Asterholm, I., and Scherer, P.E. (2008).“The adipocyte as an endocrine cell”. *Endocrinology and Metabolism Clinics of North America,* 37(3), 753–768.

Hamdy, A.S., Seham, A., Nader, N., and Iman, E.S. (2012). “Metabolic syndrome in the Middle East” . *Indian J Endocrinol Metab olisme*,16(1).

Hampton, S.M., Morgan, L.M., Lawrence, N., Anastasiadou, T., Norris, F., Deacon, S., Ribeiro, D., and Arendt, J. (1996). Postprandial hormone and metabolic responses in simulated shift work. *The Journal of Endocrinology,* 151 (2), 259–67.

Hanley, A.J., Karter, A.J., Williams, K., Festa, A., D'Agostino RB Jr., Wagenknecht, L.E et al.,(2005). Prediction of type 2 diabetes mellitus with alternative definitions of the metabolic syndrome: the Insulin Resistance Atherosclerosis Study. *Circulation,* 112 (24), 3713–3721.

Hansson, G.K.(2005). Inflammation, atherosclerosis, and coronary artery disease. *The New England Journal of medicine,* 352 (16), 1685–95.

Harzallah, F., Alberti, H. and Ben Khalifa, F. (2006). The metabolic syndrome in an Arab population: a first look at the new International Diabetes Federation criteria. *Diabetic Medicine,* 23 (4), 441-444.

Haupt, C.M., Alte, D., Do¨rr, M., Robinson, D.M., Felix, S.B., John, U., and Völzke, H. (2008). The relation of exposure to shift work with atherosclerosis and myocardial infarction in a general population. *Atherosclerosis,* 201(1), 205–211. doi: 10.1016/j.

Holloszy, J.O., Schultz, J., Kusnjerkiewicz, J., Hagberg, J.M., and Ehsani, A.A. (1986). Effect of exercise on glucose tolerance and insulin resistance, Brief review and some preliminary result. suppl 711, 55-56.

Holm, K. and Liewellyn, J. (1986).Nursing research for nursing practice. W.B. Sounders Company. Philadelphia.

Holzberg, D., and Albrecht, U. (2003). The circadian clock: a manager of biochemical processes within the organism. *Journal of Neuroendocrinology,* 15 (4), 339 -343.

Hu, F.B., Manson, J.E., Stampfer, M.J., Colditz, G., Liu, S. et al., (2001). Diet, lifestyle, and the risk of type 2 diabetes mellitus in women. *The New England journal of medicine,* 345 (11), 790–797.

Institute for Work and Health. Fact sheet.Shiftwork. (2003) [cited 2010 August 15]. http://www.iwh.on.ca/media/images/ shiftwork.pdf. [accessed on March 2017].

Isomaa, B., Almgren, P., Tuomi, T., Forsén, B., Lahti, K., Nissén, M., Riitta Taskinen, M., and Groop, L. (2001). Cardiovascular morbidity and mortality associated with the metabolic syndrome. *Diabetes Care,* 24 (4), 683–689.

Jaber, L. A., Brown, M. B., Hammad, A., Zhu, Q., and Herman, W. H. (2004). The prevalence of the metabolic syndrome among Arab Americans. *Diabetes Care,* 27 (1), 234– 238.

Jamee, A., Abed, Y., and Abu tawila, H. (2013). "Risk Factors of Metabolic Syndrome among Clinic Patients in Gaza - Palestine." *American Journal of Cardiovascular Disease Research,* 1(1), 20-24.

Jennings, G., Nelson, L., Nestel, P., Esler, M., Korner, P., Burton, D. et al., (1986). The effects of changes in physical activity on major cardiovascular risk factors, hemodynamics, sympathetic function, and glucose utilization in man: a controlled study of four levels of activity. *Circulation,* 73(1), 30–40.

Jensen, M.D., Caruso, M., Heiling, V., and Miles, J. M. (1989). Insulin regulation of lipolysis in nondiabetic and IDDM subjects. *Diabetes,* 38(12), 1595-1601.

Juutilainen, A., Lehto, S., Rönnemaa, T., Pyörälä, K., and Laakso, M. (2005). Type 2 diabetes as a "coronary heart disease equivalent": an 18-year prospective population-based study in Finnish subjects. *Diabetes Care,* 28 (12), 2901-2907.

Kaduka, L.U., Kombe, Y., Kenya, E., Kuria, E., Bore, J.K., and Bukania, Z.N. (2012). Prevalence of metabolic syndrome among an urban population in Kenya. *Diabetes Care,* 35(4), 887-93.

Kaplan, N.M. (1989). The deadly quartet.Upper-body obesity, glucose intolerance, hypertriglyceridemia, and hypertension. *Archives of internal medicine,* 149 (7), 1514-20.

Karlson, B., Knutsson, A., and Lindahl, B. (2001). Is there an association between shift work and having a metabolic syndrome? Results from a population based study of 27,485 people. *Occupational and environmental medicine,* 58(11), 747–52.

Kathleen, H., Prussian, Debra, J., Barksdale-Brown ,and Dieckmann, J.(2007). Racial and Ethnic Differences in the Presentation of Metabolic Syndrome. *The Journal for Nurse Practitioners,* 3 (4), 229-239.

Kawada, T., Otsuka, T., Inagaki, H., Wakayama, Y., Katsumata, M., Li, Q., et al., (2010). A cross-sectional study on the shift work and metabolic syndrome in Japanese male workers. Aging Male. 13(3), 174-8.

Kelliny, C., William, J., Riesen, W., Paccaud, F., and Bovet, P. (2007). ”Metabolic syndrome according to different definitions in a rapidly developing country of the African region. *Cardiovascular Journal of South Africa,* 93(1), 70-6.

Kesse-Guyot, E., Ahluwalia, N., Lassale, C., Hercberg, S., Fezeu, L., and Lairon, D. (2013). Adherence to Mediterranean diet reduces the risk of metabolic syndrome: a 6-year prospective study. *Nutr Metab Cardiovasc Dis.,* 23(7), 677-83.

Khader, Y., Bateiha, A., El-Khateeb, M., Al-Shaikh, A., and Ajlouni, K. (2005). High prevalence of the metabolic syndrome among Northern Jordanians. *Journal of Diabetes and Its Complications,* 21 (2007), 214–219.

Klerman, E.B. (2005). Clinical aspects of human circadian rhythms. *Journal of biological Rhythms,* 20, 375–86.

Knutson, A., Andersson, H., and Berglund,U. (1990). Serum lipoproteins in day and shift workers: a prospective study. *British journal of industrial medicine,* 47(2), 132–4.

Knutsson, A., and Bøggild, H. (2000). Shift work and cardiovascular disease: review of disease mechanisms. *Reviews on environmental health,*15 (4), 359–72.

Korean centers for disease control and prevention, (2007). The 3rd in-depth study of Korean national health and nutrition examination survey (translated by Ye HH). Korean: health screening sector; 4.

Kroenke, C.H., Spiegelman, D., Manson, J., Schernhammer, E.S., Colditz, G.A., and Kawachi, I.(2006). Work characteristics and incidence of type 2 diabetes in women. *American journal of epidemiology,* 165(2),175–83.

Kurl, S., Laukkanen, J.A., Niskanen, L., Laaksonen, D., Sivenius, J., Nyyssönen, K. et al.,(2006). Metabolic syndrome and the risk of stroke in middle-aged men. Stroke. *Journal of the American heart association,*

Kylin, E. (1923). "Studien ueber das Hypertonie-Hyperglyca"mie-Hyperurika"miesyndrom," Zentralblatt fuer Innere Medizin. 44, 105–127.

Lakka, H. M., Laaksonen, D. E., Lakka, T. A., Niskanen, L. K., Kumpusalo, E., Tuomilehto, J. et al., (2002). The metabolic syndrome and total and cardiovascular disease mortality in middle-aged men. *JAMA : The Journal of the American Medical Association,* 288 (21), 2709-2716.

Lann, D., and LeRoith, D. (2007). Insulin resistance as the underlying cause for the metabolic syndrome. *The Medical clinics of North America,* 91 (6),1063-77.

Last, M. (1983). Dictionary of epidemiology. New York: Oxford University Press.

Lau, D.C.W., Dhillon, B., Yan, H., Szmitko, P.E., and Verma, S. (2005). "Adipokines: molecular links between obesity and atheroslcerosis". *The American Journal of Physiology—Heart and Circulatory Physiology,* 288(5), 2031–2041.

Lee,W.Y., Park, J.S., Noh, S.Y., Rhee, E.J., Kim, S.W., and Zimmet, P.Z. (2004). Prevalence of the metabolic syndrome among 40,698 Korean metropolitan subjects.. *Diabetes research and clinical practice,* 65 (2), 143-9.

Leloup, J.C. and Goldbetter, A. (2003). "Toward a detailed computational model for the mammalian circadian clock" in Proceedings of the National Academy of Sciences of the United States of America.100 (12), 7051–7056.

Levin, K.(2006). Study Design III: Cross-Sectional Studies. Evidence-Based Dentistry, 7(1), 24-25.

Liese, A. D., Mayer-Davis, E. J., and Haffner, S. M. (1998). Development of the multiple metabolic syndrome: an epidemiologic perspective. *Epidemiologic reviews,* 20 (2), 157-172.

Lisabeth, L.D. (2009). Rotating night shift work and the risk of ischemic stroke. *American journal of epidemiology,* 169 (11), 1370–7.

Lohsoonthorn, V., Dhanamun, B., and Williams, M .A. (2006). Prevalence of Metabolic syndrome & its relationship to white blood cell count in population of Thai men &women receiving routine health examinations. *American journal of hypertension,* 19 (4), 339-45.

Malhotra, A., Kang, B., Cheung, S., Opawumi, D. and Meggs, L. (2001)."Angiotensin II promotes glucose-induced activation of cardiac protein kinase C isozymes and phosphorylation of troponin I. *Diabetes,* 50(8), 1918–1926.

McKeown, N.M., Meigs, J.B., Liu, S., Saltzman, E., Wilson, P. and Jacques, P.F.(2004). Carbohydrate Nutrition, Insulin Resistance, and the Prevalence of the Metabolic Syndrome in the Framingham Offspring Cohort. *Diabetes care,* 27(2),538-546.

McLaughlin, T., Abbasi, F., Lamendola, C., Liang, L., Reaven, G., Schaaf, P., and Reaven, P. (2002). “Differentiation between obesity and insulin resistance in the association with C-reactive protein” .Circulation, 106 (23), 2908–2912.

Meiatlini, F., Prencipe, L., Bardelli, F., Giannini, G., and Tarli, P. (1978). The 4-hydroxybenzoate/4 aminophenazone chromogenic system used in the enzymic determination of serum cholesterol. *Clinical Chemistry*, 24 (12), 2161-2165.

Menuet, R., Lavie, C.J ., and Milani, R.V. (2005). Importance and management of dyslipidemia in the metabolic syndrome: *The American Journal of the Medical Science*, 330(6), 295-302.

Skilton, R.M., Moulin, P., Terra, J., and Bonnet, F. (2007). Associations Between Anxiety, Depression, and the Metabolic Syndrome. *Biological psychiatry*, 62 (11), 1251–1257.

Mikuni, E., Ohoshi, T., Hayashi, K., and Miymura, K.(1983). Glucose intolerance in an employed population. *Tohoku journal of experimental medicine,* 141 (Suppl), 251–6.

MOH, (2005). Health annual report Palestine (2005).Gaza.

MOH, (2013). National health strategy. 2011- 2013. setting direction- getting results, MOH.

MOH, (2015). Health annual report Palestine (2015).

MOH, (2014). Health Annual Report, Palestine 2014.

Mohebbi, I., Shateri, K. and SeyedMohammadzad, M. (2012). The relationship between working schedule patterns and the markers of the metabolic syndrome: Comparison of shift workers with day workers. *International journal of occupational medicine and environmental health*, 25(4), 383 – 391.

Montagnani, M. and Quon, M.J. (2000). Insulin action in vascular endothelium: potential mechanisms linking insulin resistance with hypertension. *Diabetes, Obesity and Metabolism*, 2 (5), 285-292.

Moreira, L.B., Fuchs, F.D., Moraes, R.S., Bredemeier, M., Cardozo, S., Fuchs, S.C. et al., (1996). Alcoholic beverage consumption and associated factors in Porto Alegre, a southern Brazilian city: a population-based survey. *Journal of studies on alcohol, 57(3), 253-9.*

Morikawa, J., Nakagawa, H., Miura, K., Soyama, Y., Ishizaki, M., Kido, T. et al., (2005). Shift work and the risk of diabetes mellitus among Japanese male factory workers. *Scandinavian journal of work, environment and health,* 31(3), 179–82.

Mottillo, S., Filion, K. B., Genest, J., Joseph, L., Pilote, L., Poirier, P. et al., (2010). The metabolic syndrome and cardiovascular risk a systematic review and meta-analysis. *Journal of the American College of Cardiology,* 56 (14), 1113-1132.

Mushtaha, A.A. (2009). Incidence of Septicemia among infants at El- Nassr Hospital- Gaza Governorate- 2007. Un published master thesis. AL- Quds University, Jerusalem, Palestine.

Murphy, P.J., and Campbell, S.S. (1996). Physiology of the circadian system in animals and humans. *Journal of clinical Neurophysiology,* 13(1), 2–16.

Nagaya, T., Yoshida, H., Takahashi, H., and Kawai, M. (2002). Markers of insulin resistance in day and shift workers aged 30–59 years. *International archives of occupational and environmental health,* 75 (8), 562–568.

Nesto, R.W.(2003). The relation of insulin resistance syndromes to risk of cardiovascular disease. *Reviews in cardiovascular medicine,* 4 Suppl 6:S11-8.

Niedhammer, I., Lert, F., and Marne, M.J. (1996). Prevalence of overweight and weight gain in relation to night work in a nurses' cohort. *International journal of obesity and related metabolic disorders,* 20(7), 625-33.

Pan, A., Schernhammer, E.S., Sun, Q., and Hu, F.B. (2011). Rotating night shift work and risk of type 2 diabetes: Two prospective cohort studies in women. *PLoS medicine,* 8(12):e1001141.

Pan, X.R., Li, G.W., Hu, Y.H., Wang, J.X., Yang, W.Y., An, Z.X. et al., (1997). Effects of diet and exercise in preventing NIDDM in people with impaired glucose tolerance. The Da Qing IGT and Diabetes Study. *Diabetes Care,* 20(4), 537–544.

Park, Y. W., Zhu, S., Palaniappan, L., Heshka, S., Carnethon, M. R., and Heymsfield, S. B. (2003). The metabolic syndrome: Prevalence and associated risk factor findings in the US population from the Third National Health and Nutrition Examination Survey, 1988–1994. *Archives of internal medicine,* 163 (4), 427– 436.

PCBS, (2015) http://www.pcbs.gov.ps/ .[Accessed on February 2016].

PCBS, (2016) http://www.pcbs.gov.ps/ .[Accessed on March 2017].

PCBS, (2016). Labour Force Survey: (April– June, 2016) Round, (Q2/2016).

Phengtham, U. (2011). Prevalence of Metabolic Syndrome among Health Care Personnel and Office Workers in Lampang Hospital. *Lampang medical journal,* 32(1).

Pietroiusti, A., Neri, A., Somma, G., Coppeta, L., Iavicoli, I., Bergamaschi, A. et al., (2010). Incidence of metabolic syndrome among night-shift healthcare workers. *Occupational and environmental medicine,* 67(1), 54-7.

Pimenta, A.M., Kac, G., Souza, R.R., Ferreira, L.M., and Silqueira, S.M. (2012). Night-shift work and cardiovascular risk among employees of a public university. *Journal of the Brazilian Medical Association,* 58 (2),168–77.

Plandevall, M., Singal, B., Williams, L., Brotons, C., Guyer, H., Sadurni, J. et al., (2006). A single factor underlies the metabolic syndrome. *Diabetes Care,* 29(1), 113-122.

Polit, D. and Beck, T. (2oo4). Nursing research.Principles and Methods.Seventh ed. Lippincontt Williams and Wilkins, New York, USA.

Rantala, A., Kauma, H., Lilja, M., Savolainen, M., Reunanen, A., and Kesa¨niemi, Y. (1999).Prevalence of the metabolic syndrome in drug-treated hypertensive patients and control subjects. *Journal of internal medicine,* 245 (2),163–174.

Reaven, G.M. (1988). Banting lecture 1988. Role of insulin resistance in human disease. *Diabetes,* 37 (12), 1595-1607.

Reaven, G.M. (2005). Compensatory hyperinsulinemia and the development of an atherogenic lipoprotein profile: the price paid to maintain glucose homeostasis in insulin-resistant individuals. *Endocrinology and Metabolism Clinics in North America,* 34 (1), 49-62.

Reilly, M., Wolfe, M., Rhodes, R., Girman, C., Mehta, N., and Rader, D. (2004). Measures of insulin resistance add incremental value to the clinical diagnosis of metabolic syndrome in association with coronary atherosclerosis. *Circulation,* 110(7), 803-809.

Reilly, M.P., and Rader, D.J.(2003). "The metabolic syndrome :more than the sum of its Parts ? *Circulation,* 108(13), 1546-1551.

Rhee, S.Y., Park, S.W., Kim, D.J., and Woo, J. (2013). Gender disparity in the secular trends for obesity prevalence in Korea: analyses based on the KNHANES 1998–2009. *The Korean journal of internal medicine,* 28 (1), 29–34.

Ridker, P. M., Buring, J. E., Cook,N. R. and Rifai, N. (2003). "C-reactive protein, the metabolic syndrome, and risk of incident cardiovascular events: an 8-year follow-up of 14719 initially healthy American women. *Circulation,*107(3), 391–397.

Ross, R. (1999). Atherosclerosis--an inflammatory disease. *The New England journal of medicine,* 340 (2), 115-126.

Salas-Salvado, J., Fernandez-Ballart, J., Ros, E., Martinez-Gonzalez, M., Fito, M., Estruch, R. et al., (2008). Effect of a Mediterranean diet supplemented with nuts on metabolic syndrome: one year results of the PREDIMED randomized trial. *Archives of internal medicine,* 168 (22), 2449-2458.

Saleh, M. M. (Ed). (2012). The Palestinian Strategic Report 2010/2011. AlZaytouna center for Studies and Consultations http://www.alzaytouna.net/english/ publication/PSR/0-11/Full.pdf. [accessed on February 2016]

Saleh, H.A. (1985). Palestinian Population, Demography and Geography. (Arabic), Dar Elshoroq, Amman, Jordan.

Salmenniemi, U., Ruotsalainen, E., Pihlajamaki, J., Vauhkonen, I., Kainulainen, S., Punnonen, K. et al., (2004). Multiple abnormalities in glucose and energy metabolism and coordinated changes in levels of adiponectin, cytokines, and adhesion molecules in subjects with metabolic syndrome. *Circulation,* 110(25), 3842-3848.

Sattar, N., Gaw, A., Scherbakova, O., Ford, I., O'Reilly, D.S., Haffner, S.M. et al., (2003). Metabolic syndrome with and without C-reactive protein as a predictor of coronary heart disease and diabetes in the West of Scotland Coronary Prevention Study. *Circulation*, 108(4), 414-9.

Sattar, N., Williams, K., Sniderman, A.D., D'Agostino, R. Jr., and Haffner, S.M.(2004). Comparison of the associations of apolipoprotein B and non-high-density lipoprotein cholesterol with other cardiovascular risk factors in patients with the metabolic syndrome in the Insulin Resistance Atherosclerosis Study. *Circulation,* 110 (17), 2687–2693.

Schindler, C. (2007). The metabolic syndrome as an endocrine disease: is there an effective pharmacotherapeutic strategy optimally targeting the pathogenesis? *Theraputic advances in cardiovascular disease,* 1(1),7–26.

Scott, C. (2003). Diagnosis, prevention, and intervention for the metabolic syndrome. *The American journal of cardiology,* 92 (1A), 35i-42i.

Sharma, A.M., Janke, J., Gorzelniak, K., Engeli, S., and Luft, F.C. (2002). Angiotensin blockade prevents type 2 diabetes by formation of fat cells Hypertension. 40 (5), 609-611.

Shafei, M.N., Awang, A.F., and Wan Mohamad, Z.W. (2011). Prevalence of metabolic syndrome and its associated factors among female nurses in a teaching hospital in North-Eastern state of Malaysia. *Journal of public health and epidemiology,* 3(9), 394-400.

Sirdah, M., Abu Ghali, A., and Al Laham, N. (2012). The reliability of the National Cholesterol Education Program's Adult Treatment Panel III (NCEP/ATP III) and the International Diabetes Federation (IDF) definitions in diagnosing metabolic syndrome (MetS) among Gaza Strip Palestinians. *Diabetes and metabolic syndrome,* 6(1), 4-8.

Sonnenberg, L., Pencina, M., Kimokoti, R., Quatromoni, P., Nam, P.H., D'Agostino, R., Meigs, J.B., Ordovas, J., Cobain, M. and Millen, B. (2005). Dietary Patterns and the Metabolic Syndrome in Obese and Non-obese Framingham Women. *Obesity research,*13(1), 153-162.

Sookoian, S., Gemma, C., Fernandez, Gianotti, T., Burgueño, A., Alvarez, A., González, C.D., and Pirola, C.J.(2007). Effects of rotating shift work on biomarkers of metabolic syndrome and inflammation. *Journal of internal medicine,* 261(3), 285-292.

Soto González, A., Bellido Guerrero, D., Buño Soto, M., PértegaDíaz, S., Martinez-Olmos, M. and Vidal, O. (2006). "Metabolic syndrome, insulin resistance and the inflammation markers C-reactive protein and ferritin," *European Journal of Clinical Nutrition,* 60(6), 802–809.

Srikanthan, K., Feyh, A., Visweshwar, H., Shapiro, J.I., and Sodhi, K. (2016). Systematic Review of Metabolic Syndrome Biomarkers: A Panel for Early Detection, Management, and Risk Stratification in the West Virginian Population. *International journal of medical sciences,* 13(1), 25-38.

Steele, A., Sheilds, B., Knight, B. and Pearson, E. (2005). Waist circumference: A predictive tool for insulin resistance. *Journal of Diabetes Nursing,* 9(10), 389- 393.

Stern, M., Williams, K., Gonzalez, Villalpando, C., Hunt, K.J., and Haffner, S.M. (2004). "Does the metabolic syndrome improve identification of individuals at risk of type 2 diabetes and or cardiovascular disease?" *Diabetes Care,* 27(11), 2676-81.

Straif, K., Baan, R., Grosse, Y., Secretan, B., Ghissassi, F.E., Bouvard, V. et al., (2007). Carcinogenicity of shift-work, painting, and fire-fighting. *Lancet oncology,* 8(12), 1065-6.

Stratton, I. M., Adler, A. I., Neil, H. A., Matthews, D. R., Manley, S. E., Cull, C. A. et al., (2000). Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. *British Medical Journal,* 321(7258), 405-412.

Sumner, A.D., Sardi, G.L., and Reed, J.F. (2012). Components of the metabolic syndrome differ between young and old adults in the US population. *Journal of clinical hypertension (Greenwich),* 14(8), 502-6.

Suwazono, Y., Dochi, M., Oishi, M., Tanaka, K., Kobayashi, E., and Sakata, K.(2009). Shiftwork and impaired glucose metabolism: a 14-year cohort study on 7104 male workers. *Chronobiology international,* 26(5), 926–41.

Suwazono, Y., Dochi, M., Sakata, K., Okubo , Y., Oishi, M., Tanaka, K., Kobayashi, E., Kido, T., and Nogawa, K. (2008). Long-term longitudinal study on the relationship between alternating shift work and the onset of diabetes mellitus in male Japanese workers. *Journal of occupational and environmental medicine,* 16(8), 1887-93.

Suwazono, Y., Uetani, M., Oishi, M., Tanaka, K., Morimoto, H., and Sakata, K. (2010). Calculation of the benchmark duration of shift work associated with the development of impaired glucose metabolism: a 14- year cohort study on 7104 male workers. *Occupational and environmental medicine*, 67(8), 532—7.

Szpak, A., Jamiolkowski, J., and Witana, K. (2005). Overweight and obesity and their determinants among men from Podlasie region in the years 1987-1998. *Roczniki Akademii Medycznej w Bialymstoku1*, 245-9.

Targher, G., Seidell, J.C., Tonoli, M., Muggeo, M., De, S.G., and Cigolini, M.(1996). The white blood cell count: its relationship to plasma insulin and other cardiovascular risk factors in healthy male individuals. *Journal of internal medicine*, 239(5), 435–41.

Timer, O., sisieter, F., and Levey, E. (2000). Metabolic syndrome X. A review. *The Canadian journal of cardiology*, 6(16),779-789.

Tran, A., Gelaye, B., Girma, B., Lemma, S., Berhane, Y., Bekele, T., Khali, A., and Williams, A.M. (2011). Prevalence of Metabolic Syndrome among Working Adults in Ethiopia. *International journal of hypertension.*

Trayhurn, P., and Wood, I.S. (2004).“Adipokines: inflammation and the pleiotropic role of white adipose tissue”. *British Journal of Nutrition,* 92(3), 347–355.

Trinder, P. (1969). Annals., Clinical biochemistry, 6, 24.

Tripathy, D., Mohanty, P., Dhindsa, S., Syed, T., Ghanim, H., Aljada, A. et al., (2003). Elevation of free fatty acids induces inflammation and impairs vascular reactivity in healthy subjects. *Diabetes,* 52(12), 2882-2887.

UNDP (2012). Gaza Facts Sheet Available at: http://www.undp.ps/en/newsroom/publications/pdf/other/GazaFactSheet 2012. pdf [Accessed on March 2016].

United Nations Relief and Works Agency (UNRWA) Operational Response, 2013. Available at: http://www.unrwa.org/userfiles/2013pdf [Accessed on March 2016].

Vague, J. (1947).“Sexual differentiation. A factor affecting the forms of obesity”. *La Presse Medicale*, 30, S39–S40.

van Amelsvoort, L.G., Schouten, E.G., and Kok, F.J. (1999). Duration of shift work related to body mass index and waist to hip ratio. *International journal of obesity and related metabolic disorders,* 23(9), 973-8.

Van Cauter, E., Spiegel, K., Tasali, E., and Leproult, R. (2008). Metabolic consequences of sleep and sleep loss. *Sleep medicine,* 9(1), 23-28.

Van Drongelen, A., Boot, CR.L., Merkus, S.L, Smid, T., and van der Beek, A.J. (2011). The effects of shift work on body weight change - a systematic review of longitudinal studies. *Scandinavian journal of work, environment and health,* 37(4), 263–75.

Villegas, R., Perry, I.J., Creagh, D., Hinchion, R., and O'Halloran, D. (2003). Prevalence of the metabolic syndrome in middle-aged men and women. *Diabetes care,* 26(11), 3198-9.

Vyas, M.V., Garg, A.X., Iansavichus, A.V., Costella, J., Donner, A., Laugsand, L.E. et al., (2012). Shift work and vascular events: systematic review and meta-analysis. *BMJ,* 345, e4800.

Wang, H., Zhang, H., Jia, Y., Zhang, Z., Craig, R., Wang, X. et al., (2004). Adiponectin receptor 1 gene (ADIPOR1) as a candidate for Type 2 diabetes and insulin resistance. *Diabetes,* 53(8), 2132-2136.

Wassink, A.M., Olijhoek, J.K., and Visseren, F.L. (2007). The metabolic syndrome: metabolic changes with vascular consequences. *European journal of clinical investigation,* 37(1), 8-17.

Westerbacka, J., Seppälä-Lindroos, A., and Yki-Järvinen, H. (2001). Resistance to acute insulin induced decreases in large artery stiffness accompanies the insulin resistance syndrome. *Journal of Clinical Endocrinology and Metabolism,* 86 (11), 5262-5268.

WHO, (1999). Department of Noncommunicable Disease Surveillance. Definition, Diagnosis and Classification of Diabetes Mellitus and its Complications. Report of WHO Consultation. Geneva [cited 2010 August 10]. Available from http://www.staff.ncl.ac.uk/philip.home/who_dmg.pdf. [accessed on January, 2016].

WHO, (2015). http://apps.who.int/gb/ebwha/pdf_files/WHA68/A68_INF4-en.pdf [accessed on January, 2016].

WHO, (2016). Health conditions in the occupied Palestinian territory, including east Jerusalem, and in the occupied Syrian Golan. Geneva, 23–28 May 2016).

Wild, S.H., Roglic, G., Green, A., Sicree, R., and King, H.(2004). Global prevalence of diabetes: estimates for the year 2000 and projections for 2030 - Response to Rathman and Giani. *Diabetes care,* 27(10), 2569.

Wingard, D., Von Muhlen, D., Barrett-Connor, E., and KritzSilverstein, D. (1996). Factor analysis of proposed components of the insulin resistance syndrome. *Diabetes,* 45, 137A.

Wu , S.H., Liu, Z., and Ho, S. (2010). Metabolic syndrome and all-cause mortality: a meta-analysis of prospective cohort studies. *European journal of epidemiology,* 25(6), 375-84.

Yamada, S., Gotoh, T., Nakashima, Y., Kayaba, K., Ishikawa, S., Nago, N., Nakamura, Y., Itoh, Y., and Kajii, E. (2001). Distribution of serum C-reactive protein and its association with atherosclerotic risk factors in a Japanese population : Jichi Medical School Cohort Study. *American journal of epidemiology,* 15;153(12),1183-90.

Yasein, N., Ahmad, M., Matrook, F., Nasir, L. and Froelicher, E.S. (2010). Metabolic syndrome in patients with hypertension attending a family practice clinic in Jordan. *Eastern Mediterranean Health Journal,* 16(4), 375-80.

Ye, H.H., Jeong, J.U., Jeon, M.J. , and Sakong, J. (2013). The Association between Shift Work and the Metabolic Syndrome in Female Workers. *Annals of occupational and environmental medicine,* 25(1), 33.

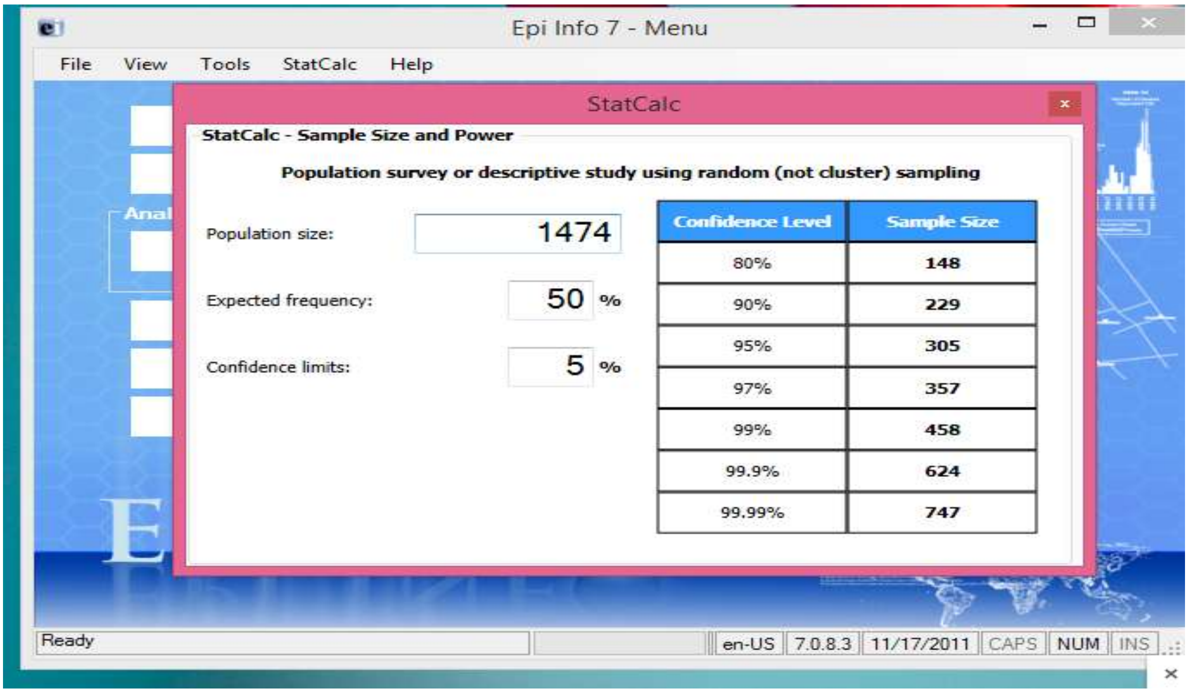
Yusuf, S., Hawken, S., Ôunpuu, S., Dans, T., Avezum, A., Lanas, F. et al.,(2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *The Lancet,* 364(9438), 937–952.

Zhao, I., Bogossian, F., Song, S., and Turner, C. (2011). The association between shift work and unhealthy weight: a cross-sectional analysis from the Nurses and Midwives' e-cohort Study. *Journal of occupational and environmental medicine,* 53(2), 153–158.

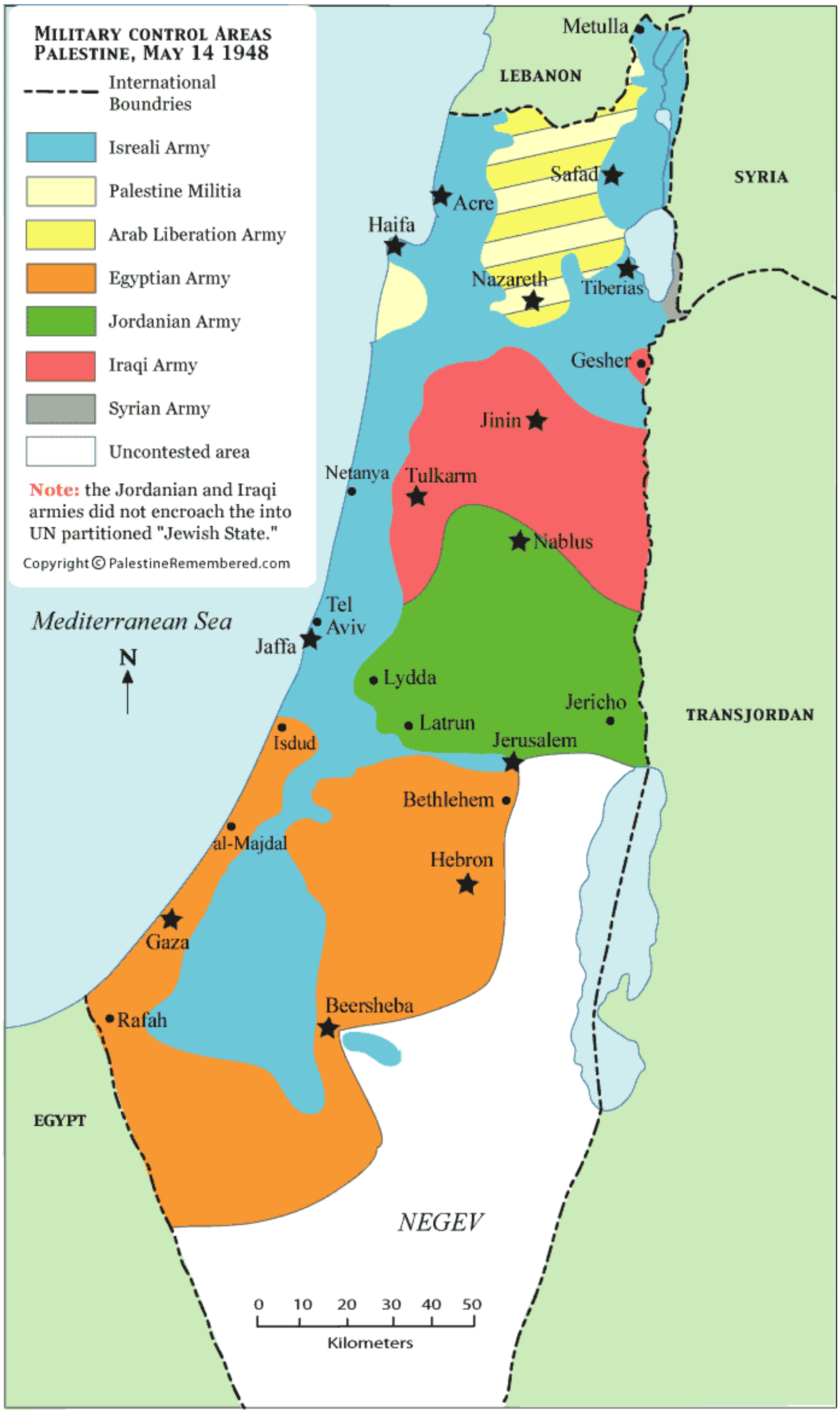
Zulfiqar, S. and Ahmad, M. (2007). SYDROME X: Time to pay heed! *Review article,* 3(2).

Annexes

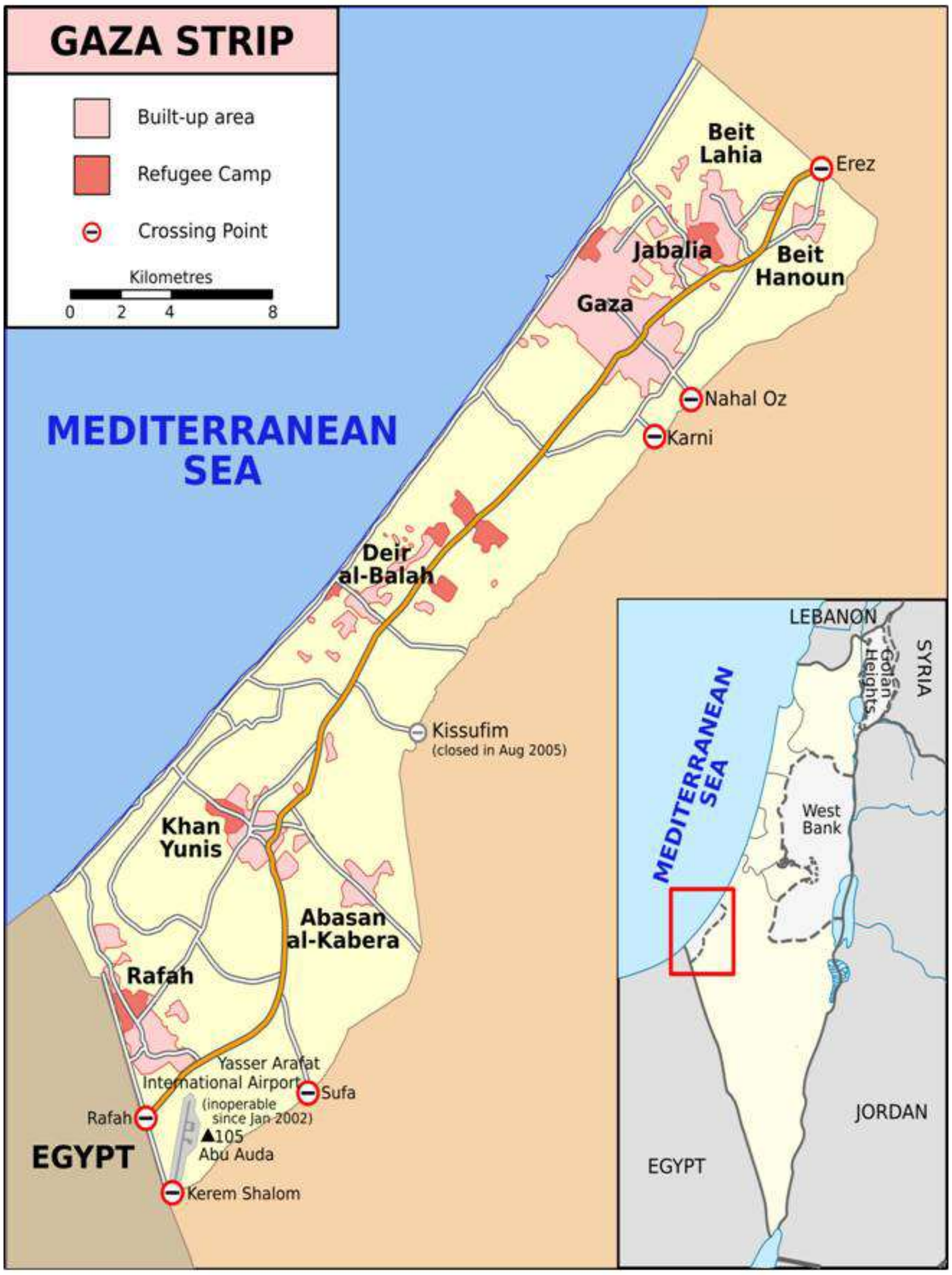
Annex 1: Sample size calculation by using Epi-Info version 7



Annex 2: Palestine Map



Annex 3: Gaza Strip Map



Annex 4: Consent Form (Arabic)

جامعة القدس

كلية الصحة العامة

أخي/أختي المشارك/ة:

أنا الباحثة: هبة محمد عرفات– ادرس بكلية الصحة العامة جامعة القدس – أبو ديس، أقوم بإعداد بحث بعنوان

"تأثير المناوبات الدورية على المؤشرات الحيوية لمتلازمة الأيض و الالتهابات بين العاملين في المجال الصحي–مدينة غزة ،"دراسة مقارنة

باعتباره متطلب للتخرج والحصول على درجة الماجستير في الصحة العامة – علم الأوبئة.

يهدف هذا البحث بشكل أساسي إلى معرفة مدى انتشار متلازمة الأيض بين العاملين بشكل دوري و لاستكشاف تأثير المناوبات الدورية على المؤشرات الحيوية لمتلازمة الأيض و الالتهابات بين العاملين في المجال الصحي –مدينة غزة

لإجراء هذا البحث تم اختيار العاملين في المجال الصحي من (أطباء- تمريض –أخصائي تصوير طبي _ أخصائي تحاليل طبية) في مستشفى الشفاء و مستشفى النصر في مدينة غزة البحث يتطلب من كل شخص تعبئة استبانة (10 دقائق) و سحب عينة دم لإجراء الفحوصات التالية

- قياس نسبة السكر
- قياس نسبة الدهون بأنواعها (الدهون الثلاثية ، الكوليسترول ، الدهون عالية الكثافة (HDL) ، الدهون منخفضة الكثافة (LDL)
- قياس تحليل الدم الكامل CBC
- قياس مؤشر الالتهابات (CRP)
- قياس ضغط الدم
- قياس الطول
- قياس الوزن

و سيتم تشخيص المتلازمة الأيضية على حسب برنامج تعليم الكوليسترول الوطنATP-IIINCEP-، وجود على الأقل ثلاثة من الاتي:

- السمنة المتوسطة
- ارتفاع نسبة الدهون الثلاثية
- انخفاض مستوى الدهون الحميدة (HDL)
- ارتفاع ضغط الدم
- ارتفاع الجلكوز

مشاركتك تطوعية، في حال موافقتك على المشاركة يفضل الالتزام بإجابة الاستبانة وتقديم العينات ، بإمكانك رفض الإجابة عن أي سؤال في الاستبانة و أرغب أن أؤكد لك أن المعلومات التي تذكرها ستكون مصدر ثقة وسرية وستستخدم فقط لغرض

البحث العلمي وبدون ذكر الأسماء فالنتائج لن تنشر بشكل خاص و انما سوف تنشر بشكل جماعي ولن ينسب أي شيء اليك وقد تم حصول البحث على موافقة لجنة هلسنكي وقد تم ارفاق الموافقة.

نتائج البحث سوف تساهم في وضع التوصيات اللازمة للوزارات المعينة من أجل الوصول الى درجة كافية من السلامة للعاملين في المجال الصحي.

وشكرا لك على حسن تعاونك

الباحثة / هبة عرفات

توقيع المشارك :

....

Annex 5: Arabic Self administrating Questionnaire

نموذج استبانة

أختي الكريمة/ أخي الكريم

أرجو مساعدتنا في إتمام هذه الدراسة و ذلك استكمالا لمتطلبات الحصول على درجة الماجستير في الصحة العامة من جامعة القدس –أبو ديس (فرع غزه)

و التي تختص بدراسة تأثير المناوبات الدورية على حدوث متلازمة الأيض و الالتهابات. حيث إن هدف هذه الدراسة توجيه الاهتمام إلى مدى تأثير المناوبات على حدوث المتلازمة و علاقتها كعامل خطورة للإصابة بمرض السكري و أمراض القلب و الالتهابات و ذلك من خلال الإجابة على هذه الاستبانة و تبرعك بعينة دم لإجراء بعض الفحوصات الطبية ذات العلاقة بالمتلازمة:

الرقم: .... **الاسم ثلاثي:**...

الجنس: .... **الحالة الاجتماعية:** ....

العمر: .... **طبيعة العمل (المهنة):** ....

رقم الجوال:...........................

مكان السكن: ....

مدينة ☐ **قرية** ☐ **مخيم** ☐

ما هو مستوى دخل الأسرة الشهري(بالشيكل):

أقل من1000 ☐ **من 1000-2000** ☐ **أكثر من 2000** ☐

❖ التاريخ المرضي للفرد و العائلة:

هل تعاني من مرض السكر؟

- ○ نعم
- ○ لا

- **إذا كانت الإجابة بنعم**

متى ظهر المرض؟

- ○ قبل البدء في أداء المناوبات
- ○ بعد البدء في أداء المناوبات

هل لديك أحد من أفراد عائلتك (الوالدين - أخوة) مصاب بمرض السكر؟

- ○ نعم
- ○ لا

هل تعاني من مرض في القلب؟

- ○ نعم
- ○ لا

- **إذا كانت الإجابة بنعم**

متى ظهر المرض؟

- ○ قبل البدء في أداء المناوبات
- ○ بعد البدء في أداء المناوبات

هل لديك أحد من أفراد عائلتك (الوالدين- أخوة) مصاب بأمراض في القلب؟

- ○ نعم
- ○ لا

هل تعاني من ارتفاع في نسبة الكوليسترول؟

- ○ نعم
- ○ لا

- **إذا كانت الإجابة بنعم**

متى لاحظت ارتفاع نسبة الكوليسترول؟

- ○ قبل البدء في أداء المناوبات
- ○ بعد البدء في أداء المناوبات

هل لديك أحد من أفراد عائلتك (الوالدين- أخوة) يعاني من ارتفاع في نسبة الكوليسترول؟

- ○ نعم
- ○ لا

هل تعاني من ارتفاع في نسبة الدهون الثلاثية؟

- ○ نعم
- ○ لا

- **إذا كانت الإجابة بنعم**

متى لاحظت ارتفاع نسبة الدهون الثلاثية؟

- ○ قبل البدء في أداء المناوبات
- ○ بعد البدء في أداء المناوبات

هل لديك أحد من أفراد عائلتك (الوالدين- أخوة) يعاني من ارتفاع في نسبة الدهون الثلاثية؟

- نعم
- لا

هل تعاني من ارتفاع ضغط الدم؟

- نعم
- لا

- **إذا كانت الإجابة بنعم**

متى لاحظت ارتفاع ضغط الدم؟

- قبل البدء في أداء المناوبات
- بعد البدء في أداء المناوبات

هل لديك أحد من أفراد عائلتك (الوالدين- أخوة) يعاني من ارتفاع ضغط الدم؟

- نعم
- لا

هل تعاني من أي التهابات في الجسم؟

- نعم
- لا

- **إذا كانت الإجابة بنعم**

متى ظهرت هذه الالتهابات؟

- قبل البدء في أداء المناوبات
- بعد البدء في أداء المناوبات

هل لديك أي مشاكل صحية أخرى؟

- نعم
- لا

إذا كانت الإجابة بنعم، من فضلك اذكرها ....

❖ نمط الحياة للفرد:

هل أنت مدخن؟

- مدخن حاليا
- مدخن سابق
- غير مدخن

هل لاحظت زيادة في وزنك في الفترة الأخيرة ؟

- نعم
- لا

- **إذا كانت الإجابة بنعم**

متى حصلت هذه الزيادة ؟

- قبل البدء في أداء المناوبات
- بعد البدء في أداء المناوبات

هل تجلس طويلا (أكثر من 4 ساعات) أمام التلفاز/ الحاسوب أثناء مناوبتك ؟

- دائما
- أحيانا
- نادرا
- لا أجلس أمام التلفاز/الحاسوب

هل تمارس الرياضة و خصوصا رياضة المشي؟

- دائما
- أحيانا
- نادرا
- لا أمارسها

- **إذا كنت تمارس أي نوع من أنواع الرياضة الأخرى ، من فضلك حددها ....**

❖ طبيعة عمل الفرد:

هل سبق و أن كلفت بأداء مناوبات ليلية في العمل؟

- دائما
- أحيانا
- غير مكلف

هل أنت مكلف بأداء مناوبات ليلية في العمل حاليا ؟

- دائما
- أحيانا
- غير مكلف

كيف يكون عملك خلال الأسبوع؟

- فترة صباحية فقط
- فترة صباحية و مسائية فقط
- فترة صباحية و مسائية وليلية
- فترة مسائية و ليلية فقط
- فترة مسائية فقط
- فترة ليلية فقط

ما هو المكان الذي أمضيت/ تمضي معظم المناوبة فيه ؟

- قسم الأطفال
- قسم الحضانة
- قسم القلب و الأوعية الدموية
- العناية المركزة
- قسم الاستقبال و الطوارئ
- أقسام الباطنة
- أقسام الجراحة
- قسم النساء و الولادة
- غير ذلك، من فضلك حددها ....

كم عدد السنوات التي كلفت فيها بأداء مناوبات ليلية؟

- لم أكلف
- سنة
- سنتان
- ثلاث سنوات
- أربعة سنوات
- خمس سنوات
- أكثر من ذلك ،من فضلك حددها ....

كم عدد المناوبات التي تقوم بأدائها شهريا؟

- غير مكلف
- (2-1)
- (4-3)
- (6-5)
- (8-7)
- (10-9)
- أكثر من ذلك ، من فضلك حددها ....

أنا موافق/موافقة على تعبئة هذه الاستبانة التي تتعلق بصحتي التوقيع:....................

الباحثة/ هبة محمد عرفات شكرا لكم على حسن تعاونكم

(الفحوصات الإكلينيكية) The clinical tests

The test	**Value**
Length	…….cm
Weight	………kg
Body Mass Index (BMI)	……….
Blood pressure	……….mm Hg

(الفحوصات المخبرية)The laboratory tests

Test Name	**Results**	**Normal Range**
Fasting blood sugar (FBS)		Normal 70-99mg/dl Prediabetes 100-125mg/dl Diabetes ≥ 126mg/dl
T. Cholesterol		Normal <200 mg/dl Borderline High 200-239 mg/dl High >240 mg/dl
Triglyceride (TG)		Desirable <200 mg/dl Borderline High 200-400 mg/dl Elevated >400 mg/dl
HDL-High density lipoprotein		40-80 mg/dl
LDL-low density lipoprotein		Desirable <130 mg/dl Borderline High risk 130-160mg/dl High risk >160 mg/dl
CRP C- Reactive Protein		Up to 5.0 mg/L

Any further tests/comments:

Annex 6: Helsinki Committee Approval Letter

المجلس الفلسطيني للبحث الصحي

Palestinian Health Research Council

تعزيز النظام الصحي الفلسطيني من خلال مأسسة استخدام المعلومات البحثية في صنع القرار

Developing the Palestinian health system through institutionalizing the use of information in decision making

Helsinki Committee

For Ethical Approval

Date: 01/08/2016 **Number:** PHRC/HC/154/16

Name: HEBA M. ARAFAT **الاسم:** هبة محمد عرفات

We would like to inform you that the committee had discussed the proposal of your study about:

نفيدكم علماً بأن اللجنة قد ناقشت مقترح دراستكم حول:

Effect of Rotating Shift on Biomarkers of Metabolic Syndrome and Inflammation among Health Personnel in Gaza Governorate

The committee has decided to approve the above mentioned research. Approval number PHRC/HC/154/16 in its meeting on 01/08/2016

و قد قررت الموافقة على البحث المذكور عاليه بالرقم و التاريخ المذكوران عاليه

Signature

Member Chairman Member

1/8/2016

Genral Conditions:-

1. Valid for 2 years from the date of approval
2. It is necessary to notify the committee of any change in the approved study protocol
3. The committee appreciates receiving a copy of your final research when completed

Specific Conditions:-

E-Mail:pal.phrc@gmail.com

Gaza - Palestine غزة - فلسطين

شارع النصر - مفترق العيون

Annex 7: Al- Quds University Permission

Al-Quds University
Jerusalem
School of Public Health

جامعة القدس
القدس
كلية الصحة العامة

التاريخ 2016/10/1

حضرة الدكتور/ناصر أبو شعبان المحترم
مدير عام تنمية القوى البشرية–وزارة الصحة

تحية طيبة وبعد،،،

الموضوع: مساعدة الطالبة هبه عرفات

نشكر لكم دعمكم الدائم لمسيرة العلم والتعليم خصوصاً دعم كلية الصحة العامة وطلابها، ونود أعلامكم بأن الطالبة المذكورة أعلاه تقوم بإجراء بحث بعنوان:

"Effect of Rotating Shift on Biomarkers of Metabolic Syndrome and Inflammation among health personnel in Gaza Governorate"

كمتطلب للحصول على درجة الماجستير في الصحة العامة–مسار علم الأوبئة، وعليه نرجو التكرم بالموافقة والايعاز لمن يلزم للسماح للطالبة بجمع البيانات الخاصة ببحثها، حيث تشمل عينة العاملين في المجال الصحي (أطباء– تمريض –فني أشعة_ أخصائي تحاليل طبية) بمجمع الشفاء الطبي ومستشفى النصر التابعة لوزارتكم الموقرة.
علماً بأن المعلومات ستكون متوفرة لدى الباحثة والجامعة فقط وسنطلعكم على النتائج في حينها .

و اقبلوا فائق التحية و الاحترام،،،

Hamd

د. بسام أبو حمد
منسق عام برامج الصحة العامة
فرع غزة

College of Public Health – AL-QUDS UNIVERSITY – كلية الصحة العامة

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ص.ب. 51000 القدس

Annex 8: Ministry of health Permission Letter

http://eservices.mtit.gov.ps/manage/index.php/printMsgPg/7802

State of Palestine | **دولة فلسطين**

Ministry of health | وزارة الصحة

التاريخ:05/10/2016

السيد : ناصرالدين رافت مصطفى ابوشعبان حفظه الله
مدير عام بالوزارة/الإدارة العامة لتنمية القوى البشرية - /وزارة الصحة
السلام عليكم ورحمة الله وبركاته ,,,

الموضوع/ تسهيل مهمة باحثة/ هبه عرفات

التفاصيل //

بخصوص الموضوع أعلاه، يرجي تسهيل مهمة الباحثة/ **هبه محمد عرفات**
الملتحقة ببرنامج ماجستير الصحة العامة – مسار علم الأوبئة – جامعة القدس أبوديس في إجراء بحث بعنوان :-

Effect of rotating shift on biomarkers of metabolic syndrome and inflammation among health" personnel in Gaza governorate"

حيث الباحثة بحاجة لتعبئة استبانه وأخذ قياسات الطول والوزن وضغط الدم و عينة دم من عدد من العاملين في المناوبات الليلية بمجمع الشفاء الطبي ومستشفى النصر للأطفال.

نأمل توجيهكم لذوي الاختصاص بضرورة حصول الباحثة على الموافقة المستنيرة من الموظفين الذين هم على استعداد للمشاركة في البحث، ووفق الأسس التي يتم بها التعامل مع عينات الدم وعلى مسئولية الباحثة، وبما لا يتعارض مع مصلحة العمل وضمن أخلاقيات البحث العلمي، و دون تحمل الوزارة أي أعباء أو مسئولية

وتفضلوا بقبول التحية والتقدير ,,,

محمد ابراهيم محمد السرساوي
- مدير دائرة/الإدارة العامة لتنمية القوى البشرية

التحويلات

- محمد ابراهيم محمد السرساوي(مدير دائرة) ← ناصر الدين رافت مصطفى ابوشعبان(مدير عام بالوزارة) إجراءاتكم بالخصوص

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غزة — تلفون. (+970) 8-2846949 — فاكس. (+970) 8-2826295

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Annex 9: List of Expert Names

Dr. Yehia Abed	Associate professor of epidemiology
Dr. Bassam Abu Hamad	Associate professor of human resource management
Prof. Mohammed Shubair	Professor of laboratory medicine
Prof. Mahmoud Sirdah	Professor of blood pathophysiology and molecular genetics
Prof. Yousef El- Jeesh	Professor of public health
Prof. Abdelraouf Elmanama	Professor of microbiology
Dr. Basem Ayesh	Associate professor of medical and molecular genetics
Dr. Mohammed Hamdan	Assistant professor of microbiology
Dr. Abeer Al- Qutati	Assistant professor of clinical chemistry
Dr. Nabeel El- Eaila	Assistant professor of medical and molecular microbiology
Dr. Ahmed Nijim	Assistant professor of nursing
Dr. Saleh Mwafi	Assistant professor of physiology

Annex 10: Sample size of Self-administering questionnaire

	ASH		ANPH	
	Number of healthcare workers	**Sample size**	**Number of healthcare workers**	**Sample size**
Physicians	470	97	55	12
Nurses	680	140	120	25
Others(medical technologists, radiologists, and radiologic technologists)	118	24	31	6
Grand Total	1268	262	206	43

Source: ASH and ANPH reports

Annex 11: AL-Shifa Hospital

Al-Shifa Hospital (ASH) is the biggest governmental health organization in the Gaza Strip. It is considered as a secondary health care delivery organization. The hospital has been established in 1946 on an area of over 45,000 sq. M. ASH is subdivided into three hospitals as surgical hospital, medical hospital and obstetrics and gynecology hospital.

In 2006, the hospital capacity grows to be 590 hospitalization beds, there were 93 daily care beds in the hospital; also, a total number of employees are 1285 represents all categories work in the hospital (Aljeesh & Alkariri, 2010). The hospital offers paramedical services such as laboratory, radiography, pharmacy and physiotherapy, each hospital has its own management team and manager submit to the general director of the hospital. The average occupancy rate at ASH in 2002 was 84,6%, including the occupancy rate of daily care beds, the average length of stay was 3 days (MOH, 2005).

Outpatients is the biggest department in ASH. It includes twenty one sub-clinics related to the medical, surgical and paramedical services like, x-ray department, laboratory minor operations room and admission department. The sub-clinics were distributed over the five days. Its services about 90,00 patients every year (ASH records, 2009).

Annex 12: Al- Nassir Pediatric Hospital

Al- Nassir Pediatric Hospital deals only with children aged 12 years or less. It is located in Gaza and it had been constructed in 1962 for gynecological and obstetric cases but it was changed in 1972 to pediatric hospital.

The hospital developed very much especially after the arrival of Palestinian National Authority in 1994, so as to meet philosophy which is based on delivery of high standard health care to Palestinian children with in the available resources. As we see, the number of beds has increased in addition to improvement of qualification and abilities of the staff in quality and quantity.

Also, subspecialty departments like hematology and oncology department were created to offer treatment for blood diseases and cancer which ultimately lead to substantial decrease in referral of patients to abroad. Intensive care unit and nephrology department deal with the peritoneal dialysis for patients with renal failure.

Great development in both quality and quantity was also observed in laboratory and X-ray departments. A big advance occurred in nursing power as the number of nurses was doubled in addition to achievement in qualification and training and a significant number of nurses have got a master degree in nursing, administration and mental health.

Finally it was a big achievement when ANPH has been recognized as teaching hospital by Egypt, faculty of medicine and paramedical colleges. The fiscal consequences of political developments in Palestine in 2006 have had an impact on the Ministry of Health's budget, and consequently on the delivery of health services and programmes. For instance, they affected its capacity to maintain a stock of pharmaceuticals and consumables and pay salaries to its staff, which has resulted in a prolonged health workers' strike across the West Bank (Mushtaha, 2009).

Abstract in Arabic

تأثير المناوبات الدورية على المؤشرات الحيوية لمتلازمة الأيض و الالتهابات بين العاملين في المجال الصحي–مدينة غزة

إعداد: هبة محمد عرفات

إشراف: د. ناهض اللحام

ملخص الدراسة

إن المناوبات الدورية في العمل تساهم في زيادة خطر الإصابة بمتلازمة الأيض الغذائي وهي متلازمة معقدة تؤدي إلى زيادة الإصابة بأمراض القلب والأوعية الدموية و / أو مرض السكري من النوع الثاني .أجريت هذه الدراسة لمعرفة مدى انتشار" متلازمة الأيض" بين العاملين في المجال الصحي، ودراسة تأثير المناوبات الدورية على عوامل الخطر لمتلازمة الأيض و الالتهابات. أجريت دراسة مقطعية على عينة من " 310" من العاملين في المجال الصحي، بحيث تم مقارنة 100 شخص يعملون صباحاً في الوقت الحالي مع 210 من الأشخاص الذين يأخذون مناوبات دورية؛ حيث تم توزيع استبانة تشمل معلومات عن الديموغرافيا الاجتماعية (الجنس ،العمر ،الحالة الاجتماعية ،الدخل ،الوظيفة والمحافظة) ،التاريخ الطبي، السلوكيات الصحية (التدخين والنشاط البدني)، التاريخ المهني حول العمل والفحص الصحي بما في ذلك القياسات الأنثروبومترية و قياس ضغط الدم الشرياني والفحوصات المخبرية.

ولقد تم استخدام بروتوكول"NCEP ATP (III)" لتشخيص، وتحديد متلازمة الأيض. تم استيفاء المتلازمة إذا كان الفرد لديه ثلاثة أو أكثر من المعايير الآتية: محيط الخصر 102cm> في الرجال، و88cm> في النساء؛ نسبة السكر صائم 110 mg/dl>، ضغط الدم 130/85 mmHg ≤، الدهون الثلاثية في الدم 150 mg/dl≤، الكولسترول الحميد 40mg/dl> في الذكور و 50mg/dl> في الإناث. تم إجراء التحليل الإحصائي باستخدام برنامج SPSS إصدار 20. أظهرت النتائج أن نسبة انتشار متلازمة الأيض بين العاملين في المجال الصحي كانت 8.4٪ (9.0٪ بين العاملين صباحا و 8.1٪ بين العاملين الذين يأخذون مناوبات دورية) دون فرق بين الذكور والإناث و طبيعة المناوبات. وكان العامل الأكثر تغيرا في كثير من الأحيان بين العاملين في المجال الصحي هو ارتفاع نسبة CRP (44.5٪)، يليها ارتفاع مستوى الدهون الثلاثية (35.5%)، ارتفاع مستوى الكوليسترول(24.8%) ، و ارتفاع مؤشر كتلة الجسم (BMI >30) (20.6%). وكانت عوامل الخطر الرئيسية لمتلازمة الأيض بين العاملين في المناوبات الدورية في كلا الجنسين مرتبة تنازليا كالاتي ارتفاع ضغط الدم (OR=59.5; 95% CI, 16.4– 215.8) ، ارتفاع مستوى السكر في الدم (OR=43.9;95% CI, 12.9– 149.1)، ارتفاع نسبة الدهون الثلاثية (OR=42.3;95% CI, 5.5– 326.6) ،السمنة (ارتفاع مؤشر كتلة الجسم> 30) (OR=11.8; 95% CI, 4– 34.6)، وانخفاض مستوى الكولسترول الحميد (OR = 1.6; 95% CI, 0.3– 6.1). من خلال النتائج تبين أن متلازمة الأيض تنتشر بين العاملين في المجال الصحي في قطاع غزة ؛ مع زيادة مطردة في معدل انتشارها مع ازدياد العمر ومؤشر كتلة الجسم، وليس هناك علاقة مباشرة بين المناوبات الدورية و متلازمة الأيض والالتهابات، قد يكون هناك عوامل أخرى مثل العوامل الوراثية، نمط الحياة، والوظيفة نفسها لها تأثير أكبر على حدوث المتلازمة من المناوبات الدورية. و كذلك نحن بحاجة إلى علاج اضطرابات ارتفاع ضغط الدم بين العاملين في المجال الصحي، والحث على عدم إغفال الظروف الصحية لموظفي المستشفيات و أيضا نحن بحاجة إلى اهتمام وزارة الصحة جنبا إلى جنب مع الممارسة الفردية للسلوكيات الصحية لإدارة متلازمة الأيض للوقاية من إمكانية حدوث أمراض القلب والأوعية الدموية عند العاملين في المجال الصحي.

الكلمات المفتاحية: متلازمة الأيض، العاملين صباحا، العاملين في المناوبات الدورية، الالتهابات، وعوامل الخطر.