

**Deanship of Graduate Studies  
Al-Quds University**



**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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*With respect*

*Heba Mohammed Arafat*

## 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  $\geq$ 110mg/dl, blood pressure  $\geq$ 130/85mmHg, serum triglycerides  $\geq$ 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

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

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