Correlation between Waist Circumference (WC) versus Body Mass Index (BMI) and Cardiometabolic Risk Factors in Egyptians

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ABSTRACT

Central obesity, a prominent feature of metabolic syndrome and obesity contributes to premature mortality from all cause of death, including cardiovascular disease (CVD) and cancer, but obesity is not included in standard multi variable risk assessments because of major imperfections in its measurement.

Body Mass Index (BMI) performs poorly as a predictor of death except in very large population cohorts.

The more recent emphasis on assessing central obesity by measuring Waist circumference has been supported by data that suggest superior prediction of CVD.

Key Words:

Metabolic syndrome; obesity**;** Waist circumference; cardiovascular disease; Body Mass Index.

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Contents

LIST OF ABBREVIATION

Apo	**Apolipoprotain.**
ATP III	**Adult Treatment Panel III.**
BMI	**Body Mass Index.**
BP	**Blood pressure.**
CARE	**Cholesterol and recurrent events.**
CHD	**Coronary hreat disease.**
CRP	**C-reactive protein.**
CT	**Computed tomography.**
CVS	**Cardiovascular disease.**
DM	**Diabetes mellitus.**
e NOS	**Endothelial nitric oxide synthase.**
EGIR	**European group for the study of insulin resistance.**
FFA	**Free fatty acid.**
FPG	**Fasting plasma glucose.**
GWA	**Genome-wide association.**
HDL	**High density lipoprotein.**
HF	**Heart failure.**
HFM	**High fat meal.**
HOMA-IR	**Homeostasis model assessment of insulin resistance**
Hs-CRP	**High sensitivity C-reactive protein.**
IAAT	**Intra-abdominal adipose tissue.**
ICAM	**Intracellular adhesion molecule.**
IDF	**International Diabetes Federation.**
IL-6	**Interleukin 6.**
IRS-1	**Insulin resistance substrate-1.**
LDL	**Low density lipoprotein.**
LTT	**Lipid tolerance test.**
LVH	**Left ventricular hypertrophy.**
MI	**Myocardial infarction.**
MRI	**Magnetic resonance imaging.**
m RNA	**Messenger ribonucleic acid.**
MS	**Metabolic syndrome.**
NC	**Neck Circumference**
NCEP	**National Cholesterol Education Program.**
NEFA	**Non esterified fatty acids**
NF K B	**Nuclear factor kappa B.**
NHANES	**National Health and Nutrition Examination Survey.**
PAI-1	**Plasminogen activator inhibitor-1.**
PPL	**Post prandial lipaemia.**
ROS	**Reactive Oxygen Species.**

SAAT	**Subcutaneous abdominal adipose tissue.**
TG	**Triglyceride.**
TNF-alpha	**Tumour necrosis factor-alpha.**
TZD	**Thiazolidinediones.**
VCAM	**Vascular cell adhesion molecule.**
WC	**Waist Circumference.**
WHO	**World Health Organisation**
WHR	**Waist Hip Ratio.**

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INTRODUCTION

Although the metabolic syndrome is a relatively new concept, research into the clustering of individual cardiovascular risk factors is an old concept. In the 1920s, investigators were reporting the occurrence of hyperglycaemia, hypertension, and hyperuricemia in certain groups of individuals. In the 1960s, obesity and hyperlipedemia were added to this cluster (Blaha & Elasy, 2006). Then in 1988, Gerald Reaven systematized the concept of a risk factor syndrome and suggested that insulin resistance and resultant compensatory hyperinsulinemia could explain most of this clustering phenomenon (Reaven, 1988).

The clustering of several cardiovascular disease risk factors and the association of such clustering with insulin resistance led investigators to propose the existence of a distinct entity called "the metabolic syndrome (Alberti & Zimmet, 1998). Environmental factors (such as high fat, energy dense diets; low levels of physical activity in childhood and adulthood; and factors related to poor intrauterine growth also contribute to development of the metabolic syndrome. The genetic predisposition is probably present in about 20-30% of all people (Lawlor et al, 2006). The metabolic syndrome is a collection of frequently associated cardiovascular risk factors that tend to aggregate in selected patient populations and that, together, increase cardiovascular (CVD) mortality.

The term "metabolic syndrome" has been used by various organizations to represent different entities. Some, such as the World Health Organization (WHO), have used this term to indicate a state of insulin resistance with dysmetabolism secondary to the state of insulin resistance (Garber, 2004).

Metabolic syndrome definition

Before the initial publication of WHO definition of the metabolic syndrome in 1998, those describing the prevalence of the metabolic syndrome used their own definitions and measures of a component and their own number and composition of the various components to define the syndrome.

The three most widely recognized attempts to define the metabolic syndrome include the WHO report from 1999, the European Group for the Study of Insulin Resistance (EGIR), also in 1999, and the definition of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults—otherwise known as the Adult Treatment Panel III (ATPIII)—in 2001 and finally the International Diabetes Federation (IDF) definition which was announced in 2005 in Munich.

The followings are details of the various

Definitions: WHO1999 (definition)

The presence of diabetes or impaired fasting glycaemia or impaired glucose tolerance or insulin resistance (under hyperinsulinemic and euglycemic conditions, the glucose uptake is in the lowest 25%) plus two or more of the following:

1- Obesity: body mass index >30 kg/m^2 or waist:hip ratio (WHR) >0.9 (male) or >0.85 (female)

2- Dyslipidemia: triglycerides >150mg/dl(1.7 mmol/L) or HDL cholesterol <36mg/dl(male) (0.9mmol/l) or <40mg/dl(female)(1.0 mmol/L)

3- Hypertension: blood pressure >140/90 mm Hg

4- Microalbuminuria: albumin excretion >20 u,g/min

EGIR 1999 definition

Insulin resistance (defined as hyperinsulinemia, top 25% of fasting insulin values among the nondiabetic population) plus two or more of the following:

1- Central obesity: waist circumference >94 cm (male) or >80 cm (female)
2- Dyslipidemia: triglycerides >176.5mg/dl(2.0 mmol/L) or HDL cholesterol <40mg/dl(1.0mmol/l).
3- Hypertension: blood pressure >140/90 mm Hg and/or medication
4- Fasting plasma glucose >109mg/dl(6.1 mmol/L) but <125mg/dl(7mmol/L) and 2 hours plasma glucose139mg/dl(7.8 mmol/L) but <198mg/dl(11.1mmol/L)

NCEP (ATPIII) 2001 definition

The presence of three or more of the following:

1- Central obesity: waist circumference >102 cm (male) or >88 cm (female)
2- Hypertriglyceridemia: triglycerides >150mg/dl(1.7 mmol/L)
3- Low HDL cholesterol: <40mg/dl(1.0 mmol/L) (male) or<52mg/dl(1.3mmol/L) (female)
4- Hypertension: blood pressure >135/85 mm Hg or medication
5- Fasting plasma glucose >109mg/dl(6.1 mmol/L) (Cameron et al, 2004).

International Diabetes Federation (IDF) definition (2005)

Recently the International Diabetes Federation (IDF) has come up with a new definition. According to its definition, for a person to be defined as having the metabolic syndrome he or she must have:

Central obesity (defined as waist circumference >94cm for Europid man and >80cm for Europid women, with ethnic specific values for other groups)

Plus any two of the following four factors:

- Raised TG levels: >150mg/dL (1.7 mmol/L), or specific treatment for this specific abnormality.

- Reduced HDL cholesterol: < 40mg /dL (1.0 mmol/L) in males and < 50 mg/dL (1.3 mmol/L) in females, or specific treatment for this lipid abnormality.

- Raised blood pressure: systolic BP >130 and/or diastolic >85 mm Hg, or treatment of previously diagnosed hypertension.

-raised fasting plasma glucose (FPG) >100mg/dL (5.6 mmol/L), or previously diagnosed type 2 diabetes.

In south Asian countries (Chinese, Malay and Asian-Indian populations), the IDF defined the central obesity as waist circumference of >90cm for man and >80cm for women.

Table 1 A comparison of some of the most widely used definitions for metabolic syndrome

WHO (1999)	EGIR (1999)	ATPIII (2001)	IDF (2005)
Diabetes, impaired fasting glucose, glucose intolerance or insulin resistance (defined by hyperinsulinaemic, euglycaemic clamp mechanism), plus two or more of the following:	Insulin resistance deemed by fasting insulin values, plus two or more of the following:	Three or more of the following:	Central obesity (ethnic specific values), plus any two of the following:
• BMI >30 kg/m^2, or waist to hip ratio >0.9 (M) or >0.85 (F)	• Central obesity with WC ≥94 cm (M) or ≥80 cm (F)	• WC >102 cm (M), >88 cm (F)	• TG >1.7 mmol/L or on specific treatment
• TG ≥1.7 mmol/L or HDL-C <0.9 (M) or <1.0 mmol/L (F)	• TG >2.0 mmol/L or HDL <1.0 mmol/L	• TG >1.7 mmol/L	• HDL-C <1.03 mmol/L (M), <1.29 mmol/L (F) or on specific treatment
• BP >130/90 mmHg	• BP ≥140/90 mmHg or on antihypertensive medication	• BP ≥135/85 mmHg or antihypertensive medication	• BP ≥130/85 mmHg or on anti-hypertensive treatment
• Albumin excretion >20 µg/min	• FBG ≥6.1 mmol/L	• FPG ≥6.1 mmol/L	• FPG ≥5.6 mmol/L or previously diagnosed type 2 diabetes

BMI: body mass index; BP: blood pressure; F: female; M: male; FPG: fasting plasma glucose; HDL-C: high-density lipoprotein cholesterol; TG: triglycerides; WC: waist circumference.

(S.A. Ritchie, J.M.C. Connell2007)

Table 2 Ethnic-specific values for waist circumference (adapted from the IDF consensus worldwide definition of the metabolic syndrome, available at http://www.idf.org) [5]

Country/Ethnic group		Waist circumference
Europids (in USA, the ATPIII values are likely to be used in clinical practice)	Male	≥94 cm
	Female	≥80 cm
South Asians	Male	≥90 cm
	Female	≥80 cm
Japanese	Male	≥85 cm
	Female	≥90 cm
East Mediterranean and Middle East population	Male	Use European cut-off values until more specific data are available
	Female	

Prevalence of metabolic syndrome

The prevalence of metabolic syndrome varies by definition used , population studied, ethnicity and the environment (Ford & Giles, 2003). In many countries, the prevalence appears to be increasing along with weight, especially in the younger individuals. It is estimated to be around 20-25% of the population (Dunstan et al, 2002). Onset varies from adolescence in the most severe cases to the very elderly.The prevalence was 6.7% among subjects aged 20 to 29 years, peaked at 43.5% among persons aged 60 to 69 years, and was 42% among participants aged 70 years or older.

Significant racial or ethnic differences also were present. Among men, the age-adjusted prevalence was 24.8% among whites, 16.4% among African Americans, 28.3% among Mexican Americans, and 20.9% among other participants. Among women, the age-adjusted prevalence was 22.8% among whites, 25.7% among African Americans, 35.6% among Mexican Americans, and 19.9% among other participants (Eckel & Kraus, 1998).

Applying the prevalence estimates from National Health and Nutrition Examination Survey(NHANES) III to the United States population for the year 2000 suggested that approximately 47 million people in the United States, about 1 in 4 adults (23%) have the metabolic syndrome. If people without diabetes (self-reported diabetes or a fasting plasma glucose concentration >126 mg/dL) were excluded, the age-adjusted prevalence was 20.1% (men, 20%; women, 20.1%) (Ford, 2004).

The prevalence of the metabolic syndrome using the **IDF** criteria was found to be 45.5%; 55.8% in women and 30.0% in men *(P < 0.001),* higher than the rates of 28.7% **(WHO)** and 24.3% **(NECP ATPIII)** using the previous definitions. Using all the definitions, the prevalence was higher in women than in men predominantly because of significant differences in central obesity and high-density lipoprotein (HDL) cholesterol and to a lesser extent, hypertension (Harzallah et al, 2006).