

Validity of Neck Circumference as One of the Indicators of Metabolic Syndrome in Ain Shams University Hospitals

Thesis

*Submitted for Partial Fulfillment of
Master Degree in **Family Medicine***

By:

Rofida Samir Hassan

*Resident of Family Medicine
Department of Family medicine
Faculty of medicine, Ain shams University*

Under Supervision of

Prof. Dr. Diao Marzouk Abd Elhamid

*Head of Family Medicine Department
Professor of Public Health
Faculty of Medicine, Ain Shams University*

Prof. Dr. Wafaa Kamal Eldin Mohammad

*Professor of Internal Medicine
Faculty of Medicine, Ain shams University*

Dr. Ghada Ossama Mohamed Wassif

*Lecturer of Public Health
Faculty of medicine, Ain shams University*

**Faculty of Medicine
Ain Shams University**

2017

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قالوا

سبحانك لا علم لنا
إلا ما علمتنا إنك أنت
العليم العظيم

صدق الله العظيم

سورة البقرة الآية: ٣٢



Acknowledgement

*First of all, all gratitude is due to **God** almighty for blessing this work, until it has reached its end, as a part of his generous help, throughout my life.*

Really I can hardly find the words to express my gratitude to Medicine Department, Professor of Public Health, faculty of medicine, Ain Shams University, for his supervision, continuous help, encouragement throughout this work and tremendous effort he has done in the meticulous revision of the whole work. It is a great honor to work under his guidance and supervision.

*I would like also to express my sincere appreciation and gratitude to **Prof. Dr. Wafaa Kamal Eldin Mohammad** Professor of Internal Medicine, faculty of medicine , Ain Shams University, for his continuous directions and support throughout the whole work,*

*Really I can hardly find the words to express my gratitude to **Dr. Ghada Ossama Mohamed Wassif**, Lecturer of Public Health, Faculty of Medicine, Ain Shams University for his continuous directions and meticulous revision throughout the whole work. I really appreciate their patience and support.*

Last but not least, I dedicate this work to my family, whom without their sincere emotional support, pushing me forward this work would not have ever been completed.



Rofida Samir Hassan

List of Contents

Title	Page No.
List of Abbreviations	1
List of Tables	2
List of Figures.....	5
abstract.....	vi
Introduction.....	1
Goal	6
Review of Literature	
▪ Metabolic Syndrome.....	7
▪ Prediction of Metabolic Syndrome.....	28
▪ Management of Metabolic Syndrome	34
Subjects & Methods.....	43
Results.....	54
Discussion	80
Conclusion.....	93
Recommendations	94
Limitations.....	95
Summary	96
References	102
Appendix.....	124
Arabic Summary	

List of Abbreviations

Abb.	Full term
<i>AACE</i>	<i>American Association of Clinical Endocrinology</i>
<i>ATP III</i>	<i>Adult Treatment Panel III</i>
<i>BMI</i>	<i>Body Mass Index</i>
<i>CHD</i>	<i>Coronary Heart Disease</i>
<i>CKD</i>	<i>Chronic kidney Disease</i>
<i>CRP</i>	<i>C-Reactive Protein</i>
<i>CT</i>	<i>Computed Tomography</i>
<i>CVD</i>	<i>Cardiovascular Disease</i>
<i>EGIR</i>	<i>European Group for the Study of Insulin Resistance</i>
<i>H1</i>	<i>Alternative Hypothesis</i>
<i>IFG</i>	<i>Impaired Fasting Glucose</i>
<i>IGF-1</i>	<i>Insulin-Like Growth Factor-1</i>
<i>IGT</i>	<i>Impaired Glucose Tolerance</i>
<i>MS</i>	<i>Metabolic Syndrome</i>
<i>MUST</i>	<i>Misr University for science and technology</i>
<i>NC</i>	<i>Neck circumference</i>
<i>NCEP</i>	<i>National Cholesterol Education Program</i>
<i>NHANES</i>	<i>National Health and Nutrition Examination Survey</i>
<i>NIH</i>	<i>National Institutes of Health</i>
<i>ROC</i>	<i>Receiver Operating Characteristic</i>
<i>RR</i>	<i>Relative Risk</i>
<i>TLC</i>	<i>Therapeutic Life Style Change</i>
<i>USA</i>	<i>United States of America</i>
<i>WC</i>	<i>Waist Circumference</i>
<i>WHO</i>	<i>World Health Organization</i>
<i>WHR</i>	<i>Waist-Hip Ratio</i>
<i>WHtR</i>	<i>Waist-to-Height ratio</i>

List of Tables

Table No.	Title	Page No.
Table (1):	Metabolic syndrome definitions	11
Table (2):	Position Statement on the metabolic syndrome.....	12
Table (3):	Comparison between cases and controls regarding personal characteristics in males.....	54
Table (4):	Comparison between cases and controls regarding personal characteristics in females	55
Table (5):	Comparison between cases and controls regarding social index score domains in males.....	56
Table (6):	Comparison between cases and controls regarding social index score domain in females	57
Table (7):	Comparison between cases and controls regarding practicing physical exercise and smoking habit in males.....	58
Table (8):	Comparison between cases and controls regarding practicing physical exercise and smoking habits in females.....	59
Table (9):	Comparison between cases and controls regarding family history of chronic disease in males	60
Table (10):	Comparison between cases and controls regarding family history of chronic disease in females.....	61
Table (11):	Comparison between cases and controls regarding present medical history in males.....	62
Table (12):	Comparison between cases and controls regarding present medical history in females	63

List of Tables cont...

Table No.	Title	Page No.
Table (13):	Comparison between cases and controls regarding environmental risk factors in males.....	64
Table (14):	Comparison between cases and controls regarding environmental risk factors in females	65
Table (15):	Comparison between cases and controls regarding results of general examination and anthropometric measures in males	66
Table (16):	Comparison between cases and controls regarding results of general examination and anthropometric measures in females	67
Table (17):	Comparison between cases and controls regarding laboratory investigations in males.....	68
Table (18):	Comparison between cases and controls regarding laboratory investigations in females	69
Table (19):	Comparison between neck circumference measure in different occupations in males cases and controls.....	70
Table (20):	Comparison between neck circumference measure regarding ex smoking in males cases and controls.....	71
Table (21):	Correlation between Duration of physical exercise and Neck Circumference in males.....	72
Table (22):	Correlation between Duration of physical exercise and Neck Circumference in females	73
Table (23):	Correlation between Neck Circumference and Waist Circumference in males.....	74

List of Tables cont...

Table No.	Title	Page No.
Table (24):	Correlation between Neck Circumference and Waist Circumference in females	75
Table (25):	Diagnostic accuracy of neck circumference to differentiate between cases with metabolic syndrome and controls (males).....	76
Table (26):	Diagnostic accuracy of neck circumference to differentiate between cases with metabolic syndrome and controls (females).....	77
Table (27):	Diagnostic accuracy of waist circumference to differentiate between cases with metabolic syndrome and controls (males).....	78
Table (28):	Diagnostic accuracy of waist circumference to differentiate between cases with metabolic syndrome and controls (females).....	79

List of Figures

Fig. No.	Title	Page No.
Fig. (1):	Prevalence of the metabolic syndrome according to different definitions in an Australian non-diabetic population.....	14
Fig. (2):	Showed BMI Classification . <i>Global Database on Body Mass Index</i>	28
Fig. (3):	Measuring waist circumference midway between iliac crest and lowest rib margin.....	30
Fig. (4):	Hip circumference at the level of the greater trochanters	30
Fig. (5):	Measuring neck circumference midway between mid cervical spine, mid anterior neck.....	32
Fig. (6):	Management of the metabolic syndrome	34
Fig. (7):	Correlation between Duration of physical exercise and Neck Circumference in males.....	72
Fig. (8):	Correlation between Duration of physical exercise and Neck Circumference in females	73
Fig. (9):	Correlation between Neck Circumference and Waist Circumference in males	74
Fig. (10):	Correlation between Neck Circumference and Waist Circumference in females	75
Fig. (11):	Diagnostic accuracy of neck circumference to differentiate between cases with metabolic syndrome and controls (males)	76
Fig. (12):	Diagnostic accuracy of neck circumference to differentiate between cases with metabolic syndrome and controls (females).....	77
Fig. (13):	Diagnostic accuracy of waist circumference to differentiate between cases with metabolic syndrome and controls (males)	78
Fig. (14):	Diagnostic accuracy of waist circumference to differentiate between cases with metabolic syndrome and controls (females)	79

Abstract

Validity of Neck Circumference as One of the Indicators of Metabolic Syndrome in Ain Shams University Hospitals

Rofida Samir Hassan, Diao Marzouk Abd Elhamid, Wafaa Kamal Eldin Mohammad, Ghada Ossama Mohamed Wassif.

Family Medicine Department, Faculty of Medicine, Ain Shams University.

Abstract

Background: Metabolic syndrome (MS) is defined as a group of coexisting metabolic risk factors, such as central obesity, lipid disorders, carbohydrate disorders, and hypertension **Objectives:** The study was conducted to determine if neck circumference could be an independent predictor of metabolic syndrome in a sample of Egyptian patients in Ain Shams University hospitals and find out the best cut off point for neck circumference that could be used in future screening of metabolic syndrome **Subjects and methods:** A case control study was carried in Family Medicine clinics on 120 who met inclusion criteria. Subjects were divided into two groups 60 Cases and 60 Controls, A lifestyle questionnaire was given containing questions like personal background, also anthropometric measurements such as weight, height, body mass index (BMI), waist circumference and neck circumference were measured **Results:** There is highly correlation between neck circumference and waist circumference (<0.001), Neck circumference can accurately and significantly differentiate between cases and healthy controls in men with an area under the curve equal 0.976 and the best cut off value for differentiation is 40.5 cm with sensitivity 96.7% and specificity 96.7%, and in females with an area under the curve equal 0.936 and the best cut off value for differentiation is 35.75 cm with sensitivity 96.7% and specificity 83.3%. **Conclusion:** Neck circumference is a simple and alternative tool to screen persons with metabolic syndrome particularly in a primary care setting.

Key words: Neck circumference (NC), Waist circumference (WC), Metabolic syndrome (MS), Obesity, Diabetes mellitus.

Introduction

Metabolic syndrome (MS) is a constellation of metabolic risk factors including central obesity, hypertension, impaired glucose tolerance, diabetes mellitus and dyslipidemia (*Zhou et al., 2013*).

The National cholesterol education program {Third adult treatment panel (ATPIII)} has set criteria for the Diagnosis of metabolic syndrome in 2009 which are: Metabolic syndrome cases should have 3 risk factors of the following (a) blood pressure $>130/85$ or patient on treatment (ttt) for hypertension (b) FBS $>100\text{mg/dl}$ or on treatment of diabetes mellitus (c) Triglyceride $>150\text{mg/dl}$ or on treatment of high triglyceride (d) HDL cholesterol: men $<40\text{mg/dl}$ and Women $<50\text{mg/dl}$ or on treatment for low HDL (e) Men with waist circumference $>102\text{cm}$ and women $>88\text{ cm}$ (*Alberti et al., 2009*).

National Cholesterol Education Program (NCEP) is a program managed by the National Heart, Lung and Blood Institute, a division of the National Institutes of Health. Its goal is to reduce increased cardiovascular disease rates due to hypercholesterolemia (elevated cholesterol levels) in the United States of America. The program has been running since 1985 (*National Institute of Health, 2002*).

A cross-sectional study carried out on representative randomly chosen sample of 3209 subjects (1567 men and 1642

women) aged 18-80 years from urban and rural areas, studied the adult Egyptian population from all Alexandria Districts based on the multistage random technique showed that the prevalence of metabolic syndrome was 42.5% in men, 61% in women according to (ATP III criteria) (*Assaad - Khalil et al., 2015*).

Another study carried by *Ahmed et al., 2014* on 800 obese (BMI >30Kg/m²) college student aged from 18 to 24 years old showed that the prevalence of metabolic syndrome among obese Egyptian college students was (24.37%), Students were recruited from Misr University for science and technology (MUST) university in Cairo. Metabolic syndrome was diagnosed based on ATP III criteria.

The prevalence of metabolic syndrome in the United States (USA) is 34% according to the data compiled by *National Health and Nutrition Examination Survey (NHANES) 1999-2006 (Mozumdar et al., 2011)*.

Currently, the waist circumference (WC) is used to measure central obesity. However, it varies with the phases of respiration and fullness of stomach. Furthermore, there are disparities in the locations used for measuring WC which may produce error in the diagnosis of metabolic syndrome (MS). Deposition of fat around the neck is a unique place that depicts upper body subcutaneous adipose tissue (*Mozaffer et al., 2016*).

The association between neck fat and metabolic syndrome and its components may be attributed to an excess release of free fatty acids into plasma from the upper body subcutaneous fat. High levels of plasma free fatty acids, in turn, have been associated with markers of oxidative stress and insulin resistance, which impact hyperglycemia. It has been suggested that fat in the neck may be more similar to visceral fat, which is more strongly related with cardio metabolic risks compared to subcutaneous fat (*Preis et al., 2010*).

Although studies have shown associations between neck circumference and components of metabolic syndrome, more studies directly comparing neck circumference with other anthropometric measures are needed, as neck circumference is not included in standard guidelines and practices and is not generally included in research studies or clinical assessments, even in situations when waist circumference may not be feasible or meaningful. Neck circumference is rarely evaluated in clinical practice or research, although it is a more practical and likely better measure, which may be especially useful in special populations such as morbidly obese people, patients in bed rest, and pregnant women. Hence more studies are needed in different populations to elucidate the utility of this measurement for assessing obesity and predicting cardio metabolic risk factors (*CDC, 2007*).

The current study was planned to determine if neck circumference could be an independent predictor of metabolic

syndrome in a sample of Egyptian patients in Ain shams university hospitals, we also intended to find out the best cut off point for neck circumference that could be used in future screening of metabolic syndrome. Because of lack of local studies in this regard, we believe this study will add to the current literature, especially in terms of NC cut-off points obtained.

Research hypothesis

Alternative Hypothesis (H1): There is a difference in Neck Circumference between patients with Metabolic Syndrome and Healthy Controls

Null Hypothesis (H0): There is no difference in Neck Circumference between patients with Metabolic Syndrome and Healthy Controls .

Research question

Does the neck circumference contribute to prediction of Metabolic Syndrome in a sample of Egyptian patients in Ain shams university hospitals?