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Original Research Article

THE CORRELATION BETWEEN BODY MASS INDEX (BMI) WITH HYPERCHOLESTEROLEMIA, AND TYPE 2 DIABETES AMONG LIBYANS CITIZENS

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Abstract: Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health.(1) Being overweight or obese is associated with an increased risk for a number of common causes of disease and death including diabetes, cardiovascular disease and some cancers.(2,3) The aim of this study is to describe the correlation between body mass index (BMI) with hypercholesterolemia, and diabetes mellitus type 2, among Libyan citizens. This study watched the development of BMI in 516 female and male patients as well as 117 healthy weight as counterpart, from 15 to 62 years old of age (32.06 ±10.8), randomly selected to take a part in this study. This paper does not cover type 1 diabetes. In this study, plasma cholesterol and type 2 diabetes are closely linked with body mass index (BMI). The risk of diabetes and plasma cholesterol in obese people is greater when compared to those of healthy weight counterpart.

Keywords: cholesterol; age; gender; body mass index; blood sugar.

Introduction: According to the estimates of the World Health Organization (WHO), overweight and obesity are the fifth risk factor for mortality worldwide, causing approximately 2.8 million deaths per year.(4) The prevalence of overweight (BMI between 25 and 30 kg/m^2) and obesity (BMI of ≥30 kg/m^2 or higher) is increasing rapidly worldwide, especially in developing countries.(5)

BMI has been shown to be a significant risk factor for all-cause and cardiovascular mortality. BMI was slightly better than the other two indices ,waist-to-height ratio (WHtR) and waist-to-hip ratio (WHR) for predicting high systolic blood pressure measurement. A high BMI can reflect increases in either fat mass or fat-free mass.(6)

Fats are chemically triglycerides, i.e. esters of glycerol and lower saturated and unsaturated fatty acids and are classified as animal Fats and vegetable fats. Vegetable fats are generally poly unsaturated. Saturated fats tend to elevate plasma cholesterol and make a person prone to various

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diseases. Moreover, elevated blood cholesterol is still an important risk factor for coronary heart disease (CHD).(7) Diabetes and hypertension are the two main causes of Chronic Kidney Disease (CKD). In the United States, for 72.4% of patients who started renal replacement therapy in 2003, diabetes or hypertensive vascular disease was the underlying cause of renal failure.(8)

Material and Methods: This study investigate the correlation between BMI with plasma cholesterol and diabetes type 2 among 516 Libyan patients of various age groups (258 male, and 258 female) from 15 to 62, years old of age (32.06 ±10.8), were seen in the Alwahda hospital in Derna. As well as 117 normal subjects were studied as counterpart at the same aged with mean age of 31.56±9.42 years . The patients and counterpart, have too fast for at least 12 hours before taking the blood sample, the main reason for this is that chylomicron clearance required at least 10 hours. The blood samples were used for the determination of serum blood glucose levels (FBS) and serum blood cholesterol level.

Blood Sample: A venous blood sample was drawn with the subject in sitting position after 12 hours fasting. Three major methods are used to measure blood glucose (chemical and enzymatic method). 1- Fasting Blood Sugar (FBS), 2- The two - hour post prandial venous sample was taking, and 3- Glucose Tolerance Tests (G. T.Ts). Beckman oxygen Electrode was used for glucose analysis to determined the percent of glucose level in blood. Serum blood cholesterol estimated by enzymatic colorimetric test.

A- Tests for Blood Glucose level

1- Fasting Blood sugar (F.B.S)

In this test blood is measured in the fasting state, the serum glucose level gives the best indication of overall glucose homeostasis. Fasting Blood glucose levels greater than 140-150 mg\dl may be considered diagnostic of diabetes mellitus. Serum glucose level of greater than 200 mg\dl also may be pathogenomonic of diabetes mellitus.

2- The two - hour post prandial

Blood glucose is usually performed in the morning 2 hours after the patient has eaten a breakfast containing at
least 100 g carbohydrate.

3- Glucose Tolerance Tests (G. T.Ts)

G.T.Ts are used to evaluate the response to a carbohydrate challenge throughout 3-5 hours period, when glucose load is presented, the normal individuals Blood insulin level will rise in response to it, will peak level occurring 30-60 min. After carbohydrate challenge will return to normal fasting level 2-3 hours later.

B- Tests Serum Blood Cholesterol level

The cholesterol determined after enzymatic hydrolysis and oxidation. The indicator quinoeimine is formed from hydrogen peroxide and 4.aminophenazone in the presence of phenol and peroxidose-

$$\text{cholesterol} + O_2 \xrightarrow{\text{Cholesterol oxidase}} \text{cholest 4 - enone} + H_2O_2$$

$$\mathbf{H_2O_2 + phenol + 4\ aminophenazone} \xrightarrow{\mathbf{peroxidasc}} \mathbf{quinoimine + H_2O}$$

Statistical analysis: Microsoft Office Excel 2007 and The Statistical Package of Social Science (SPSS) version 13.0 under Microsoft of Windows 7 professional®, was used for data analysis and descriptive statistics analysis (mean, median, and standard deviation) were calculated. Correlation coefficient was used to analyze data and significance was set at a≤0.05 ($p \leq 0.05$).

Results and Discussion: Obesity, non-insulin diabetes mellitus, hypertension and cardiovascular diseases are chronic conditions which, with the exception of obesity, usually manifest themselves relatively late in life. In the present study, a hospital based data from

obese patients (BMI > 25 kg/m^2) was collected to know the correlation of BMI with plasma cholesterol and diabetes type 2, also monitored BMI with gender and age groups separately.

It has been observed that the risks of plasma cholesterol, and diabetes type 2 increased with rising body mass index (BMI), as a age group increases(from 15-24 to 25-34 to 34-44 and then to ≥ 45. The results obtained are presented in table 1.

Table 1: Showed the correlation between BMI, Cholesterol, and FBS among male and female patients.

Age (yrs)	Male			Female		
	BMI (kg/m^2)	Cholesterol (mg/dl)	FBS (mg/dl)	BMI (kg/m^2)	Cholesterol (mg/dl)	FBS (mg/dl)
15-24	32.05	267.00	270.05	34.76	267.00	200.00
25-34	33.17	279.00	272.13	36.79	266.83	220.00
35-44	33.30	279.00	317.51	33.05	299.16	312.80
≥ 45	34.6	300.00	580.32	37.72	320.00	320.16
Average	33.28	275.00	360.00	35.58	288.25	163.24

During a 3 month study period, 256 patients who were suspected with overweight conditions were seen in the central hospital in Derna- Libya. 117 normal subjects of the corresponding age groups were studied as counterpart, (BMI < 25 kg/m^2 and the results obtained are presented in table 2. Higher BMI was strongly related to age in both sexes in our population. Plasma cholesterol and diabetes type 2 levels were found to be significantly higher in patients ($p<0.05$) compared with normal control, as showed in tables 1 and 2. Obesity was observed significantly ($p \leq 0.05$) at old of age ≥ 45 years. Among female patients obesity was increased with increasing age. The patients subjects (32.06 ±10.8 years) had significantly higher BMI when compared with other counterpart (31.56±9.42 years). Fasting blood sugar level (FBS), however no statistical significant difference between the male and female except at the age ≥ 45 years showed a positive significant ($p<0.05$) among the male subjects than the female.

Table 2: Showed the correlation between BMI, Cholesterol, and FBS among male and female in counterpart subjects..

Age (yrs)	Male			Female		
	BMI (kg/m^2)	Cholesterol (mg/dl)	FBS (mg/dl)	BMI (kg/m^2)	Cholesterol (mg/dl)	FBS (mg/dl)
15-24	20.10	127.75	94.25	21.20	154.00	103.00
25-34	22.65	182.50	98.75	21.50	145.00	101.25
35-44	22.05	155.00	113.75	22.43	150.16	104.00
≥ 45	21.50	150.00	108.30	22.06	156.60	103.30
Average	21.75	153.81	103.76	21.80	151.44	102.89

In the present study, the association of BMI, and FBS was found to be lower in female than in male. In this study a strong association between BMI and s. cholesterol was observed in male and female when compared with counterpart. This study referred to BMI was better predictor in predicting increased plasma cholesterol and FBS levels both in male and female. A positive association of total fat and waist to height ratio (WHtR) was observed by Pouliot Sc and *et al.* (9) BMI has been shown to be a significant risk factor for all-cause and cardiovascular mortality.(10,11) The previous studies referred that waist circumference (WC),

was the better predictor of the variance of total cholesterol and HDL, while BMI was better only for triglyceride.(12,13) Our results showed BMI was more strongly related to FBS, and serum cholesterol in female. In some studies, waist circumference (WC) (14,15)] and waist-to-hip ratio (16) are better than BMI. Our study agreement with others studies (chan JM et al, Sargeant La et al) referred that BMI is better predictor for type 2 diabetes (17,18) and in others, neither is significantly better.(19) BMI has been shown to be a significant risk factor for cardiovascular mortality, but very large population samples are required to achieve conclusive statistical outcome.

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