European Scientific Journal October 2015 /SPECIAL/ edition Vol.2 ISSN: 1857 – 7881 (Print) e - ISSN 1857- 7431

THE CORRELATION BETWEEN THE METABOLIC DISORDERS IN OBESE MEN AND THE BODY MASS INDEX (BMI)

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Abstract

Background: The influence of body weight on serum lipids and uric acid is often overlooked in clinical practice.

Objective: To study the magnitude of metabolic disorders (dyslipidemia and hyper-urecaemia) in asymptomatic obese men and its relation to body mass index (BMI).

Methods: The study was conducted between September 2013 and July of 2014 at the medical analyses center in the Faculty of Public Health, Lebanese University. The weight, height, BMI, waist circumference (WC) uric acid, and lipid profile of 148 obese males, apparently healthy, compared with 80 males in a control group (BMI < 25 kg / m²), were investigated. Subjects were grouped by BMI and WC in accordance with the National Institutes of Health cutoff points. Within the normal-weight (18.5-24.9), overweight (25.0-29.9), and obese (≥ 30.0) BMI categories, we distributed the results of all the blood tests and we computed the prevalence of dyslipidemia and hyperurecaemia.

Results: The present work revealed that with increasing body weight, the mean total cholesterol, LDL-C, triglycerides(TG), and uric acid increased; while the mean HDL-C decreased. These changes were as follows: the means difference between the first and second group and between the second and the third group were 29 and 31 mg/dl respectively regarding total cholesterol; for TG, these were 47.5 and 53.4 mg/dl; for LDL-C, these were 12 and 29 mg/dl; for HDL-C, these were 3.6 and 3.5 mg/dl; for uric acid, these were 0.3 mg/dl as a common difference, P=0.0245).

Conclusion: Excess body weight is associated with deleterious changes in the lipoprotein profile and uric acid.

Keywords: Metabolic disorders, obesity, Bodi Mass Index

Introduction:

Obesity is an excessive accumulation of energy in the form of body fat which impairs health.The main cause of obesity epidemic is clear: overeating, especially that of foods, which are rich in fats, extracted sugars or refined starches. This combined with decline in physical activity results in an imbalance of intake and expenditure of calories, resulting in excess weight and eventually obesity. Co-morbidities commonly associated with obesity include diabetes,cardiovascular and respiratory disease, dyslipidemia, degenerative joint disease, stress incontinence and some form of tumors and other various diseases. Dyslipidemia is a widely accepted risk factor for coronary artery disease and is an important feature of metabolic syndrome. Obesity especially visceral obesity causes insulin resistance and is associated with dyslipidemia, impaired glucose metabolism, and hypertension all of which exacerbate atherosclerosis. The primary dyslipidemia related to obesity is characterized by increased triglycerides, decreased high density lipoprotein levels and abnormal low density lipoprotein composition. Weight loss and exercise, even if they do not result in normalization of body weight, can improve this dyslipidemia and thus reduce cardiovascular risk. In addition, obese individuals needed to be targeted for intense lipid lowering therapy, when necessary(AK Singh, 2011), (Sharma S. K , 2011)(Misra A, 2008); (Gupta R, 2002), (Gupta R,, 2007)

Obesity is an increasing health issue worldwide and an economical burden, and as the hallmark of the metabolic syndrome the obese state is frequently associated with the development of chronic diseases, including type 2 diabetes (James WP,2008) ,(Wellen KE, 2005) .The association between the epidemics of obesity and diabetes has promoted research on the endocrine link between lipid and glucose homeostasis, demonstrating that adipose tissue is an endocrine organ releasing various adipokines. (SellH,2013).

Metabolic syndrome is defined as a group of coexisting metabolic risk factors, such as central obesity, lipid disorders, carbohydrate disorders, and arterial hypertension (M. Janghorbani,2012), (V. Altabas2012)

Those factors increase the risk of developing cardiovascular diseases of atherosclerotic etiology and diabetes mellitus type 2 ,which are the main cause of premature deaths among most of the European and US population (E.S.Ford, 2004)

Metabolic syndrome is defined as a group of coexisting metabolic risk factors, such as central obesity, lipid disorders, carbohydrate disorders, and arterial hypertension. (According to the 2005 IDF criteria, subsequently revised in 2009, abdominal obesity is identified as the waist circumference of ≥80 cm in women and ≥94 cm in men. It is responsible for the development of insulin resistance. The number of patients with metabolic syndrome increases with age. In the US population, the percentage of such patients above the age of 20 is approximately 23%, while the percentage of such patients above 60 is approximately 40%(M. Shields, 2012).Abdominal obesity is the major disorder constituting a base for the development of metabolic syndrome. BMI is the simplest, most practical, and most widely used system of indexing body weight. It is defined as body weight (in kilograms) divided by the square of body height (in metres).The index divides patients into appropriate categories: underweight, normal weight, overweight, and obese. Even though BMI is commonly used for monitoring the occurrence of obesity in the population, it has numerous limitations. It does not provide any information on the distribution of the adipose tissue in the organism. BMI is a calculated statistical value which does not take into consideration physiological differences in the proportions between the adipose, osseous, and muscular tissues (M. Shields, 2012).Besides, its value is affected by sex,age, constitution, and training. Evidence from the conducted studies has revealed that abdominal obesity (assessed based on the waist circumference) plays a very important role in the development of metabolic disorders and in the assessment of cardiovascular risk. According to the 2005 IDF criteria, subsequently revised in 2009, abdominal obesity is identified as the waist circumference of ≥80 cm in women and ≥94 cm in men. It is responsible for the development of insulin resistance (Marcin Gierach, 2014). Obesity has become an increasing public health problem internationally (Obesity: World Health Organ Tech Rep Ser 2000).Attention has been given to the adverse health consequences of a moderate increase in body mass index (BMI) in different ethnic groups (WHO consultation. 2000); (Kumanyika SK.1993) .Several lines of evidence indicate that the distribution of fat is a major determinant of cardiovascular risk in both normal weight, overweight and moderately obese (Larsson B 1984), Schneider HJ(2010)Australia, Brazil, China, Mauritius and Western Samoa

Overweight and obesity are linked to a host of chronic disorders, including hypertension, hyperlipidemia, diabetes mellitus and osteoarthritis. The prevalence of overweight has been reported to be increasing in varying degrees, not only in the United States, but also in Britain and elsewhere in Europe, as well as in countries as diverse as Australia, Brazil, China, Mauritius and Western Samoa. (KM Flegal, 1998)

Aim of the work:

The aim of the present work was to study the correlation between the level of nutritional obesity represented by the body mass index (BMI) in adult men (18 year and above) and the serum levels for the total cholesterol(TC), triglycerides (TG), low-density lipopolysaccharide cholesterol (LDL-C), high density lipopolysaccharide cholesterol (HDL-C), fasting blood glucose and uric acids.

Material and methods:

The study was done at the department of laboratory in the faculty of public health, Lebanese university.

This study included 248 adult men divided into three groups according to their body mass index.

Group I: 80 normal weight men (BMI < 25 kg/m²) considered as Controls.

Group II: 88 overweight men (BMI between25 and 30 kg/m2).

Group III: 80 obese men (BMI ≥ 30 kg/m2).

Inclusion criteria: Persons above 18 year
Exclusion criteria:

- Persons with endocrine diseases as Cushing's syndrome.
- Persons with diabetes mellitus, or even those with Impaired Fasting Glucose (IFG) according to the classification of the American Diabetes Association (ADA) (fasting glucose 100-125 mg/dl).
- Persons with cardiovascular disease as ischaemic heart disease, hypertension or familial hypercholesterolaemia.
- Persons with renal diseases as Nephrotic syndrome or chronic renal failure.
- Persons with family history of blood lipids disorder, ischaemic heart disease, diabetes, hypertension or obesity.

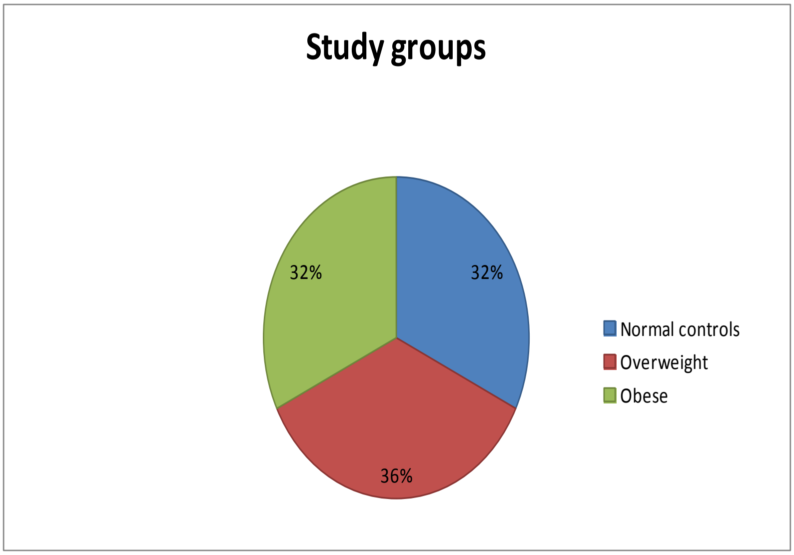

Chart 1: Distribution of the study groups

Venous blood samples were collected from each subject on an empty stomach after a fasting period at least 12 hours and after a rest period of more than 15 minutes. Then each sample is centrifuged to get the patient's serum and the samples were preserved frozen at-20 ° C for a period of less than two months (can be saved at -20 for a maximum term of three months) and then thawed to room temperature directly before the measurement.

Each person had the following measurements: the total cholesterol(TC), triglycerides (TG), low-density lipopolysaccharide cholesterol (LDL-C), high density lipopolysaccharide cholesterol (HDL-C), fasting blood glucose and uric acids.

The standards used in this study are those known universally and are outlined in the following table

Values in mg/dl	Normal	Limit	High
Total Cholesterol	< 200	200-239	≥ 240
LDL-C	< 130	130-159	≥ 160
HDL-C	< 35		
TG	< 160	160-200	> 200

Table 1: recommended world-wide standards according to the NECP

While the uric acid levels were considered high when the serum levels exceeded 6mg/dl.

Also fasting blood glucose were considered high when their level exceeded 126 mg/dl.

After getting the results of chemical analysis, we used statistical analysis software SPSS for the mean and the standard deviation of each of the variables examined in each group.

In addition to that the statistical Grubb' test was used to detect numbers far from mean values (Outliers) so as to exclude them before any statistical test.

A. Results:

The present study revealed the following results:

Table 1:

BMI (kg/m^2)	TC	HDL-C	LDL-C	TG	Uric acid
Normal weight (Mean± SD)	184±40	49.15±10.2	124.88±35	131.86±73	5.54±1
Overweight (Mean± SD)	213.5±45	45.5±9.7	136.5±39.75	179.35±74.6	5.9±1.6
Obese (Mean± SD)	244.27±43.51	41.93±8.7	165.5±33.43	232.75±98.8	6.2±1.34

1.Total cholesterol: Table I shows that the difference between the average values of total cholesterol is about 29 mg/dl higher in group II than group I and this difference is statistically significant ($P < 0.0001$); and 31 mg/dl higher in group III than group II which is also statistically significant difference ($P < 0.0001$).

This indicates that higher weight is associated with high serum level of total cholesterol.

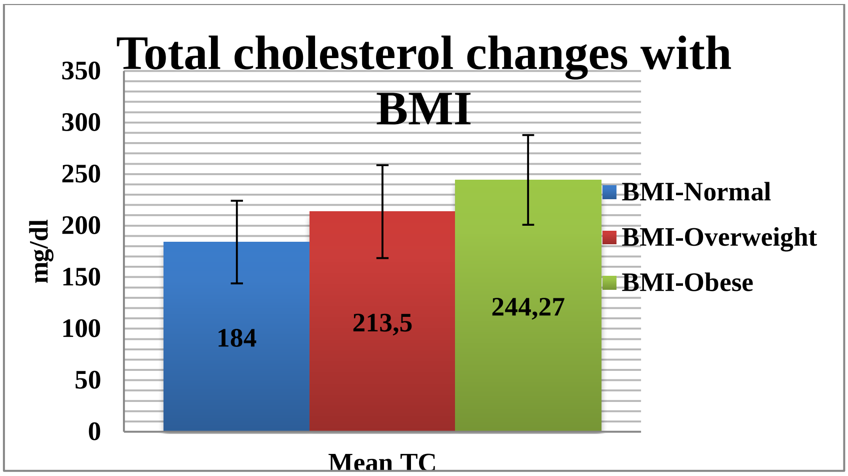

Chart …… : Total cholesterol changes with BMI

Triglycerides: Table I shows that the difference between the average values of triglycerides is about 47.5 mg/dl higher in group II than group I and this difference is statistically significant (P < 0.0001); and 53.4 mg/dl higher in group III than group II which is also statistically significant difference (P < 0.0001). This indicates that higher weight is associated with high serum level of triglycerides.

Comparing the means for trigycerides:

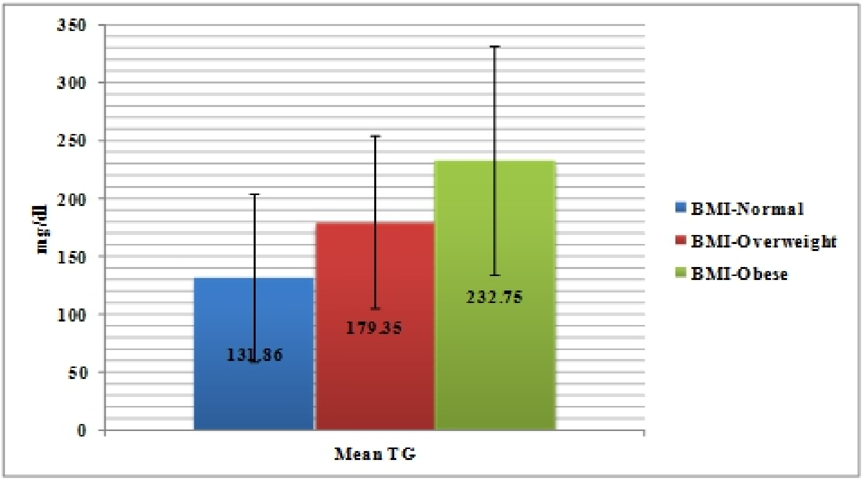

Chart …….: Total TG changes with BMI

3. low-density lipopolysaccharide cholesterol (LDL-C): Table I shows that the difference between the average values of LDL-C is about 11.6 mg/dl higher in group II than group I and this difference is statistically significant (P<0.0469); and and 29 mg/dl higher in group III than group II which is also statistically significant difference (P < 0.0001). This indicates that higher weight is associated with high serum level of LDL-C.

Comparing the means for LDL-C

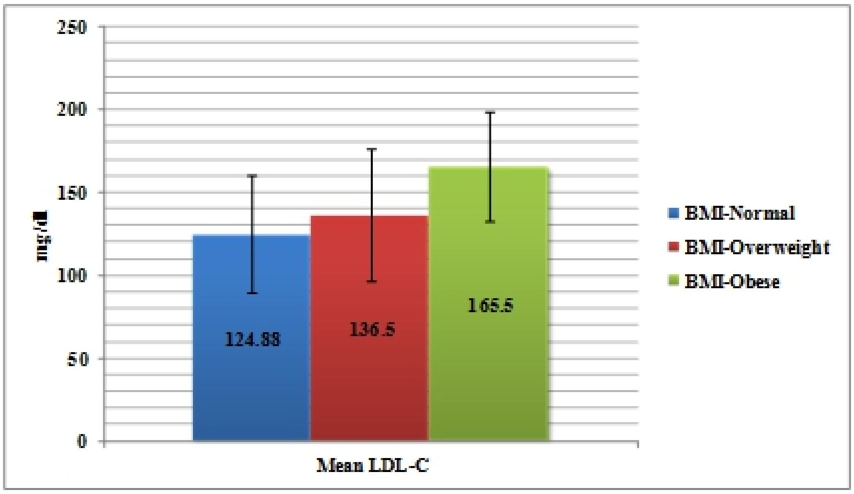

Chart ……… : Total LDL-C changes with BMI

4. High density lipopolysaccharide cholesterol (HDL-C): Table I shows that the difference between the average values of (HDL-C) is about 3.6 mg/dl lower in group II than group I and this difference is statistically significant (P < 0.0168); and 3.5 mg/dl lower in group III than group II which is also statistically significant difference (P < 0.0133). This indicates that higher weight is associated with low serum level of HDL-C.

Comparing the means of HDL-C

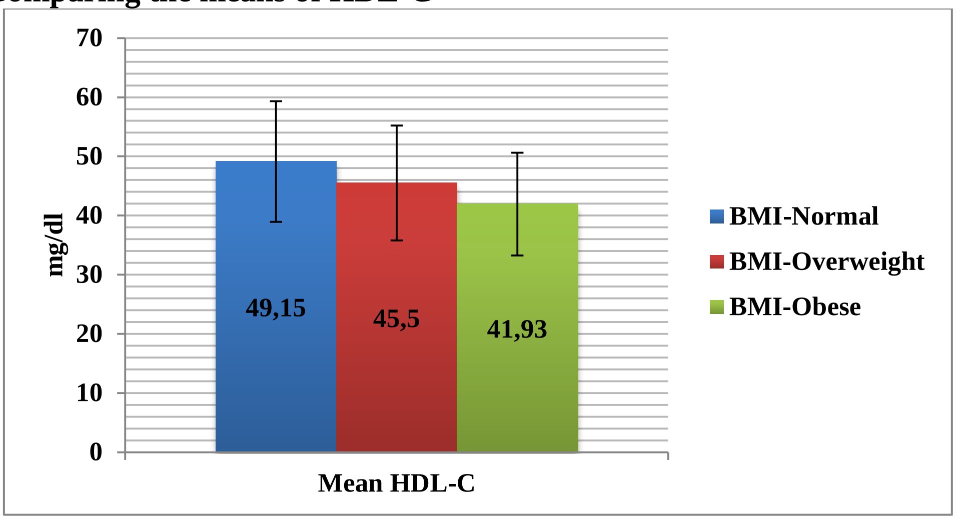

Chart3: Total HDL-C changes with BMI

5. Serum uric acid: Table I shows that the difference between the average values of uric acid is approximately 0.36 mg/dl higher in group II than group I and the difference is not statistically significant ($P < 0.0857$), and 0.3 mg/dl higher in group III than group II which is not also statistically significant (also $P < 0.1919$). This indicates that higher weight is associated with slight increase in the serum level of uric acid, without statistical significance.

Comparing the means for Uric acid

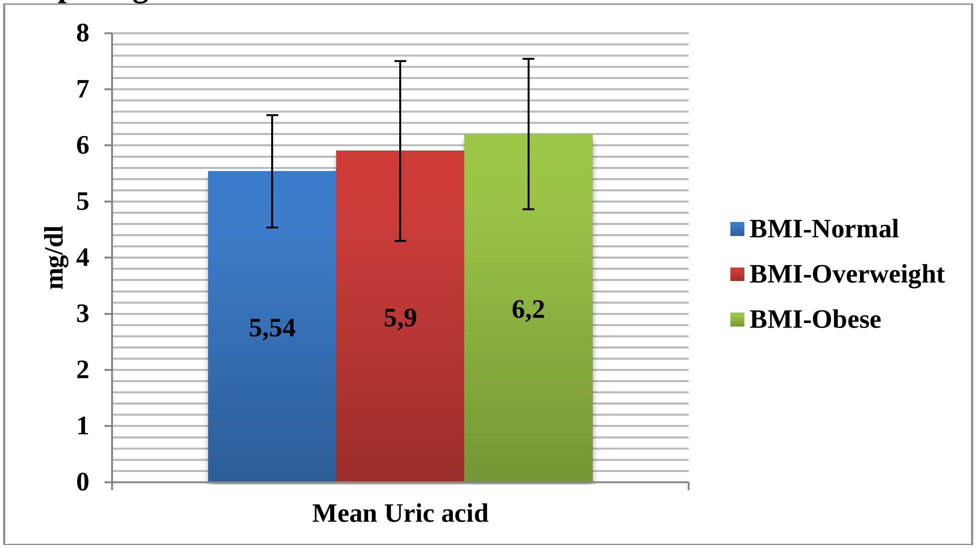

Chart6: Total uric acid changes with BMI

1. Comparison of metabolic disorders prevalence rates between the three groups:

By calculating the prevalence of metabolic disorders seen in obese and overweight men and comparing them with standard weight group (Controls) and placing the results in tables we get the following data:

% of prevalence	Group I Normal weight	Group II Overweight	Group III Obese
Total Cholesterol-High	23.1	25	59.3
Total Cholesterol-Borderline	19.6	38	26.5
LDL-C- High	6.6	21.4	62.5
LDL-C- Borderline	14.7	31	21.8
HDL-C-low	1.25	15.4	29.68
TG High	6.3	31	51.5
Hyperurecaemia	7.5	26.2	37.5

Table3: % of prevalence of metabolic disorders according to the BMI

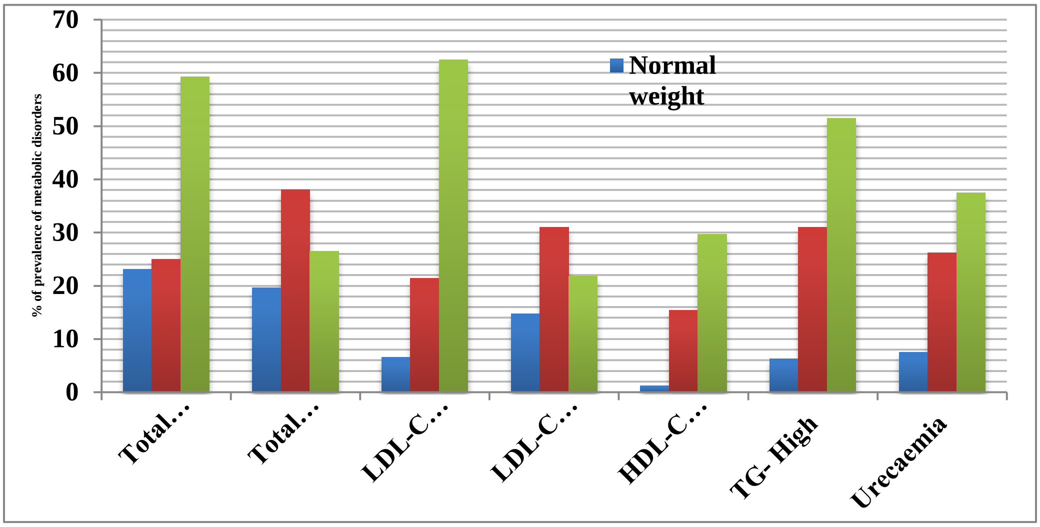

Chart 7: % of prevalence of metabolic disorders according to the BMI

1. This figure shows that the prevalence of metabolic disorders is higher in the overweight and obese group as compared with the control normal weight group.

Studying the correlation between the BMI and each of the studied variables

Correlation coefficient of Pearson was used and the results were as follows

a) Correlation between the BMI and TC

The relation between BMI and TC was linear and positive (r=0.69)

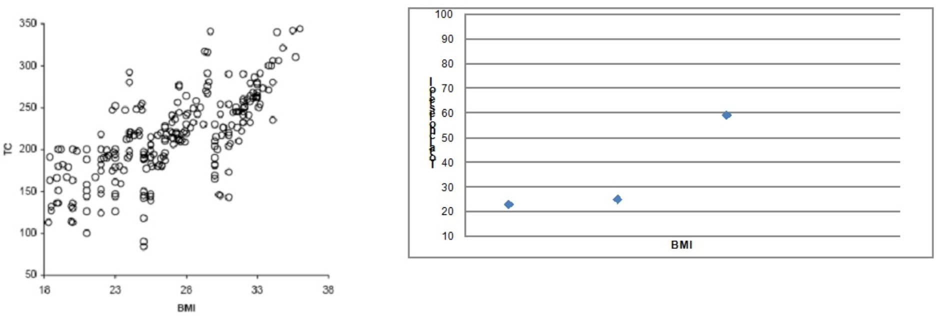

Figure1: Correlation between BMI and total cholesterol

b) Correlation between the BMI and LDL-C

The relation between BMI and LDL-C was linear and positive (r=0.59)

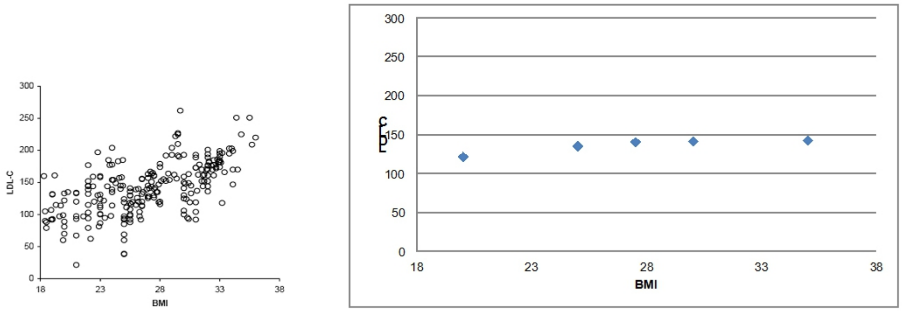

Figure2: Correlation between BMI and LDL-C values

c) Correlation between the BMI and HDL-C

The relation between BMI and HDL-C was linear and negative, but not strong (r=-0.549)

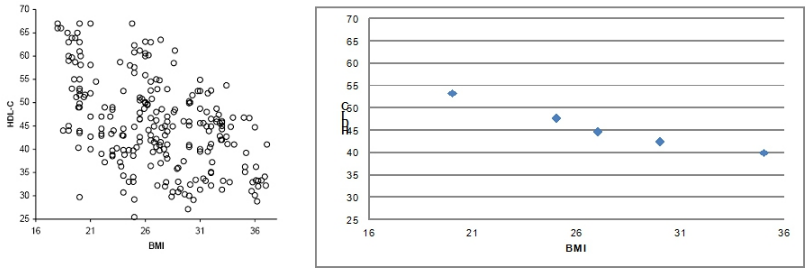

Figure3: Correlation between BMI and HDL-C values

d) <u>Correlation between the BMI and TG</u>

The relation between BMI and TG was linear and positive (r=0.66)

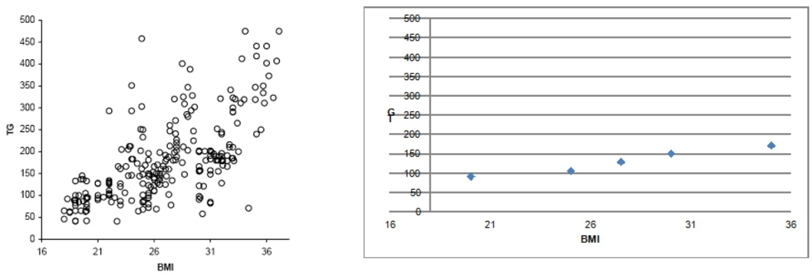

Figure4: Correlation between BMI and TG value

e) Correlation between the BMI and Uric acid

The relation between BMI and Uric acid was linear and weak (r=0.34)

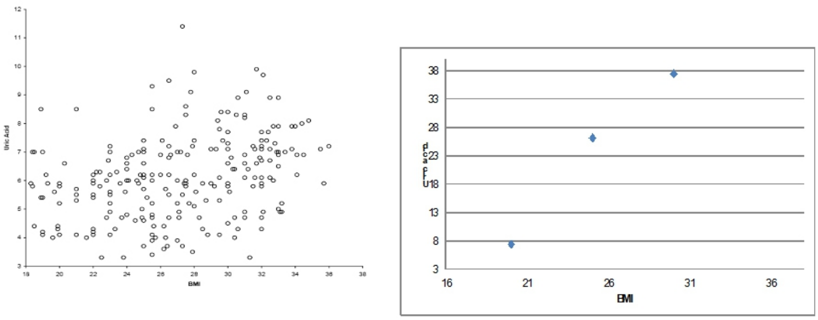

Figure5: Correlation between BMI and uric acid value.

Discussion:

1. Accompanying the increased weight with:
   - higher values for serum levels of total cholesterol, TG, LDL-C lower level values a worshipper of HDL-C.
   - Higher values for serum levels of uric acid level, but the results were not statistically significant.
   - The prevalence of higher serum levels of total cholesterol, TG, LDL-C and uric acid is higher when overweight and obese are compared to controls; and obese is higher compared to overweight. And the frequency of the low level HDL-C was higher when overweight and obese compared with controls, and higher when compared with obese overweight.
2. The relationship between positive function of increasing weight and level of total cholesterol, TG, LDL-C and reverse with the level HDL-C.
3. The relationship between increased weight and level of serum uric acid was positive and weak.

B. Comparative local studies

We did not find any local search is similar to research this and all we found was a search soon for his maysaa al Hamwi 2002 examined where fat and lipoprotein disorders in different types of obesity and its relation to cardiovascular injury frequency. Dr. Hamwi found the existence of a direct correlation between the levels of both TG and LDL-C and BMI; and the existence of an inverse relationship between HDL-C and BMI levels. Note that the study included both genders and family and non-family obesity.

C. Comparative international studies

1. Munster heart study: published by PROCAM (Groupe de reflexion international pour la prevention des maladies coronarienne) in an article entitled. Maladies coronarienne: reduire lerisque.

   The study included 12,231 men classified in 5 groups of BMI (kg/m2) are: 1. BMI ≤ 20. 2- BMI (20.1 – 25). 3- BMI (25.1 – 27.5) 4- BMI (27.6 – 30). 5- BMI > 30. The findings of this study is huge, as follows:

BMI (kg/m^2)	Mean LDL-C (mg/dl)	Mean HDL-C (mg/dl)	Mean TG (mg/dl)
≤ 20	122	53.3	92
20.1-25	136	47.8	106
25.1-27.5	141	44.7	129
27.6-30	142	42.5	151
> 30	143	40	172

   This study showed, in turn, the role and influence of weight measurements of grease and lipoproteins in the blood. This message indicates (because of the large sample studied allowed broader classification for men by BMI) that this impact continues even in ideal weight objects (De forme) and slender objects (Maigre) as evidenced by the results of this study.

2. A study by the National Health and Nutrition Examination Survey and Panel III (NHANES III); 1988-1994 17: body mass index BMI and the prevalence of risk factors in cardiovascular disease.

   Researchers examined the prevalence of high blood cholesterol, high LDL-C, low HDL-C, high triglycerides TG, and its relationship with BMI. The men were classified in four groups as follows: 1. BMI < 25. 2- BMI (25 – 26). 3- BMI(27 – 29). 4- BMI ≤ 30. And the results were as follows:

   - Increased body weight was associated with higher levels of total cholesterol.
   - Increased body weight of BMI ≤ 21 to BMI ≥ 30 was associated with higher serum levels of the TG. (The difference between these levels ranged from 62 to 118 mg/dl).
   - Statistical studies have found that changes in BMI is associated with changes in the level of serum HDL-C, noting that1 unit change in the BMI is associated with

change in level of serum HDL-C with an average of 1.1 mg/dl.

- Studies have also found that the 10 units increase in the BMI is associated with a high rate (between 10 to 20 mg/dl) in the level LDL-C.

3. Research conducted at the University of Texas, United States 5, titled "Excess body weight. An under recognized contributor to high blood cholesterol levels in white American men " to study the influence caused by overweight fat level in the serum lipids. Test results were distributed among the different types of BMI. The study showed that overweight is associated with Deleterious health damaging changes in levels of serum lipoproteins, since the high BMI at all ages is associated with a higher level of the TG, total cholesterol, TG and non-HDL-C; and a lower level of the serum HDL-C

D. Recommendations

-The need to maintain an ideal Body Weight to improve the level of triglycerides and blood lipoproteins in order to be at a lower risk for arterial disease and coronary heart and other diseases that have proved their impact on health and life.

-Encourage people, especially children in the critical stages of their development, to participate more in sports and away from sedentary life style and to avoid weight gain and obesity.

-Impose strict measures on all products with high caloric intake as did United Kingdom UK by imposing higher taxes on these articles.

- Adoption of marginal figures Cutoff Points for serum levels of total cholesterol and LDL-C and HDL-C and other studies by the NECP and the national institutes of health (NIH).

- Raising awareness of citizens about the dangers of obesity through media, seminars and lectures.

-The need for further studies to complement this study deals with the comparison of serum level of leptin in obese and non-obese.

-Complementary studies looking at the impact of reducing body weight on the levels fats and serum lipoproteins.

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