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<td>Author 2</td>
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Is there a correlation between cholesterol profile with body mass index?

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ABSTRACT

Background and objective: It is generally held opinion amongst medical personnel that body overweight is unhealthy; presently, the information available on the effects of Body Mass Index (BMI) and correlation with cholesterol profile, age and sex are limited. The aim of the present study is to investigate the relationship of BMI and its effect on cholesterol profile, age and sex in a Nigerian-based populace. Design: a population survey study was performed on 206 outpatients visiting UNTH Enugu for routine test. The entire cohort comprises 103 male and 103 females aged range 20yrs-77yrs. Patients with hypertension, obesity, other chronic diseases and smokers were excluded from the study. BMI, age, and total cholesterol where measured. The correlations of height and weight, BMI with cholesterol at different ages and sex were determined. Results: it is shown that for sex related differences the variation in weight was generally not significant in males and females (p>0.05) for age related differences variation in male weight at age range 20-64yrs was slightly greater than the males at age range 41-77yrs, with no significance (p>0.05). This also applies to the females at 20-41yrs and 41-77yrs; linear regression models explained up to 5.1% and 6% of BMI variability in man and women. Multiple logistic regression analysis revealed a negative statistically significant (p=0.001) affects modification involving age and BMI on the risk of having greater cholesterol storage in both male and females. We conclude that increase of BMI irrespective of age and sex may be more deleterious in population, in which it is accompanied by other risks factors such as a higher intake of total cholesterol (BD), particularly in females at older age 46-77yrs.

Key words: BMI, cholesterol, age and sex.

INTRODUCTION

Body Mass index (BMI) and cholesterol variation has remained a crucial attribute in physiology and clinical medicine and hydrodynamics. The use of BMI to normalize certain measures of biological functions in individuals of different body sizes is derived from findings that such parameter correlate better with body surface area than with any other index of body size (Luke 1989). Since Rubner (1863) put forward his law over a century ago, it has become established that basal metabolic rate depends on the total BMI. Kleiber (1975) has questioned this relationship; Dunn (1969) has suggested that Lean Body Mass (LBM) is a more appropriate preference than body surface area (A). Never the less, BMI has remained the popular reference for basal metabolic rate measurement. (Heusner 1983). BMI is also widely used in bioelectric unit for normalizing cardiac output, blood volume, renal clearance and vital capacity among others etc. clinically the use of BMI for parenteral fluid and electrolytes have been advocated (Khuri et al 1965), and its use for determination of appropriate drug dosages is increasingly gaining acceptance, especially in anesthesiology (Pinkel 1958). Blood cholesterol concentrations has classically been interpreted in terms of normal ranges defined from measured cholesterol level in normal populations. However, it has long been appreciated that cardiovascular risk is a function of cholesterol concentration and individuals in the upper normal range are at a greater risk than those in the lower normal range. (Igweh and Ucheya 2005). Otokh and Nwoye (2006) in their report on the indices of obesity derived from height.
and weight in a Nigerian adult population, concluded that BMI (W/H²) is the most suitable index derived from height and weight for the assessment of obesity in their study population, and recommended its use in clinical practice and epidemiological studies. In 1998 the adult treatment of the National Cholesterol education program published guidelines for recognizing and treating hypercholesterolemia in adults (Expert panel, 1998); these guidelines include a definition of cholesterol and LDL-cholesterol in terms of cardiovascular risk (Ighwet and Ucheya, 2005). Cholesterol and LDL-cholesterol levels are now grouped in three categories: (a) acceptable risk: total cholesterol < 195 mg/dL (5.15 mmol/L); LDL-cholesterol < 130 mg/dL (3.37 mmol/L); (b) borderline high risk, in which risk is about twofold greater: total cholesterol 195-239 mg/dL (5.15-6.20 mmol/L); LDL-cholesterol 130-159 mg/dL (3.37-4.00 mmol/L); (c) high risk, in which risk is increased three to fourfold: total cholesterol ≥ 240 mg/dL (6.20 mmol/L); LDL-cholesterol ≥ 160 mg/dL (4.16 mmol/L). These cut-offs were established from studies in which the accuracy of cholesterol measurement approximates those made with reference (standard) cholesterol methods. A single set of cut-offs is thus recommended to ensure uniform standards across boards. It must be emphasized that these ranges are applicable in the United States. Cut-offs for Africans is somewhat different since we have a different environment, different feeding habits and different genetic make up. This is according to Luke (1989) in his detailed research work on body surface area of Africans: A study based on direct measurement of Nigerian males. In view of his findings, he advocated that what it would be of interest to re-examine previously reported African data with respect to physiological values that are normalized with respect to surface area. Such an exercise may relate the Western atherogenic lipid pattern reported for Africans (Durren, 1969). He concluded that the use of our data should result in more precise determination of drug regimens for Africans. Garrett (1980) in his heavily referenced work on estimation of body surface area of extremely obese human subjects, concluded that the remarkable changes in shape involving the trunk and the thighs of these individuals is such as to defy the accuracy of any linear formula evolved for the general population.

This present work is based on the fact that for several years research scientists have reported limited works on BMI of Africans and its relation with cardiovascular factors. Most importantly with respect to physiological values that are normalized with respect to BMI of Africans. Thiridy to determine the correlation between BMI; cholesterol, age and sex among Africans using Nigerian based population.

MATERIAL AND METHODS

The study population was 236 normal subjects (105 males and 131 females) age range (20-76 yrs). They were outpatients visiting the University of Nigeria Teaching Hospital (UNCH) Enugu for routine test.

Exclusion criteria

They were those not diagnosed with hypertension and obesity. Patients with other chronic conditions such as diabetes, alcoholism, liver and kidney disease as well as cigarette smoking were excluded from the study. They were requested to stay off medication for five days prior to blood collection.

Measurements: (weight and height)

Body weights in light clothing were measured to the nearest 0.1 kg using an electronic scale. Averages of two readings were taken. Height was measured to the nearest 0.5cm using a flexible tape, according to standardized anthropometric measurement procedures (WHO extract, 1989, WHO extract, 1996).

Body Mass Index was calculated from the formula: weight (kg)/ height (m²).

Overweight/Obese

1. BMI≥25 to 29.9/kgm² for females; BMI: 37 to 39.9/kgm² for males

2. Cholesterol:

Cholesterol measurement

Blood samples were collected by venipuncture before breakfast. The consent of the patient was obtained, and the physician in charge of the clinic supervised blood collection.
Enzymatic colorimetric test (cholecystic method)  
Summary of principles:  
The concentration of cholesterol is measured by hydrolyzing esters in serum into free cholesterol using cholesteryl esterase. The cholesterol product is oxidized by cholesteryl oxidase with simultaneous production of hydrogen peroxide to yield greenish-yellow dye with absorption maximum at 510nm. The amount of color produced is directly proportional to the total cholesterol content of the sample.

Cholesterol esters + H₂O → Cholesterol + Fatty acids  
Cholesterol + H₂O + O₂ → Oxidase → Cholesteryl monoxide + H₂O  
H₂O₂ + 4 Aminoantipyrine + P. Hydroxybenzaldehyde → Peroxidase colored phenomonic Derivative + 4H₂O

Workeing Reagents:  
The content of the buffered enzyme/ chromogen vial was dissolved in water to give the following concentrations:
Phosphate buffer, pH 5.7 0.1Mm  
Phenolhydrazonic acid 10mm  
4-Aminooantipyrine 0.1Mm  
Cholesterol Esterase ≥350mU/ml  
Cholesterol Oxidase ≥1000mU/ml  
Surfactants 1%

Once the buffered enzyme chromogen vial has been dissolved, the reagent solution is stable for 90 days at 3-8 °C and 30 days at room temperature (≤25 °C) when protected from light.

Samples:  
Serum or plasma samples are suitable for 8 days at 2-8 °C and up to 3 months at ≤20 °C

Procedure:  
Blank (B) Sample (S) Standard (G)  
Sample ml ml ml  
Standard - 0.08 -  
Working 2.00 2.00 2.00  
Reagent - - -  

The tubes were well mixed and allowed to stand for 10 mins at room temperature.

Reading:  
Wave length: 546nm  
The color is usually stable for 4hr when protected from sunlight.
Calculations:  
SA (G) x 200  
= Mg of cholesterol/ml  
BA = Sample BT - Standard  
BT units (mg/100ml) x 0.0089 = mmol/l  
SA = Sample BT Standard  
SI units (mg/100ml) x 0.0258 = mmol/l

Main Outcome Measurements:  
1. Cholesterol level  
2. BMI (weight[kg]/height[m])

Using XPBS software in Toshiba 2002 LAPTOP  
Data was analyzed in order to assess correlations between the attributes (Body Mass Index, Cholesterol profile, age and sex).

DISCUSSION:  
It is a general opinion held amongst medical personal that being overweight is unhealthy. Affected people are said to be at increased risk of cholesterol storage, high blood pressure, heart disease, stroke, diabetes among others. Even young adults are at risk of these diseases. BMI, cholesterol variation has remained a crucial attribute in physiology, clinical medicine, hydrometabonics and body modelling. However, this study has endeavored to analyze if there is any existing relationship between BMI, cholesterol profile, age and sex.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Blank (B)</th>
<th>Sample (S)</th>
<th>Standard (G)</th>
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<tbody>
<tr>
<td>Sample</td>
<td>ml</td>
<td>ml</td>
<td>ml</td>
</tr>
<tr>
<td>Standard</td>
<td>-</td>
<td>0.08</td>
<td>-</td>
</tr>
<tr>
<td>Working</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Reagent</td>
<td>-</td>
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Table 1: There was no significant difference in the general mean weight of subjects between both sexes (male and female).

<table>
<thead>
<tr>
<th>Sex</th>
<th>N (n=266)</th>
<th>Mean+S.D</th>
<th>T (P value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>75.76 ± 7.41</td>
<td>-856(P&lt;0.05)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>78.60 ± 7.19</td>
<td>-856(P&lt;0.05)</td>
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</table>
Table 2: There were no significant differences in mean weight of subjects in respect to the age range of either sex.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Mean(S.E) (kg)</th>
<th>T (P value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-45yrs (male)</td>
<td>79.63 ± 7.65</td>
<td>1.24 (P &gt; 0.05)</td>
</tr>
<tr>
<td>46-77yrs (male)</td>
<td>78.05 ± 5.72</td>
<td></td>
</tr>
<tr>
<td>20-45yrs (female)</td>
<td>78.04 ± 8.56</td>
<td>0.98 (P &gt; 0.05)</td>
</tr>
<tr>
<td>46-77yrs (female)</td>
<td>75.30 ± 6.78</td>
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Our results suggested that sex-related differences in weight were generally not significant between males and females (p > 0.05), (Table 2).

For age-related differences in males at age range 20-45yrs, it was slightly greater than in males at age range 46-77yrs; though the difference statistically was of no significance (p > 0.05), (Table 2), this statistical variance was also the same for females at age range 20-45yrs and 46-77yrs. Linear regression models explained up to 61% and 8% of BMI variability in men and women.

In accordance with a documented statement in (www.goggles.bmi calculator), a body mass index between 18 and 25 is considered normal, while a BMI of 18 points lower or higher could also be on the low end of the growth curve of your age or very athletic. Relating this to our present study, we are of the view that apparently majority of Fitzgerald residents within Enugu reutepol do have a normal weight, and obesity is a rare occurrence. This is based on the existing data from the entire cohort studied; the lowest BMI was 18.98 at age 38, height 1.74 m weight 65 kg and total cholesterol 3.8mmol/L while highest weight was 92 kg, height 1.76 m at age 47 with BMI 39.1 and total cholesterol 4.5mmol/L. We therefore suggest that the normality in weight from the cohort studied is apparently due to better standard of living and improved nutrition. Which on the other hand suggest a community penny of undernourishment.

BMI increased variability with age (Table 3). BMI showed significant positive correlation with cholesterol and a variable significant correlation with age and sex (Table 4). Multiple logistic regression analysis revealed a negative statistically significant (p < 0.001) effect modification involving age and BMI on the risk of having higher cholesterol storage in both males and females. This result is in congruity with a report cited, (Kostynta et al 2004).

The variability of correlation between BMI, age, sex and cholesterol at age range (50-65yrs) was the same (Table 5). However, this might be due to the fact that populations within this range participate more in physical activity and this might apparently reduce their BMI accompanied by reduction of other cardiovascular risk factors such as cholesterol profile (Joseph 1961).

Age related variability in correlation with BMI and cholesterol was weaker in males than females.

Table 3: There was a difference in mean variation in the increase of BMI in respect to the age range of subjects in the male and female.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Mean(S.E) (Age)</th>
<th>Mean(S.E) (BMI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-45yrs (male)</td>
<td>37.17 ± 6.2</td>
<td>29.77 ± 2.6</td>
</tr>
<tr>
<td>46-77yrs (male)</td>
<td>52.88 ± 6.9</td>
<td>28.85 ± 1.7</td>
</tr>
<tr>
<td>20-45yrs (female)</td>
<td>37.67 ± 5.22</td>
<td>28.52 ± 2.05</td>
</tr>
<tr>
<td>46-77yrs (female)</td>
<td>46.9 ± 7.02</td>
<td>26.85 ± 1.39</td>
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Table 4: There was a significant correlation between BMI and cholesterol in respect to the age range of both sexes (male and female).

**Correlation between BMI and cholesterol**  
- **20-45yrs**  
  - Males: r = 0.76, p < 0.05  
  - Females: r = 0.69, p < 0.05
- **46-77yrs**  
  - Males: r = 0.46, p < 0.05  
  - Females: r = 0.51, p < 0.05

**Correlation with cholesterol and a variable significant correlation with age and sex (Table 4).**

Multiple logistic regression analysis revealed a negative statistically significant (p < 0.001) effect modification involving age and BMI on the risk of having greater cholesterol storage in both males and females. This result is in agreement with the report cited, (Kostynta et al 2004).

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Age related variability in correlation with BMI and cholesterol was weaker in males than females.
We conclude that increases in BMI irrespective of age and sex may be more deleterious in population in which it is accompanied by other risk factors such as intake of total fat (total cholesterol) and, particularly in females of older age 45-77 yrs.

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