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Evaluation of body mass index and lipid profiles among Joseph Ayo Babalola University students, Ikeji Arakeji, Osun state, Nigeria

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Abstract

The aim of the study was to access the relationship between body mass index and lipid profiles among Joseph Ayo Babalola University Students as a means of evaluating their cardiovascular risk. This was a prospective longitudinal study carried out in Joseph Ayo Babalola University, Ikeji Arakeji, Osun State Students. The study was conducted within a period of 5 months (May– September 2024). A total of 90 students were selected from the recruitment process after consenting to participate in the study. The students recruited were grouped into the following categories: underweight (BMI <18.5 kg/m^2), normal weight (BMI =18.5-24.9 kg/m^2), overweight (BMI=25 – 30 kg/m^2) and obese (BMI >30 kg/m^2) based on BMI standard classification of weight. After categorization of study subjects, blood samples were drawn from the antecubital veins into lithium heparin bottles using standard antiseptic technique and blood pressures were taken using automated blood pressure device. Five millitres (5mls) of fasting blood samples collected from each subject into lithium heparin bottles was spun at 3500 rpm for 5 minutes to obtain plasma. Total cholesterol (TC) and Triglyceride (TG) were assayed based on enzymatic methods. High density lipoprotein (HDL) was assayed using precipitation and enzymatic method while low density lipoprotein (LDL) was calculated using Friedewald equation. The ANOVA results from the comparisons of the mean values of BMI obtained showed significance difference in underweight, normal weight, overweight and obese subjects while the mean values of the lipid parameters and blood pressure were statistically insignificant between the groups. The result of Pearson's correlation showed no relationship positive association of BMI with total cholesterol in the underweight subjects. But there was no association of BMI and lipid profile in the overweight and obese subjects. In conclusion our study subjects are not posed with risk of metabolic disorders.

Keywords: Evaluation; Body Mass Index; Lipid Profile; Classification; Cardiovascular Risk; Underweight; Overweight and Obese.

1. Introduction

Body mass Index (BMI) is the method of utilizing an adult's height and weight to broadly place them into underweight, normal weight, overweight and obese categories (10). Body mass Index (BMI) can be calculated via mathematical operations where height and weight values are used to estimate the health status of a person (11). BMI as a measurement is typically used to gauge the risk of developing chronic conditions such as diabetes, hypertension, depression, and cancer (1). Individuals with abdominal (Visceral) obesity are at a greater risk of acquiring multiple pathological conditions and have a higher morbidity and mortality rate. However, BMI has no way to account for this variable. In the calculation of BMI, height is squared to reduce the contribution of leg length in taller people, as most

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body mass remains within the trunk. Of concern is that with this normalization, the equation distributes equal mass to each height level, which subtracts from the utility of BMI in studies of differing body types (10). Worldwide, among adults, 8.8% of men and 9.7% of women are underweight (Body mass index =BMI 18.5kg/m square) and 10.8% of men and 14.9% of women are obese (BMI greater than 30kg/m square) (NCD, 2024). Factors associated with underweight in adulthood may include male sex, younger or older age, lower socioeconomic status, and rural residence, health risk behaviors such as smoking, and insufficient food intake and fear of being obese. Socio-demographic factors associated with overweight, or obesity include middle aged, female sex, higher socio-economic status, urban residence, and ethnicity (2). Being dietary risk behaviors impacting on obesity include the "consumption of energy-dense foods high in sugars and fats "and insufficient fruit and vegetables intake (12). Hyperlipidemia is abnormally high levels of any or all lipids (e.g. fats, triglycerides, cholesterol, phospholipids) or lipoproteins in the blood. The term hyperlipidemia refers to the laboratory finding itself and is also used as an umbrella term covering any of various acquired or genetic disorders that result in that finding (15). Hyperlipidemia represents a subset of dyslipidemia and a superset of hypercholesterolemia. Lipids (water-insoluble molecules) are transported in a protein capsule. The size of that capsule, or lipoprotein, determines its density (6). The lipoprotein density and type of apolipoproteins it contains determines the fate of the particle and its influence on metabolism. Hyperlipidemias are divided into primary and secondary subtypes. Primary hyperlipidemia is usually due to genetic causes (such as a mutation in a receptor protein), while secondary hyperlipidemia arises due to other underlying causes such as diabetes. Lipid and lipoprotein abnormalities are common in the general population and are regarded as modifiable risk factors for cardiovascular disease due to their influence on atherosclerosis (9). Hyperlipidemias are also classified according to which types of lipids are elevated, that is hypercholesterolemia, hypertriglyceridemia or both in combined hyperlipidemia. Elevated levels of Lipoprotein(a) may also be classified as a form of hyperlipidemia (3).

Cardiovascular diseases (CVDs) are the primary consequence of dietary risks with 7.94 million annual deaths attributed to dietary risks including obesity and overweight (5). People with a Body Mass Index (BMI) of 25.0-29.9 kg/m2 or over have an increased risk of developing hypertension.

In addition, overweight and obesity increase the risk of hypertension, dyslipidemia, and type 2 diabetes (13). Weight loss is also associated with improvements in CVD risk factors and adverse CV events. According to a post-hoc analysis from the look ahead trial, individuals with type 2 diabetes who lost ≥10% body weight had a 21% decrease in 4-point MACE incidence (defined as CV death, non-fatal acute myocardial infarction, non-fatal stroke, or hospitalization for angina). A weight loss of 5% has significant health benefits, and a sustained weight loss of 10–15% or more can further enhance these benefits and provide additional improvements to health. Hypertension is a very common complaint in the general population and leads to an enormous social burden and growing mortality around the word (14). The epidemic of hypertension undoubtedly imposes a challenging burden for a clustering of cardio-metabolic disorders, including cardiovascular disease (CVD), chronic kidney disease, and mortality (4)

Despite numerous studies exploring the relationship between lipid parameters such as Total Cholesterol, Triglycerides, High Density Lipoprotein, Low density Lipoprotein and body mass index, there remains a scarcity of research specifically investigating the body mass index and lipid profile among Joseph Ayo Babalola University, Ikeji Arakeji, Osun State. Hence the purpose of this study is to evaluate the serum lipids and BMI and to identify both normal and abnormal findings of BMI and lipids among Joseph Ayo Babalola University Ikeji Arakeji Osun State.

2. Materials and methods

2.1. Study Area

The research was conducted within Joseph Ayo Babalola University (JABU) located in Ikeji-Arakeji, Osun State, Nigeria. JABU's College of Health Sciences, specifically the Department of Medical Laboratory Sciences. The department's well-equipped laboratory facilities and due to it being a private University had witness different number of restaurants (fast foods) making junk or high calorie foods easily accessible, which therefore facilitated the assessment of lipid profile and measurement of Body Mass index. The study leverages the university's diverse student population to obtain samples representative of various demographics.

2.2. Ethical Approval

Ethical approval was obtained from the College of Health Science Research and Ethical Committee, Joseph Ayo Babalola University, affirming the research's legitimacy and purpose.

2.3. Research Methodology

2.3.1. Criteria for Inclusion and Exclusion

A structured questionnaire was given to all participants to obtain demographic information, medical history, and pattern of lifestyle. Participants included in this study were apparently healthy (asymptomatic) subjects between 18-30 years of age, non-smokers, non-hypertensive, non-diabetic and without any history of chronic disease. Blood pressure was checked using Sphygmomanometer. Participants excluded from this study were subjects below 18 years or above 30 years, smokers, and subjects with history of other chronic diseases like liver and renal diseases were excluded. Also, subjects on lipid lowering drugs or anti-hypertensive drugs or anti-diabetic drugs were also excluded.

2.3.2. Size Determination

The sample size was calculated according to the sample size formula for proportions.

N=X^2*M(1-M)

Z^2

Where; N=required sample size,
X=confidence level interval at 95% (Standard value of 1.96)
M=estimated prevalence of hyperlipidemia variable of interest from literature review (5.5%)
Z= margin of error at 5% (standard value of 0.05)
N= (1.96)2×0.055×(1−0.055)

(0.05)2

N = 3.8416×0.055×0.946

0.0025

N = 0.19967

0.0025

N= 79.9 approximately 80 (Okoye, *et al*., 2011)

2.3.3. Study Categories

A total of 127 participants were recruited in this study of which 80 participants were selected for this study and were divided into three categories as indicated.

2.3.4. Control

This comprised 20 subjects who were apparently healthy and are not on any medications and between the age 18-30 years.

2.3.5. Experimental categories one.

This comprised 30 underweight subjects and are between the age 18-30 years.

2.3.6. Experimental categories two

This include 25 overweight subject and are between the age 18-30 years.

2.3.7. Experimental categories three

This include 5 obese subjects and are between the age 18- 30 years.

3. Results and Discussion

Table 3 Results (Mean ± SD) of Lipid Parameters, BMI, and Blood Pressure of Underweight, Normal, Overweight, and Obese Subjects

Parameter	Underweight (BMI<18.5)	Normal (BMI=18.5-25.5)	Overweight (BMI=26 - 30)	Obese (BMI>30)	F value	P value	Remark
BMI (kg/m^2)	16.72±1.56^a	21.85±2.45^b	27.68±1.15^c	33.94±1.44^d	290.9	<0.0001	S
CHOL (mmol/L)	4.76±2.66	4.95±1.46	4.45±1.29	5.27±1.56	0.389	0.7611	NS
TG (mmol/L)	1.07±0.44	1.29±0.63	1.41±0.76	1.52±0.64	2.051	0.1135	NS
HDL (mmol/L)	1.53±0.65	1.89±0.50	1.49±0.54	1.75±0.62	2.265	0.0875	NS
LDL (mmol/L)	2.73±2.25	2.46±0.94	2.30±0.57	2.81±0.89	0.382	0.7662	NS
Systolic (mmHg)	108.8±10.08	112.5±9.89	116.3±12.58	113.0±4.83	2.086	0.1088	NS
Diastolic (mmHg)	70.63±9.82	73.33±7.61	76.25±15.0	77.0±4.83	1.661	0.1822	NS

PostHoc: BMI: values within same row with different superscripts differ significantly at p<0.05; Keys: BMI=Body Mass Index, CHOL= Cholesterol, TG= Triglyceride, HDL= High Density Lipoprotein, LDL= Low Density Lipoprotein, NS= Not Significant at p<0.05, S=Significant at p<0.05.

Table 4 Comparison of Mean ± SD of BMI, Lipid Profile Parameters, and Blood Pressure between Male and Female Subjects

Parameter	MALE	FEMALE	T value	P value	Remark
BMI (kg/m^2)	20.81±4.22	22.72±6.32	0.7278	0.4689	NS
CHOL (mmol/L)	4.23±0.79	4.91±2.06	0.7937	0.4298	NS
TG (mmol/L)	1.55±0.9354	1.27±0.61	1.036	0.3035	NS
HDL (mmol/L)	1.55±0.46	1.68±0.61	0.4943	0.6225	NS
LDL (mmol/L)	2.05±0.44	2.64±1.61	0.8872	0.3777	NS
Systolic (mmHg)	121.7±14.72	111.2±9.57	2.461	0.0161	S
Diastolic (mmHg)	76.67±8.17	73.24±10.35	0.7888	0.4326	NS

Keys: BMI=Body Mass Index, CHOL= Cholesterol, TG= Triglyceride, HDL= High Density Lipoprotein, LDL= Low Density Lipoprotein, NS= Not Significant at p<0.05, S=Significant at p<0.05.

Table 5 Correlation (Pearson's) indicating Associations of BMI, Lipid Profile Parameters and Blood Pressure in Underweight Subjects

Parameters	Systolic (mmHg)	Diastolic (mmHg)	BMI (kg/m^2)	CHOL (mmol/L)	TG (mmol/L)	HDL (mmol/L)	LDL (mmol/L)
BMI (kg/m^2)	r=0.0401 p=0.827	r=0.315 p=0.078	r=1.00 p=0.00				
CHOL (mmol/0L)	r= -0.426 p=0.015	r= -0.195 p=0.002	r=0.175 p=0.003	r=1.00 p=0.00			
TG (mmol/L)	r= -0.01 p=0.954	r=0.202 p=0.266	r=0.123 p=0.501	r=-0.184 p=0.311	r=1.00 p=0.00		

HDL (mmol/L)	r=-0.191 p=0.293	r=-0.178 p=0.327	r=0.322 p=0.072	r=0.768 p=0.0002	r=-0.101 p=0.582	r=1.00 p=0.00	
LDL (mmol/L)	r= -0.44 p=0.011	r=-0.180 p=0.322	r=0.108 p=0.552	r=0.973 p=0.0003	r=-0.300 p=0.09	r=0.628 p=0.0001	r=1.00 p=0.00
Systolic (mmHg)	r=1.00 p=0.00						
Diastolic (mmHg)	r=-0.038 p=0.83	r=1.00 p=0.00					

Keys: BMI=Body Mass Index, CHOL= Cholesterol, TG= Triglyceride, HDL= High Density Lipoprotein, LDL= Low Density Lipoprotein, r=correlation *coefficient, p=Probability value of occurrence at less than 0.05 CI. Bold figures: Significant correlations or Association.*

Table 6 Correlation (Pearson's) indicating Associations of BMI, Lipid Profile Parameters, and Blood Pressure in Overweight Subjects

Parameters	**Systolic (mmHg)**	**Diastolic (mmHg)**	**BMI (kg/m²)**	**CHOL (mmol/L)**	**TG (mmol/L)**	**HDL (mmol/L)**	**LDL (mmol/L)**
BMI (kg/m²)	r=0.044 p=0.869	r=0.153 p=0.570	r=1.00 p=0.00				
CHOL (mmol/L)	r=0.409 p=0.110	r=0.393 p=0.131	r=- 0. 422 p=0.979	r=1.00 p=0.00			
TG (mmol/L)	r=0.019 p=0.945	r=0.269 p=0.313	r=- 0.256 p=0.337	r=0.705 p=0.002	r=1.00 p=0.00		
HDL (mmol/L)	r=0.496 p=0.053	r=0.405 p=0.119	r=0.075 p=0.780	r=0.969 p=0.0006	r=0.653 p=0.0060	r=1.00 p=1.00	
LDL (mmol/L)	r=0.424 p=0.105	r=0.307 p=0.245	r=0.060 p=0.827	r=0.891 p=0.00003	r=0.356 p=0.170	r=0.821 p=0.0009	r=1.00 p=0.01
Systolic (mmHg)	r=1.00 p=0.00						
Diastolic (mmHg)	r=1.00 p=0.102	r=1.00 p=0.00					

Keys: BMI=Body Mass Index, CHOL= Cholesterol, TG= Triglyceride, HDL= High Density Lipoprotein, LDL= Low Density Lipoprotein, r=correlation coefficient, p=Probability value of occurrence at less than 0.05 CI. **Bold figures: Significant correlations or Association.**

Table 7 Correlation (Pearson's) indicating Associations of BMI, Lipid Profile Parameters and Blood Pressure in Obese Subjects

Parameters	**Systolic (mmHg)**	**Diastolic (mmHg)**	**BMI (kg/m²)**	**CHOL (mmol/L)**	**TG (mmol/L)**	**HDL (mmol/L)**	**LDL (mmol/L)**
BMI (kg/m²)	r=-0.037 p=0.918	r=0.168 p=0.641	r=1.00 p=0.00				
CHOL (mmol/L)	r=0.327 p=0.358	r=-0.212 p=0.555	r=- 0.191 p=0.597	r=1.00 p=0.00			
TG (mmol/L)	r=0.418 p=0.228	r=-0.040 p=0.910	r=- 0.016	r=0.552 p=0.097	r=1.00 p=0.00		

			p=0.964				
HDL (mmol/L)	r=0.316 p=0.376	r=-0.121 p=0.738	r=-0.247 p=0.490	**r=0.938** **p=0.000056**	r=0.622 p=0.054	r=1.00 p=0.00	
LDL (mmol/L)	r=0.239 p=0.508	r=-0.253 p=0.479	r=-0.192 p=0.594	**r=0.917** **p=0.000182**	r=0.235 p=0.512	**r=0.749** **p=0.0125**	r=1.00 p=0.00
Systolic (mmHg)	r=1.00 p=0.00						
Diastolic (mmHg)	r=0.285 p=0.418	r=1.00 p=0.00					

Keys: BMI=Body Mass Index, CHOL= Cholesterol, TG= Triglyceride, HDL= High Density Lipoprotein, LDL= Low Density Lipoprotein, r=correlation coefficient, p=Probability value of occurrence at less than 0.05 CI. **Bold figures: Significant correlations or Association.**

In our study, we also focused on association of the different parameters in the underweight, overweight, and obese subjects. In the underweight, BMI was positively associated cholesterol was positively associated with total cholesterol. And total cholesterol was positively associated with HDL and LDL but negatively associated with systolic and diastolic pressure. There was no associated between BMI and LDL and with HDL. LDL was correlated with HDL and negatively associated with systolic pressure. When we compared our study with study similar studies, our finding was contrary to Hussain *et al.* (2019), and Ibioku and Jossy (2018) study. Ibioku and Jossy (2018), reported no correlations between the lipid parameters with BMI. In the overweight subjects, there was no association between BMI and lipid profile. Total cholesterol was associated with HDL, LDL and TG. We found positive association too between LDL and HDL. While in the obese subjects, we found no association between BMI and the lipid profile. Cholesterol was positively associated with LDL and HDL. And LDL was positively associated with HDL.

4. Conclusion

In conclusion, there was no statistical difference in lipid profile between the underweight, normal weight, overweight and obese. Similarly, no statistical difference in BMI, lipid profile was found between male and female subjects in comparison. Furthermore, there existed positive association of BMI with total cholesterol in the underweight subjects. But there was no association of BMI and lipid profile in the overweight and obese subjects. Our study subjects are not posed with risk of factors of metabolic disorders.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of ethical approval

Ethical approval was obtained from the College of Health Science Research and Ethical Committee, Joseph Ayo Babalola University, affirming the research's legitimacy and purpose.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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