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PREVALENCE OF PREHYPERTENSION AND ASSESSMENT OF CARDIOVASCULAR FUNCTION AMONG PREHYPERTENSIVE UNDERGRADUATE STUDENTS IN NNEWI, ANAMBRA STATE, NIGERIA.

***Obiorah M.O.[1], Ogbodo E.C.[1], Amah U.K.[1], Ezeugwunne I.P.[1,2], Analike R.A.[1,3], Onah C.E.[3], Okwara J.E.[1], Egbe J.U.[1], Oha P.C.[1], Ajulu, C.A.[1] Ugwu, M.C.[1], Meludu, S.C.[1,2].**

[1]Department of Medical Laboratory Science, Nnamdi Azikiwe University, Nnewi Campus; [2]Department of Human Biochemistry, Nnamdi Azikiwe University, Nnewi Campus; [3]Department of Chemical Pathology, Nnamdi Azikiwe University Teaching Hospital, Nnewi.
*Corresponding author: justunique122@gmail.com

ABSTRACT

This study investigated the prevalence of prehypertension and cardiovascular function in prehypertensive students of the College of Health Sciences, Okofia, Nnewi, Nigeria. A total of 210 apparently healthy respondents aged 18-28, were recruited for the initial screening. Their blood pressure readings and body mass index (BMI) were obtained, whereas 5mls of blood sample was collected from 18 prehypertensive and 19 normotensive subjects. Lipid profile was assayed using enzymatic method, while serum magnesium was analyzed using Xylidyl blue method. Results showed a comparatively low prehypertensive prevalence rate of 11.4%, with higher percentage in males (12.12%) than in females (10.81%). The mean values of BMI, SBP and DBP in prehypertensives (26.3±4.8, 126.7±5.8mmHg, 79.6±6.6mmHg) were significantly higher compared with values in normotensives (21.3±2.4, 107.7±9.1mmHg, 69.5±7.4mmHg) respectively ($P<0.05$). However, there was no significant difference in age of prehypertensives and normotensives (24.2±2.3 vs 24.0±2.2; $P>0.05$). HDL cholesterol and Mg were lower in prehypertensives (1.19±0.11mmol/l vs 1.27±0.11mmol/l; 1.60±0.65mmol/l vs 2.11±0.53mmol/l; $P<0.05$) respectively; but no significant difference in TG, TC and LDL between the groups ($P>0.05$). Importantly this preliminary study did show that TC, TG, and LDL still remained normal and this may be due to the age of the subject.

Key Words: Hypertension, Prehypertension, Cardiovascular Disease, Lipid Profile, Magnesium.

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INTRODUCTION

The prevalence of hypertension and cardiovascular disease is rapidly increasing in developing countries. This is likely related to changing lifestyle and increase longevity. The estimate shows that cardiovascular diseases have led to 1.59 million deaths in India by year 2000 and this number is projected to increase in future (Gaffar *et al.,* 2004). Hypertension affects nearly 26 percent of the adult population worldwide (Kearney *et al.,* 2005). It is an independent predictor for cardiovascular diseases, cerebrovascular diseases and death.

The seventh report of joint national committee on prevention, detection, evaluation, and treatment of blood pressure (JNC 7) defines hypertension as blood pressure greater than 140/90 mmHg (Chobanian, 2003). Persons with blood pressure above optimal levels, but not clinical hypertension, are defined as having "prehypertension". Prehypertension is defined by JNC 7 report as systolic blood pressure (SBP) ranging between 120 to 139 mmHg and/or diastolic blood pressure (DBP) ranging between 80-89 mmHg (Miller *et al.,* 2004). This range was earlier classified as high normal blood pressure. Classifying this range as prehypertension has placed many people who were earlier considered normal under this high risk category. Persons with prehypertension have a greater risk of developing hypertension than do those with lower blood pressure levels (Greenlund *et al.,* 2004). In addition, prehypertension itself is a risk factor for

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major cardiovascular events, independent of the other cardiovascular risk factors (Lizka *et al.,* 2005).

Dyslipidemia also increases the rate of macrovascular complications (atherosclerosis) (NCEP, 2002; Gaede *et al*., 2003). Studies have shown increased level of dyslipidemia in patients with hypertension as compared to normal subjects (Nan *et al.,* 2007). Increase level of blood lipids signify the increased cardiovascular risk in patients suffering from prehypertension. Studies also suggest that prehypertensives are more likely to progress to hypertension as compared to subjects with normal BP, therefore early detection of this derangement and early interventions may arrest the progression of prehypertension to hypertension and prevent complications in individuals suffering from prehypertension. This present study was undertaken to assess the lipid profile in prehypertensives and compare it with that of normal subjects and to study the correlation of blood pressure with lipid profile.

Magnesium affects blood pressure by modulating vascular tone and reactivity. It acts as a calcium channel antagonist, stimulates production of vasodilator prostacyclins and nitric oxide and alters vascular responses to vasoactive agonists. Magnesium deficiency has been implicated in the pathogenesis of hypertension with epidemiological and experimental studies demonstrating an inverse correlation between blood pressure and serum magnesium levels (Bruno *et al.,* 2006). The assessment of magnesium in prehypertensives will help one know its level.

Reports from the third National Health and Nutrition Examination Survey (NHANES III; 1999–2000) in the USA showed that the prevalence of prehypertension is 31% with no apparent difference noted in persons of different race/ethnicity (Wang *et al.,* 2004). Women were less likely to have prehypertension than men (23% vs. 40%). In the same study, individuals aged more than 60 years of age were less likely to have prehypertension than younger individuals (24% vs. 34%), probably because the majority of individuals in the older age group (65%) have progressed to clinical hypertension (Wang and Wang, 2004). Like hypertension, prehypertension tends to cluster with other metabolic risk factors such as dyslipidemia and obesity; hence, predisposing affected individuals to the higher risk of cardiovascular diseases. Only a few studies have addressed the magnitude of prehypertension and factors associated with it in Nigerian adults. One of such studies was carried out among adults in the community (Isezuo *et al.,* 2011) and the other, among treated diabetic patients in an out patient clinic (Nwankwo *et al.,* 2007) both in Northern Nigeria. Other studies on prehypertension focused mainly on the adolescents (Ujunwa *et al.,* 2013). Lipid profile is a panel of blood tests that serves as an initial broad medical screening tool for abnormalities in lipids, such as cholesterol and triglycerides. The lipid profile typically includes: Low density lipoprotein (LDL), High density lipoprotein (HDL), Triglycerides, Total cholesterol, Very low density lipoprotein (NCEP, 2002).

Surprisingly, we do not know the magnitude of prehypertension among adults in our environment and its determinants/association but according to the research conducted in adolescents in Enugu, the prevalence of prehypertension was 17.3% while the prevalence amongst males and females were 14.3% and 20.1% respectively. Hence this study investigates the Prevalence of Prehypertension and Assessment of cardiovasular function among prehypertensive students of the College of Health Sciences, Nnamdi Azikiwe University, Nnewi, Anambra State, Nigeria.

MATERIALS AND METHODS

Study Area: Nnamdi Azikiwe University, Okofia-Otolo, Nnewi campus comprises the college of Health Sciences having the faculties of Basic Medical Sciences, Health Sciences and Technology and Medicine. It is located in the suburb of Nnewi - a popular town in Anambra State Nigeria. The environment is poorly developed and lacking basic amenities such as housing, road, communication, electricity and potable water compared to campuses located in urban areas.

Study Design: A total of 210 apparently healthy student respondents aged 18-28 were recruited for the initial screening. Their blood pressure readings and body mass index were obtained, whereas 5mls of blood sample was collected from 18 prehypertensive and 19 normotensive subjects. Lipid profile (HDL, LDL, TC and TG) were assayed using enzymatic method, while serum magnesium was analysed using Xylidyl blue method as described by Haeckel, 1981; Miller et al., 2002; McGowan, 1983; Rifal and Warnick, 1994 and Barbour and Davison, (1988) respectively.

Ethical Consideration: Ethical approval was obtained from the Faculty of Health Sciences and Technology ethical committee, Nnamdi Azikiwe University, Nnewi campus, Anambra State, Nigeria for sample collection.

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Inclusion criteria and Exclusion criteria: Apparently healthy subjects aged 18-28 years who consented to the study and had no obvious clinical conditions were recruited for the study. Subjects younger than 18years or older than 28years old who were acutely or chronically ill-looking and known hypertensive were excluded from this study.

Statistical analysis: Statistical package for social science (SPSS) version 20 was employed in the analysis of the result. The results for anthropometric parameters and lipid parameters and Magnesium were expressed as mean± standard deviation and compared between the prehypertensives and normotensives using student's t- test. Level of significance was set at $p<0.05$.

Table 1: Demographics of the participants

Group	Total Number (210)	Frequency (N)	Percentage (%)
Normotensives	210	186	88.47
Male of Tp	210	99	47.14
Female of Tp	210	111	52.86
Male of PH	99	12	12.12
Female of PH	111	12	10.81
Male of NH	186	87	46.77
Female of NH	186	99	53.23
Aw of PH amongst TP	210	93	44.28
Not aware of PH amongst TP	210	117	55.71
FH of Hx amongst PH	24	15	62.50
FH of Hx amongst TP	210	75	35.71
Illness amongst PH	24	1	4.17
Alcohol and Cigrette Smoker in PH	24	5	20.83
Non-alcohol and Cigrette Smokers in PH	24	19	79.17

RESULTS

Among 210 study respondents, 186 (88.6%) had normal blood pressure while 24(11.4%) were found to be prehypertensive. 99 (47%) of the total subjects were males while 111(53%) were females. Among the 99 male subjects, 12% were prehypertensive while among the 111 females, 11% were prehypertensive. Hence, there were higher cases of prehypertension among males than in females. Also among 186 of the non-prehypertensives, 87 (46.8%) of male and 99 (53.2%) of females were non-prehypertensives. Among the total subjects, 75 (35.7%) had a family history of hypertension, while 93 (44.2%) were aware of the condition Prehypertension and 117 (55.7%) were not aware of the condition. Amongst 24 prehypertensives 15 (62.5%) had family history of hypertension. Also excessive alcohol intake and cigarette smoking is associated with 21% (5) of the prehypertensives while 19 (79%) were not associated with this.

Table 1 show that the mean values of BMI (26.31±4.76, 21.60±2.44) SBP (126.67±5.76, 107.68±9.09) and DBP (79.56±6.57, 69.52±7.39) were significantly increased in prehypertensives compared to normotensives subjects respectively. However, there were no significant difference in

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AGE (24.22±2.38, 24.0±2.22) between the prehypertensives and normotensives.

In table 2, there was mean significant difference between HDL (1.19±0.11) and Mg (1.60±0.65) in prehypertensives as compare to HDL (1.27±0.11) and Mg (2.11±0.53) of normotensive subjects with p-values < 0.05. However, there were no significant differences in TG, TC and LDL between the two groups with p- value > 0.05 although there was slight difference in their mean values.

Table 3, showed significant association in Wt vs Ht, Wt vs BMI, Wt vs SBP, Wt vs DBP, BMI vs SBP, BMI vs DBP, SBP vs DBP P<0.05 amongst the study population.
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In table 4, there was statistically significant association in TC vs TG, TC vs HDL, TC vs LDL, TG vs HDL, TG vs LDL parameters amongst the total population with p<0.05.

In table 5, there was a significant relationship in the Wt vs BMI, Age vs BMI, BMI vs SBP, BMI vs DBP, SBP vs TC, SBP vs TG, TC vs TG, TC vs HDL, TC vs LDL, TG vs LDL with P<0.05 and no significant association between TG vs Mg, SBP vs Mg with P>0.05 amongst prehypertensives while in normotensives there was significant association between TC vs TG, TC vs HDL, TC vs HDL, TG vs HDL, TG vs LDL with P<0.05 and no significant association TG vs Mg P>0.05.

Table 2: Anthropometric parameters of prehypertensive and normotensive subjects (Mean±SD)

Variables	Prehypertension (n = 18)	Normotension (n= 19)	t- value	p-value
Age	24.22±2.38	24.0±2.22	0.29	.770
BMI	26.31±4.76	21.31±2.44	3.84	.001*
SBP	126.67±4.76	107.68±9.09	7.53	.000*
DBP	79.56±6.57	69.52±7.39	4.35	.000*

*Statistically significant p-values at < 0.05. (Mean±SD)

Table 3: lipid profile and magnesium of prehypertensives and normotensives.

Variables	Prehypertensives (n=18)	Normotensives (n=19)	t-value	P-value
TC	4.68±0.49	4.32±0.68	1.774	.085
TG	0.91±0.39	1.01±0.28	0.860	.396
HDL	1.19±0.11	1.27±0.11	2.127	.041*
LDl	2.74±0.39	2.53±0.49	1.379	.177
Mg	1.60±0.65	2.11±0.53	2.499	.018*

* Statistically significant P-values at <0.05 level of significance (Mean±SD)

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Table 4: Correlation of anthropometric parameters among total population Total population

Variables	r-value	p-value
Wt vs Ht	.481	.003*
Wt vs BMI	.895	.000*
Wt vs SBP	.439	.007*
Wt vs DBP	.550	.000*
BMI vs SBP	.390	.017*
BMI vs DBP	.579	.000*
SBP vs DBP	.679	.000*

*Statistically significant P-values at <0.05 level of significance

Table 5: Correlation of lipid parameters amongst total population

Variable	Total population	
	r-value	p-value
TC vs TG.	.679	.000*
TC vs HDL	.877	.000*
TC vs LDL	.777	.000*
TG vs HDL	.490	.003*
TG vs LDL	.624	.000*

* Statistically significant P-values at <0.05 level of significance

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Table 6: correlations of different parameters amongst prehypertension and Normotension

	Prehypertension		Normotension	
Variables	**r - value**	**p-value**	**r - value**	**P-value**
Wt vs Ht	.447	.063	.490	.033*
Wt vs BMI	.853	.000*	.844	.000*
Age vs BMI	.559	.016*	-.249	.303
BMI vs SBP	-.503	.033*	.410	.081
BMI vs DBP	.494	.037*	.270	.264
SBP vs TC	-.499	.049*	.086	.727
SBP vs TG	-.615	.011*	.082	.738
SBP vs MG	.193	.473	.268	.267
TC vs TG	.825	.000*	.791	.000*
TC vs HDL	.845	.000*	.891	.000*
TC vs LDL	.818	.000*	.737	.000*
TG vs HDL	.582	.018*	.604	.006*
TG vs LDL	.690	.003*	.735	.000*
TG vs MG	.106	.695	.074	.765
Wt vs Ht	.447	.063	.490	.033*

DISCUSSION

This study investigated the prevalence of pre-hypertension and assessment of cardiovascular function in pre-hypertensive students in College of Health Sciences, Okofia, Nnewi. This population (apparently healthy individuals) were specifically studied because prehypertension is not a disease condition but it can predispose one to hypertension if lifestyle is not modified. The prevalence of prehypertension in the study population was 11.4% with the male and female prevalence rates of 12.1% and 10.8% respectively. The observed prevalence of prehypertension was lower contrary to the findings by Ujunwa *et al* (2013) who reported a prevalence of 17.3% among adolescents in secondary schools in Enugu, South-east Nigeria. Also, a prevalence rate of 45.5% was reported in Umuahia, southeast Nigeria (Chimezie *et al.,*2015) and a study of prehypertension among US adults according to the new joint national committee reported a prevalence of 60% (Wang *et al*., 2004). This lower prevalence is probably because of the rural setting and lifestyle where the college is located. Since urbanization is an independent predictor of elevated blood pressure (Kevin *et al., 2014*), the high prevalence reported by these authors can be due to adaptation to westernization and the daily stressful lifestyle peculiar to those living in urban communities.

The prevalence of hypertension in this study was higher in males (12.12%) than in female (10.81%). This difference in the observed prevalence may probably be due to the role of male androgen (testosterone). Men are generally at greater risk for cardiovascular and renal diseases than age-matched post-pubertal and premenopausal women (Jane, 2001; Kumar *et al*., 2014). This elevated blood pressure may also be a result of response to stress hormones since young males are found to be more active in their daily activities, involving themselves in strenuous activities and manual labour which could also contribute to the development of prehypertension. Only 44.28% of the study participants were aware of the condition "Prehypertension", while 62.50% of the prehypertensives were aware. This entails that more awareness should be created and the study population sensitized about this condition so as to enable early lifestyle modifications and proper management in the appropriate cases. This way, prehypertensive individuals will be prevented from progressing to full blown hypertension. The presence of a family history of hypertension was seen in 62.50% of the prehypertensive subjects. This affirms the report that family history of hypertension is a risk factor for

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prehypertension (Archana and Kailash, 2015; Ujunwa *et al*., 2013).

The anthropometric variables were shown to correlate positively with age, SBP, DBP and BMI, and this is consistent with the report of several authors (Akinkugbe et al., 1999; Ejike et al., 2008; Jaddou et al., 2001). The implication of this increase in blood pressure with age is that it may continue into adult stage hence further increasing the prevalence of hypertension in the adult group with its attendant morbidity, disability and mortality. This group of individuals in the prehypertensive range are those who might become hypertensive later in life if adequate lifestyle modifications such as weight reduction and lifestyle modifications are not instituted since about 54% of the prehypertensive students are either Overweight (33.33%) or obese (20.8%) as observed from their BMI. Body weight, an important determinant of body mass index, also increases with age in the study population. An increased body weight is directly proportional to an increased body mass index, systolic and diastolic blood pressure. This means that as the weight of an individual increases, it is inevitable that the BMI will increase. An increase in BMI will in turn bring about more circulation of fats in the blood, the accumulation of "bad fats" mainly cholesterol in the blood vessels forming plaque which occludes the blood vessels. Hence, more force will be exerted in the pumping of blood to the heart causing a subsequent increase in the systolic and diastolic blood pressure. This increased BMI in prehypertensives is consistent with the findings of other researches that BMI is a strong predictor of prehypertension (Ishikawa *et al*., 2008).

In the result there was no significant difference in the TG, TC and LDL levels between the prehypertensives and normotensives and this is contrary to the studies by Pongwecharak *et al.* (2010) *and* Ray *et al.* (2011) that reported a significant difference in lipid profile between prehypertension and normotensives in a study done on 767 healthy military personnel. However, there was a significant difference in HDL level between the Prehypertensives and normotensives in the study. The insignificant difference in the TG, TC and LDL and significant difference may be as a result of the age, the kind of diet and life style of the present population and this limits their risk of developing coronary heart disease.

There was significant difference in magnesium concentration between prehypertensives and normotensives and this agrees with the study conducted by (Rodriguez-Ramirez *et al.,* 2015) that individuals with prehypertension exhibited lower magnesium levels than individuals without prehypertension.

CONCLUSION

The prevalence of prehypertension in this study population was 11.4% which demonstrated a low prevalence of prehypertension amongst students of College of Health of Sciences Okofia, Nnewi, Anambra State compared to the study by Ujunwa *et al* in 2013 that showed prevalence rate of 17.33% among adolescents in secondary schools in Enugu, South-east Nigeria. Also, a prevalence rate of 45.5% was reported in Umuahia, southeast Nigeria (Chimezie *et al.,* 2015). A low awareness of prehypertension was observed; also majority of the prehypertensives had a family history of prehypertension affirming the fact that family history is a risk factor of prehypertension. BMI and blood pressure was elevated or higher in prehypertensive compared to normotensives.

HDL is the good lipoprotein that transports cholesterol out of the cell and Mg functions by modulating vascular tone was lower in prehypertensives and since its low predisposes them to coronary heart disease and increasing evident indicates that low magnesium may play a pathophysiological role in the development of hypertension. Importantly this preliminary study did show that TC, TG, and LDL still remained normal and this may be due to the age of the subject. The insignificant difference of these parameters may be due to age, social and economic status of the subjects in the present study. That is why timely diagnosis and life style modification is required in prehypertensives.

RECOMMENDATION

It is recommended that periodic screening and monitoring of blood pressure of adolescents and post-

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pubertal individuals should be embarked on while general public health education and awareness on prehypertension and its associated risk factors should be strengthened to keep the population informed. The dietary recommendation to increase consumption of major food sources containing magnesium, copper, chromium and zinc such as green leafy vegetables, whole grains, nuts and fruits so as to help reduce lipid profile and increase magnesium content which helps infighting hypertension. Exercise should be encouraged to reduce the body mass index (BMI) and also avoidance of sedentary life style is necessary.

LIMITATIONS

The results of this study should be interpreted with caution because of some limitation. The diagnosis of prehypertension on the study population was for the first time. Blood pressure measurements were taken twice on a single day without follow up repeated for practical reasons. Hence, we may have over-diagnosed prehypertension and this might not truly represent prehypertensive status.

Some of the prehypertensives did not consent to the collection of their blood sample hence; fewer samples were analyzed biochemically, representing the prehypertensive population.

The timing of feeding of the participants were not controlled in this study and this could affect the biochemical analysis of lipid profile and magnesium of the subjects.

Again, amongst the total population of 210, 18 prehypertensive blood samples were collected and 19 controls were used due to financial constraints.

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AUTHORS' CONTRIBUTIONS

All authors (Obiorah M.O, Ogbodo E.C, Amah U.K, Ezeugwunne I.P, Analike R.A, Onah C.E, Okwara J.E, Egbe J.U, Oha P.C, Ajulu C.A, Ugwu M.C, Meludu S.C.) contributed to the completion of this research work and were actively involved in the presentation of this manuscript.

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