Blood Sugar and Blood Pressure Levels and their Relationship with Dietary Diversity among Undergraduates in Ebonyi State

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ABSTRACT

Background: *Hypertension is an extremely common co-morbidity of diabetes, affecting 20–60% of individuals with diabetes.*

Objective: *The aim was to determine the blood sugar and blood pressure levels and evaluate their relationship with dietary diversity among undergraduates of Alex-Ekwueme Federal University Ndufu-Alike, Ebonyi State.*

Methodology: *A cross-sectional descriptive study was conducted among 200 students (69 males and 131 females) across the 11 faculties of the institution. A pre-tested semi-structured interviewer-administered questionnaire was used to collect data on socio-demographic profile, anthropometric measurements and 24-hr dietary recall. Blood sugar levels were determined using Accu-chek multi-monitoring system, blood pressure was determined using sphygmomanometer. Dietary diversity was determined using 14 food groups. Statistical Package for Social Science (SPSS) version 23 was used to analyze all data at 5% level ($P < 0.05$).*

Results: *The mean age, height, weight and body mass index (BMI) were 22±2.47 years, 1.7 ± 0.08m, 66.3±8.44kg and 19.8±2.38 kg/m^2 respectively. The mean blood sugar and mean blood systolic pressure were142 ±13.66mg/dl and 150.37 ±7.34mmHg respectively. Mean Dietary Diversity score was 5.66±1.29. Glucose level has a positive correlation with dietary diversity score ($r = 0.166$, $p = <0.05$). About 82.0% had average dietary diversity tercile (DDT), 18.0% had low DDT.*

Conclusion and recommendations: *Mean blood sugar and mean blood pressure were high, mean dietary diversity score was low. Regular measurement of blood pressure and blood sugar for early detection and prevention is advocated*

Keywords: Blood sugar, Blood pressure, Dietary diversity, Undergraduates

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INTRODUCTION

Diabetes mellitus (DM) and hypertension are global health conditions affecting millions of people with many victims unaware that they have the sickness (1). Diabetes Mellitus occurs because the body cannot produce any or sufficient of the hormone insulin or use insulin efficiently (2, 3). It is a disorder in which the patient blood sugar level is high either because insulin production is insufficient or the body cells do not respond properly to insulin or both. The International Diabetes Federation (IDF) in their study in Nigeria reported that up to 3.9 million Nigerians between the ages of 20 -79 years had diabetes (4). In Nigeria, studies by several authors (5-7) reported prevalence of DM in adolescents to be 4.0%, 9.4%

and 5.5%, 8.9% respectively. Adolescents and young adults with youth-onset diabetes may experience complications such as kidney disease, retinopathy, and peripheral neuropathy after <10 years diabetes duration (8). Comorbidities such as hypertension in youths and young adults with diabetes increase the risk for cardiovascular disease and diabetes-related complications in adulthood (8).

Hypertension is a chronic non-communicable disease that affects people of all age groups, sex and socio-economic classes (9, 10). Hypertension is defined as a systolic blood pressure of ≥140mmHg and /or a diastolic blood pressure of ≥ 90mmHg, it is a global health problem with higher prevalence among certain ethnic/racial groups (11). Hypertension was earlier considered to be rare among young people (12). However, with the increasing reports of hypertension in children all over the world including Africa, this view has changed (13).

In Sub-Saharan Africa, the prevalence of hypertension in teenagers ranges from 0.2 to 24.8% (14) while prevalence studies of hypertension in teenagers and children in Nigeria reported increase from between 11-20% to 40% (15), and from 0.1% to 17.5% (16). However, in earlier studies, ranges of 1.9% in Lagos (13) to 4.8% in Oyo (17) have been reported in Southern Nigeria while in Northern Nigeria, zero prevalence was reported in Zaria (18) and 7.3% in Kano (19). The increase in prevalence of hypertension in teenagers and children is bad because the condition can damage the heart, or the brain leading to stroke, heart failure, systemic or pulmonary failure due to the presence of combination of some risk factors such as: tobacco use, unhealthy diet and obesity. Hypertension in children and young adults requires adequate attention because raised blood pressure in youth can lead to hypertension during adulthood, thus making blood pressure in youth a useful predictor of essential hypertension in adulthood (20).

There is paucity of studies among undergraduates on DM and hypertension in Nigeria and the few studies that have been among students in post-primary schools in Nigeria on DM and hypertension showed poor knowledge of the diseases (21-23). Information on the prevalence of DM and hypertension is a crucial part of primary prevention of these two diseases. It is therefore pertinent to assess the prevalence of DM and hypertension among undergraduate students in Ebonyi state and the relationship between diabetes and Dietary Diversity scores, to enable the government formulate both preventive and intervention policy

METHOD

Study Location: The study was carried out in Alex Ekwueme Federal University, Ndufu Alike Ikwo (AEFUNAI), Ebonyi State. The institution is located in Ikwo Local Government Area of Ebonyi State which is about 25 kilometers from the State capital, Abakaliki. The university has eleven faculties with students' population of 9,500 students.

Study design: This was a descriptive cross-sectional study to access the sugar level and blood pressure of students of Alex Ekwueme Federal University, Ndufu Alike, Ikwo Local Government of Ebonyi State.

Study Population: Participants were male and female undergraduates of Alex Ekwueme Federal University, Ndufu-Alike Ikwo, Ebonyi State.

Sample selection: The total number of students in each faculty was determined and the proportion of students to be selected in each of the faculty relative to the total number of students was calculated. Random sampling method was used to select the required number of participants from each faculty. A total of 200 students (69 males and 131 females) were randomly selected from the different faculties for the study.

Inclusion criteria: All males and female undergraduate students' of AEFUNA across the eleven faculties who were full time undergraduates students were included except those that were pregnant and post graduate students.

Ethical Approval/Informed Consent: Ethical clearance with reference number FUNAI/SEN/EBC/17/VOL1/7 was given by Alex Ekwueme Federal University Ndufu- Alike Ethics Committee. The purpose of the study was explained to the students who gave their consent and also dully filled the informed consent forms. Participants (students) were informed of their freedom to withdraw or refuse to take part in the study without prejudice.

Data Collection: A semi-structured interviewer-administered questionnaire was designed and pre-tested to collect information used for this study. The questionnaire had four sections which included:

a. Socio-Demographic, Economic and Personal Data: This was used to collect personal information which included the respondent's sex, age, ethnic group, department, faculty and monthly allowance, expenditure, religion etc

b. Anthropometric Measurements: The height of participants was measured in meters using

standiometer and reading taken to the nearest 0.1m. Weights of the participants were measured to the nearest 0.1kg using a portable bathroom scale (Hana bathroom scale). Each participant was made to stand erect on the scale with light clothing and without shoes. The scale reading was zeroed after each measurement. Body mass index (BMI) of participants was calculated using the formula;

$$BMI = \frac{\text{Weight (kg)}}{\text{Height}^2\ (m^2)}$$

The BMI calculated was compared with (24). The BMI was classified as follows:

Underweight: < 18.5 Kg/m^2,
Normal: 18.5 - 24.9 Kg/m^2,
Overweight: 25- 29.9 Kg/m^2,
Obesity: 30 and above Kg/m^2

c. Biochemical and physiological measurement

Blood Glucose Measurement: Blood glucose level was measured using accu-chek glucometer by random blood sugar (RBS) method. An accu-chek glucometre with a measuring range 100-600mg/dl (0.6-33.3 mmol/L). Accu-chek active test strip was inserted into the glucometer with the appropriate code chip and the glucometer automatically turned on. A cotton wool was used to apply methylated spirit on the individual's fingertip (usually the third finger) to sterilize the area. Soft clix lancing device was prepared for pricking the fingertip and a small drop of blood was applied on the middle of the green colored square on the test strip after a dropping sign was displayed on the glucometer. The glucometer measured and displayed the level of glucose in the individual's blood which was recorded. The values obtained were classified according to WHO standards (25): Normal 60-99 mg/dL, Pre-diabetes 100-125 mg/dL, Diabetes 126 mg/dL and above

d. Blood Pressure measurement: The blood pressure of participants' was measured using OMRON HEM-7202-E (V) Sphygmomanometers while observing standard protocol (26). The mean of two readings taken at least 5 min apart was determined. Prehypertension was defined as Systolic Blood Pressure (SBP) between 120 mmHg-139 mmHg, or Diastolic Blood Pressure (DBP) between 80 mmHg-89 mmHg and Hypertension was defined as SBP ≥ 140 mmHg and DBP of ≥ 90 mmHg.

e. Dietary Assessment and Measurement of Dietary Diversity Score: A 24-hour dietary recall section of the questionnaire was used to obtain information on the subjects' food intake. Participants were asked to recall all foods and beverages taken in the previous twenty-four hours prior to the interview specifying the volume/size, place taken and time, price of food if purchased. Using information obtained from a 24-hour dietary recall, the dietary diversity was assessed based on the number of food groups consumed over the immediate past 24-hours. A maximum of fourteen food groups was used in assessing the dietary diversity of subjects (27). A point was awarded to each food group consumed over the reference period, and the sum of all points was calculated for the dietary diversity score for each individual.

f. Classification of Dietary Diversity Terciles:

Dietary Diversity terciles were derived from the fourteen (14) food groups (28) and categorized into low, medium and high dietary diversity. Individual dietary diversity score (IDDS) were then classified based on their position on the scale. The classification is as follows;

Low = 1-4 food groups,
Average = 5-9 food groups,
High = 10-14 food groups

3.11 Statistical Analysis

All statistical analysis was performed with the use of SPSS for WINDOWS (version 23; SPSS Inc, Chicago) for descriptive statistics, Chi square, and Pearson's correlation at p=0.05 level of significance.

RESULTS

Distribution of age and anthropometric indices of respondents

Table 1 shows that the subjects were made up of 69 (34.5%) males and 131 (65.5%) females. The mean age, height and weight and BMI of males were 22 ± 2.47 years, 1.68±0.08m, 73.3± 6.3kg and 23.21 ±3.06 respectively while the mean age, height, weight and BMI for the females were 22 ± 2.47 years, 1.68 ±0.08m, 52.5 ± 3.16kg and 22.1±2.25 respectively. The mean blood sugar and mean blood systolic pressure were142 ±13.66mg/dl and 150.37 ±7.34mmHg respectively

Table 1: shows Distribution of age and anthropometric indices of respondents

Parameters	Variable	Minimum	Maximum	Mean	SD
Sex					
Males (n=69)	Age (Years)	16	28	22	±2.47
	Height (M)	1.45	1.86	1.68	±0.075
	Weight (Kg)	49.00	95.10	73.34	±6.28
	BMI(kg/$m^{2)}$	16.83	36.71	23.21	±3.06
Females (n =131)	Age (Years)	16	28	22	±2.47
	Height (M)	1.45	1.86	1.68	±0.075
	Weight (Kg)	43.0	9.00	52.50	±3.16
	BMI(kg/$m^{2)}$	16.50	35.20	22.10	±2.25
All Participant	Blood sugar(mg/dl)	70	156	142	±13.66
	Systolic blood Pressure (mmHg)	100	180	150.37	±7.34

Table 2 shows that about 97.0% of the participants were Igbo, majority (46.5%) received monthly allowance of N5, 100- N10, 000, while 35.5% and 31.5% spent N200- N500 and N900- N1200 per meal respectively.

Prevalence of Pre-diabetes, Diabetes Mellitus, pre- hypertension and hypertension among the participants

Table 3 shows that the prevalence of diabetes (126 mg/dl and above) in both male and female was 4% and pre- diabetes (100-125mg/dl) was 41% (male-31.9%; Females -45.8%). Table 3 also shows that systolic pre- hypertension (120-139mm/Hg) was significantly higher in females (22.9%) than in males (2.9%) ($P<0.05$) while diastolic pre-hypertension (80-90mm/Hg) was significantly higher in males (85.5 %,) than in female (51.1%) ($P<0.05$). Diastolic hypertension (≥90mm/Hg) was found in 10% of the participants.

Table 4: shows the dietary diversity scores and dietary diversity terciles of the participants. The Dietary Diversity Score (DDS) of individual subjects ranged from 3 to 9. The dietary diversity of highest frequencies were 6 (37.0%), 5(23.0%) and 7 (15.0%). The proportion of the subjects with the scores in each of the three tercile categories of low, medium/average, for the participants was 18.0%, 82.0% and 7.8%, respectively. Nobody scored high. Mean Dietary Diversity score is 5.66±1.29. The analysis of the data revealed a significant correlation between the dietary diversity score and blood glucose level ($r = 0.17$, $p < 0.05$).

Table 5 shows classification of BMI. About 3.5%, 18.5% and 3.0% of the respondents were underweight, overweight and obese respectively. More females were underweight (4.58%) and overweight (16.03%) than the males.

Table 2: Socio-demographic and socio-economic variables of the participants

Variables	Male		Females		Total	
	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
Gender	69	34.5	131	65.5	200	100
Ethnic Group						
Igbo	67	97.10	127	96.9	194	97.0
Non-igbo	2	2.9	4	3.1	6	3.0
Year of Study						
Year 1	6	8.7	6	4.6	12	6.0
Year 2	22	31.9	62	47.3	84	42.0
Year 3	13	18.8	20	15.3	33	16.5
Year 4	28	40.6	43	32.8	71	35.5
Monthly Allowance						
N 5,000 to N 10,000	37	53.6	83	63.4	120	60.0
N 10,100 to N 20,000	26	37.7	36	27.5	62	31.0
20,100 to N 40,000	6	8.7	10	7.6	16	8.0
Above N 40,000	0	0	2	1.5	2	1.0
Amount spent on food per meal						
N 200- N 500	16	23.2	55	42.0	71	35.5
N 550- N 850	20	29.0	32	24.5	52	26
N 900- N 1200	25	36.2	38	29.0	63	31.5
N 1230- N 1550						
N 1600- N 1900	2	2.9	-	-	2	01
N 1950- N 2250	-	-	-	-	-	-
N 2300- N 2500	4	5.8	2	1.5	6	03
Above N 2500	2	2.9	2	1.5	4	02
	-	-	2	1.5	2	01
Is Monthly Allowance Enough						
Yes	20	29.0	52	39.7	72	36.0
No	49	71.0	79	60.3	128	64.0
Residence						
Hostel	16	23.2	68	51.9	84	42.0
Off campus	53	76.8	63	48.1	116	58.0

Table 3: Prevalence of Pre-diabetes, Diabetes Mellitus, pre- hypertension and hypertension among the participants

Variable	Male		Female		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Blood Sugar						
Normal	43	62.3	67	51.1	110	55.0
Pre-diabetes	22	31.9	60	45.8	82	41.0
Diabetes	4	5.8	4	3.1	8	4.0
Systolic Blood Pressure						
Normal	67	97.1	101	77.1	168	84.0
Pre-hypertension	2	2.9	30	22.9	32	16.0
Diastolic Blood Pressure						
Normal	6	8.7	48	36.6	54	27.0
Pre-hypertension	59	85.5	67	51.1	126	63.0
Hypertension	4	5.8	16	11.3	20	10.0

Table 4: Dietary Diversity Scores and Dietary Diversity Terciles

Numbers of food groups consumed per day	Male		Female		Total	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
3	2	2.9	10	7.6	12	6.0
4	7	10.1	17	13.0	24	12.0
5	22	31.9	24	18.3	46	23.0
6	22	31.9	52	39.7	74	37.0
7	10	14.5	20	15.3	30	15.0
8	4	5.8	6	4.6	10	5.0
9	2	2.9	2	1.5	4	2.0
Dietary Diversity Terciles						
Low (1-4 food groups)	9	13.0	27	20.6	36	18
Medium/Average (5-9 food groups)	60	87.0	104	79.4	164	82
High (10-14 food groups	-	-	-	=	-	-

Table 5: shows classification of BMI

Variables	Male		Female		Total	
	Frequency	Percent (%)	Frequency	Percent (%)	Frequency	Percent (%)
Underweight	1	1.45	6	4.58	7	3.5
Normal	48	69.56	102	77.86	150	75.0
Overweight	16	23.19	21	16.03	37	18.5
Obese	4	5.80	2	1.53	6	3.0

DISCUSSION

Hypertension has increased gradually in younger age groups in the past 20 years (29). The prevalence of hypertension of 10.0% was lower than the prevalence of 23.1%, 21.0%, 27.8%, 14.8%, and 33.4% reported by (30, 31, 32, 33 and 34) in their study in new university intake, among undergraduates in Rivers state, among staff of a Nigerian university community, in two local government areas in Ebonyi state and among Company Workers in Rivers State respectively but higher than prevalence of 4.6% by (35) in Nnamdi Azikiwe University. The differences between studies may be ascribed to environmental and socioeconomic factors. Study by Sotonye and Ofori (31) on young adults in Rivers State noted that the increased prevalence in the young population might be due to westernization of diets and lifestyle changes in the Nigeria. The belief that hypertension is the disease of the elderly is erroneous and could be the reason why much study has not be done to assess prevalence of hypertension among the youth in Nigeria. Health professionals should educate the public on the existence of hypertension in the youth. There is also need to create awareness of hypertension in the youth and promote early lifestyle changes. It is apparent from this study that hypertension is an important public health problem among the undergraduate students. Regular measurement of blood pressure could be an effective preventive method for early detection of hypertension and its complications among the youth.

The overall prevalence of diabetes mellitus in both male and female was 4.0% and pre- diabetes was 41%. This was lower than the prevalence of 16.8%, and 5.8%, reported by (36, 37,) in Niger Delta, and Port Harcourt, respectively but higher than 3.47% reported by (38) in Olabisi Onabanjo University and comparable to 4.6% reported in the South-east (37). The prevalence of Pre-diabetes in this study is higher than pre-valence of 9.4% and 17% found in a study among adolescent in Osun state (39) and Port Harcourt respectively (40). The high prevalence of pre-diabetes could be as a result of high consumption of cereals and white root and tubers where 91.0% and 41.0% ate cereals and white root and tubers respectively within 24 hrs. Glucose level has a positive correlation with dietary diversity score ($r = 0.17$, $p = <0.05$) and this could be the reason for the low prevalence of diabetes. The prevalence of pre-diabetes is becoming high and common in our communities and if left unattended will give rise to epidemic of diabetes in Nigeria in future. Urgent actions are therefore crucial to curb this jeopardy. Such actions comprise raising awareness of the disease and regular screening exercise among the youth.

The mean dietary diversity score was 5.66 ± 1.29 out of 14 food groups. This result is similar to study by (41) who reported a mean DDS of 5 ± 2.74 among young Nigeria undergraduates and (42) who reported a DDS of 4.07 ± 1.84 for male and 4.53 ± 3.07 for female among undergraduates in the South west Nigeria but in contrast to findings of (43, 44) who reported higher mean DDS of 6.96 ± 1.80 and 8.29 ± 1.3 in South East zone and Osun State respectively. This poor dietary diversity score could be due to low monthly pocket money where majority (46.5%) received N 10,000 as pocket money and lack of time to prepare meal or eat meal because of tight lecture schedule. The dietary diversity of 82% average and 18% low is in contrast to the study by (45, 46) who reported that 64.8% of the undergraduate students in Enugu and 78.3% of young adults in central China had low dietary diversity. Lack of diversity in the diet is strongly associated with inadequate intake and risks of deficiencies of essential micronutrients. Low dietary diversity has been linked to diseases due to malnutrition, such as stunted growth, as well as an increased risk of developing cardiovascular diseases, metabolic syndrome, and dyslipidemia (47).

High-dietary diversity indicates significantly higher intakes of most key nutrients and availability for the body to maintain a normal nutritional status. Hence, a positive correlation was obtained in this study between blood glucose level and dietary diversity score. A significant correlation indicates that changes in the dietary diversity score are associated with changes in the blood glucose levels. This findings suggests that dietary diversity could play a role in managing or influencing blood glucose levels, which may have implications for dietary recommendations or interventions aimed at controlling blood glucose. While the significant correlation points to a relationship between dietary diversity and blood glucose levels, it is important to consider other factors that might influence this relationship and to conduct further research to confirm these findings.

It may be challenging to increase dietary diversity with limited budget irrespective of how much nutritional information they receive; therefore, educational intervention combined with other supports is required to promote behavior changes. Adequate information, skills and encouragement to

obtain and to consume appropriate diets is needed. Such education should cover improvement of personal food supplies and more effective use of available foodstuff and financial resources to provide nourishing diets and better care.

CONCLUSION

Mean blood sugar and mean blood pressure were high, mean dietary diversity score was low. Regular measurement of blood pressure and blood sugar for early detection and prevention is advocated

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Authors' Contribution
This work was carried out in collaboration among all authors. Author GNO conceived and designed the study, Authors NNU, FCA and GOU performed the field work and managed the literature search. Author ICU wrote the first draft of the manuscript. Author GNO managed the statistical analysis of the study and wrote the final draft of the manuscript. All authors read and approved the final manuscript.

Competing interest
The authors declare that there is no competing interests.

Consent for Publication
Consent for publication is not necessary because this manuscript does not have personal data like individual details, images or videos.

REFERENCES

1. Wokoma, F S. (2012) Gestational diabetes mellitus in a Nigeria antenatal population and associated diseases. Tropic. J. Obstetrics Gyne. 18:56-60.
2. International Diabetes Federation. (2017) Knowledge of Diabetes Mellitus among Students of a Public Secondary School in Southern Nigeria. A Cross-Sectional Study. Diabetes Atlas 8th Edition. Available from: http: //www. 11 diabetesatlas.org. (Accessed on March 26th 2024).
3. Kazeem, A. (2005) What you need to know about diabetes care. Diabetes Care, 2:2-5
4. International Diabetes Federation (2013) IDF Diabetes Atlas. 6th Edition. International Diabetes Federation.
5. Arigbede O, Adeoye Ikeola, Olatokunbo O. J, Yesuf O. (2016) Pre-diabetes among Nigerian adolescents: A School-based study of the prevalence, risk factors and pattern of fasting blood glucose in Ibadan, Nigeria. International Journal of Diabetes in Developing Countries, 37(4) 10.1007/s13410-016-0505-6
6. Akintayo-Usman N. O, Okanlawon F. A, Usman S. O. (2021) Prevalence of pre-diabetes and risk factors among secondary school adolescents in Osogbo Local Government Area, Osun State, Nigeria. Afr Health Sci., 21(3):1301-1309
7. Zaidu Musa A, Isa Umar, U. Ngozi, Obiagwu P. and Ibrahim M. (2023) School-based Study of the Prevalence and Associated Factors of Pre-diabetes among Adolescents in Kano, Nigeria: Nigerian Medical Journal, 64(1), 43–53.
8. Dabelea D, Stafford JM, Mayer-Davis EJ, D'Agostino R Jr, Dolan L et al., (2017) Association of Type 1 Diabetes vs Type 2 Diabetes Diagnosed During Childhood and Adolescence With Complications During Teenage Years and Young Adulthood. J Am Med Assoc. 317:825–835.
9. Williams B, Mancia G, Spiering W, Agabiti Rosei E, Azizi M, Burnier M et al. (2018) ESC/ESH guidelines for the management of arterial hypertension: the task force for the management of arterial hypertension of the European Society of Cardiology (ESC) and the European Society of Hypertension. Eur Heart J. 39(33):3021-104.
10. Ramachandran A, Snehalatha C, Vijay V, King, H. (2002) Impact of poverty on the prevalence of diabetes and its complications in urban southern India. Diabet. Med. 19(2):130-5.
11. Guidelines Subcommittee, WHO/ISH. (1999) Guidelines for management of Hypertension. J Hypertension. 17: 151-83
12. Aderele W.J.O and Seriki, O.J. (1979) Hypertension in Nigerian Children, Arch Dis Childr. 49: 313-7
13. Akinkugbe O.O. (1990) Epidemiology of cardiovascular diseases in developing countries. J hypertens. 8 (suppl 7): S233-S238
14. Noubiap J. J, Essouma M, Bigna J. J, Jingi A.M, Aminde L.N, Nansseu J. R. (2017) Prevalence of elevated blood pressure in children and adolescents in Africa: a systematic review and meta-analysis. Lancet Public Health, 2(8):e375–e386.
15. Obinna D, Odinkemelu N. (2015) The rate of hypertension in Nigeria, Daily Sun, p22. Available at http://www.sunnewsonline.com. Accessed on 26/03/2024.

16. Ejike C.E. (2017) Prevalence of Hypertension in Nigerian Children and Adolescents: A Systematic Review and Trend Analysis of Data from the Past Four Decades. J Trop Pediatr. 1; 63(3):229–241.
17. Ekunwe O, Odunjinri O.M.T. (1989) Proteinuria and Blood pressure profile of Lagos Children. Nig.J Paediatr. 16: 15-22
18. Etta K.M, Watson R. S. (2005) Casual blood pressures and their possible relation to age, body weight, Quetelet's index, serum cholesterol, percentage of body fat and mid-arm muscle circumference in three groups of northern Nigerian residents. Afr J Med Med Sci. 5:255-262
19. Mijinyawa M. S, Iliyasu Z, Borodo M. M. (2008) Prevalence of hypertension among teenage students in Kano, Nigeria. Niger J Med. 17(2):173-8.
20. Bao W, Threefoot, S. A, Srinivassan S. R, Berenson G. S. (1995) Essential hypertension predicted by tracking of elevated blood pressure from childhood to adulthood. The Bogalusa heart Study. Am J Hypertens, 8:657-65
21. Ubangha L. O, Odugbemi, T. O., Abiola A. O. (2016) Diabetes mellitus: Identifying the knowledge gaps and risk factors among adolescents attending a public school in Lagos State. Journal of Clinical Sciences, 13:193-8.
22. Okoh B. A, Jaja T. (2014) Knowledge and awareness of diabetes among adolescents in Port Harcourt, Nigeria. African Journal of Diabetes Medicine 22:18-20.
23. Unadike B. C., Chinenye S. (2009) Knowledge, awareness and impact of diabetes among adolescents in Uyo, Nigeria. African Journal of Diabetes Medicine, 17:12-4
24. World Health Organization. (2003) Diet, nutrition and prevention of chronic diseases. World Health Organization/Food and Agriculture Organization (WHO/FAO), Geneva, Switzerland: World Health Organization, (WHO Technical report series, No 916). www.fao.org/docrep/017/i3261e/i3261e05.pdf. Accessed on 22/03/2024.
25. World Health Organization. (2012) New highlight on increase of hypertension, diabetes mellitus. Geneva Health Statistics, 844:24-30.
26. National Heart, Lung and Blood Institute. (2021). "How to prepare for a blood pressure test". Archived from the original on 22-03-2024.
27. Food and Agriculture Organization. (2010) Guidelines for measuring household individual dietary diversity. Prepared by Gina Kennedy, Terri Ballard and Marie Claude Dop Nutrition and Consumer Protection Division, Food and Agriculture Organization United Nations. Reprinted 2013. SBN 9 7 8 - 9 2 - 5 - 1 0 6 7 4 9 - http://wwwfoodsec.org/tr/nut/guidelnes.pdf. Visited on March 26th 20204.
28. Food and Agriculture Organization (FAO). (2007) Guidelines for measuring Household and individual dietary diversity. FAO Nutrition and consumer Protection Division, with support from EC/FAO Food Security Information for Action Programme and the food and Nutrition Technical Assistance (FANTA) project. http://wwwfoodsec.org/tr/nut/guidelnes.pdf. Visited on July 2024.
29. Moussa, M. M. M., El-Mowafy, R. I., & El-Ezaby,H. H. (2016) Prevalence of hypertension and associated risk factors among university students: Comparative study. Journal of Nursing Education and Practice, 6(5), 19-27
30. Abiodun Olumide, Ladele Akindele, Olu-Abiodun Oluwatosin and Ashipa, Temitope. (2021) Hypertension among adolescents in Nigeria: a retrospective study of adolescent university freshmen" International Journal of Adolescent Medicine and Health, vol. 33, no. 5, pp. 20180287.
31. Sotonye Tamunobelema Dodiyi Manuel & Ofori S. (2022) Hypertension in the Young Adults. Saudi J Med, 7(11): 598-602.
32. Bappah B.S, Shittu A, Usman, J.S, Nuhu J.M, Sumaila F.G, Ahmad, A.A, Mohammed J. (2022) Prevalence and correlates of undiagnosed hypertension among staff of a Nigerian university community. Pan Afr Med J., 31; 42:80.
33. Onyeji G.N, Ifeanacho, M.O., Ikpemo, K.O, Benneth-Ugochukwu, I.C, Ufebe O.G. (2023) Prevalence and awareness of prehypertension and hypertension among artisans in two selected local government areas of Ebonyi State, Nigeria. Nigerian Journal of Nutritional Sciences , Vol. 44 No. 2 pg 11-22
34. Adeyanju O.Z, Okuku, M.O., Opurum, G. C., Bills, U. S. (2023) Prevalence and Predictors of Hypertension among Company Workers in Rivers State, Nigeria. Vol. 14 No. 2
35. Ogbodo E. C, Analike R.C, Okwara J.E, Meludu S.C (2022) Evaluation of dyslipidemia prevalence among undergraduate University Students. Journal of clinical research and reports, Vol. 12, iss: 1 pp 01-07.
36. Amaewhule M. N.1, Daka I. R, Wekhe C. (2021) Prevalence and Risk Factors for Diabetes Mellitus in an Apparently Healthy Population in the Niger Delta Region of Southern Nigeria. Greener Journal of Medical Sciences, Vol. 11(2), pp. 190-200.
37. Uloko A.E, Musa B.M, Ramalan, M.A, Gezawa, I.D, Puepet, F.H et al., (2018) Prevalence and Risk

Factors for Diabetes Mellitus in Nigeria: A Systematic Review and Meta-Analysis. Diabetes Ther. 9(3):1307-1316.
38. Ogunkolo O.F Amballi A.A. (2005) Prevalence of Diabetes Mellitus in Newly Admitted Undergraduates of Olabisi Onabanjo University, Nigeria. Nigerian Medical Practitioner Vol.47(3) 2005: 26-28
39. Akintayo-Usman NO, Okanlawon FA, Usman SO. (2021) Prevalence of pre-diabetes and risk factors among secondary school adolescents in Osogbo Local Government Area, Osun State, Nigeria. Afr Health Sci. 21(3):1301-1309.
40. Jaja T, Oduwole A O, Fetuga B, and Abdus-Salam I A (2015) Prevalence of prediabetes in secondary school students in Port Harcourt, Nigeria. Original Article, African Journal of Diabetes Medicine, Vol 23 No 1 pg 11-14
41. Onyeji G. N, Ogbu P. N, Obasi N. A. and Anosike F. C. (2021). Assessment of Dietary Diversity and Nutritional Status of Young Nigerian Undergraduates. Nigerian Journal of Nutritional Sciences Vol.42 No.2 September 2021 pg 11-19
42. Sedodo N.S., Oguntona C.R.B., Onabanjo O.O., Fakoya E.O (2013) Dietary Diversity Scores and Nutritional Status of women in two seasons in rural areas of Ogun state. Nigeria Nutrition and Food Science, 43: 60-67
43. Onyeji G. N and Sanusi R. A. (2020) Dietary diversity of reproductive age women in three south-eastern states of Nigeria. African Journal of Food, Agriculture, Nutrition and Development, 20(02):15490-15508
44. Oladoyinbo C, Ugwunna U, Ekerette N. (2017) Dietary diversity and nutrient intake adequacy among women in Iwo local government area, Osun state Nigeria. Afr. J. Food Agric. Nutr. Dev. 17(4): 12641-12656.
45. Nnadi, N (2021) Dietary Diversity and Nutritional Status of Undergraduate In Two Universities In Enugu State. Mouau.afribary.org: Retrieved Jul 31, 2024, from https://repository.mouau.edu.ng/work/view/dietary-diversity-and-nutritional-status-of-undergraduate-in-two-universities-in-enugu-state-7-2
46. Zhou Y, Wang J, Duan Y, Luo X, Wan Z,Luo Y, Li Y, Wang Y and Xie J (2022)Dietary diversity and determinants of young adults in central China: Across-sectional study from 2015 to2020. Front. Nutr. 9:931107.doi: 10.3389/fnut.2022.
47. Gassara G, Chen J. (2021) Household food insecurity, dietary diversity, and stunting in sub-Saharan Africa: a systematic review. Nutrients. 2021; 13:4401.