Original Article

Nutrition Transition, Family History and Hypertension: Investigating the Association of Dietary Patterns, Obesity, and Mothers' Blood Pressure with Raised Blood Pressure among 6–19-Year-Olds in Southwestern Nigeria

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ABSTRACT

Background: Hypertension is on the increase among children and adolescents globally, including low- and middle- income countries (LMICs). While studies in high-income countries (HICs) have reported family history, obesity, diet and physical activity as risk factors for childhood and adolescent hypertension, there is limited data on the subject in LMICs including Nigeria. This study therefore investigated the relationship between dietary patterns, obesity, mothers' blood pressure and raised blood pressure (RBP) among adolescents in southwestern Nigeria.

Methods: This was a cross-sectional study carried out among 1185 school-aged children and adolescents (i.e. 6 – 19-year-olds) and their mothers in Osun State, southwestern Nigeria. Respondents were selected using a five-stage multi-stage sampling technique, and data were collected using pretested structured questionnaires. Anthropometry, blood pressure, and nutrition status were assessed using standard protocols. The guideline for screening high blood pressure (BP) in children and adolescents by the American Academy of Pediatrics was used to define RBP, which was the outcome variable. Dietary patterns and mothers raised blood pressure (main explanatory variables) were defined using principal component analysis and the World Health Organization's BP classification respectively. A five-model multi-variable regression analysis was used to investigate the associations and control for possible confounders. All analyses were done using STATA with the level of significance set at $p \leqslant 0.05$.

Results: The mean age of the respondents (the children) is 10.77 ± 3.45 years with a Male:Female ratio of 1:1.14. The overall prevalence rate of RBP among the 6 – 19-year-olds was 20.1%. After adjusting for all possible confounders (Model 4), RBP had statistically significant associations with meat and poultry dietary pattern (OR: 1.9; p=0.004; 95% CI: 1.2, 3.1) and mother's SBP (OR: 1.9; p=0.004; 95% CI: 1.2, 3.1). Participants with high adherence to meat and poultry dietary pattern and those whose mothers had raised SBP had 90% higher odds of having raised blood pressure compared to the others.

Conclusions: RBP among children 6-19 years had positive statistically significant associations with meat and poultry dominated dietary pattern and raised systolic blood pressure in their mothers. Efforts should be made to address RBP in Nigerian children and adolescents through targeted interventions

Keywords: Raised blood pressure, Nutrition transition, Obesity, Family History, Hypertension, Children, Adolescents

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INTRODUCTION

Globally, hypertension(HT) stands as a significant contributor to cardiovascular diseases (CVDs) and related premature deaths, being the most prevalent noncommunicable disease (NCD) and the leading risk factor for CVD morbidity and mortality.[1,2] Hypertension occasionally begins in adolescence or childhood1 and often tracks into adulthood,[3] leading to long-term health implications such as coronary artery calcification and increased carotid intima-media thickness.[4,5] Furthermore, earlier onset of raised blood pressure (BP) has been linked to longer treatment cycle, harder blood pressure (BP) control, and worse prognosis.[5] Therefore, understanding the

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prevalence and risk factors of hypertension among children and adolescents is of paramount public health and clinical significance.[6,7] Aside from its association with family history, HT in low- and middle-income countries (LMICs) has been linked to the rising prevalence of obesity and nutrition transition.[8] This is a reason why childhood HT is now being reported in increasing measures in LMIC.

The association between hypertension and family history is almost as old as the disease. However, the major tropical driver of the increasing prevalence of HT among children and adolescents today is the rising rate of obesity.[9] In Nigeria, childhood and adolescent obesity was once rare, so hypertension in these age groups was also uncommon. Now, as obesity rates climb, childhood and adolescent HT is becoming a significant concern.[9] This rise in obesity is closely linked to the nutrition transition in Nigeria, where traditional diets are being replaced by Westernized diets high in sugar, refined foods, and saturated fats.[9-11] This dietary shift is particularly pronounced among children and adolescents and is compounded by a decrease in physical activity due to more sedentary lifestyles, further increasing the risk of obesity and related health issues.[12] Urbanization in Sub-Saharan Africa (SSA) has fueled this shift with the rise of food manufacturing, promoting Western-style products.13 Despite a plateau in high-income countries, obesity rates are still climbing globally, particularly in LMIC.[13,14] By 2025, nearly 20% of adults worldwide are expected to have obesity. Childhood obesity is also on a significant increase rising from less than 1% in 1975 to over 7% in 2016, and this is a cause for concern.[15]

While studies in high-income countries (HICs) have reported family history, obesity, diet and physical activity as risk factors for childhood and adolescent HT[16-21,] there is limited data on the subject in LMICs. In Nigeria, only a few studies have been done on childhood and adolescent obesity, childhood and adolescent HT, and, the relationship between the two.[3,12,22-25] Studies usually use reference values for HT from studies in HICs26 which may not be representative of the Nigerian context. This is because studies in adult populations have shown differences in the epidemiology and pathophysiology of HT among adults in HICs and those of African descent.[27-29] This may be due to the difference in the context of their dietary patterns, activity patterns, and even genetic predisposition.[29] Majority of the few studies that have been conducted in SSA did not consider family history and nutrition transition as determinants of HT among children and adolescents.[3,12,22-25]

One of the global targets for NCDs is to reduce the prevalence of hypertension by 33% between 2010 and 2030.[30] The World Health Assembly also has a target of reducing the prevalence of raised blood pressure by 25% by 2025 compared with its 2010 level.[31] Against this backdrop, this study aims to investigate the associations of dietary patterns, obesity, and mothers' blood pressure on raised blood pressure among 6 – 19-year-olds in Osun State, Nigeria. By examining these factors, we seek to better understand the dynamics of raised blood pressure in this population which could inform targeted interventions aimed at reducing its prevalence and associated risk factors.

METHODOLOGY

Study design and population

This was a cross-sectional study carried out among school-aged children and adolescents (i.e. 6 – 19-year-olds) and their mothers in Osun State, southwestern Nigeria. Respondents were only included when their biological mothers were present at the time of data collection. Respondents with deformities that prevented them from standing erect on a weighing scale, or from the sphygmomanometer cuff from being tied around their upper arms, and those who were married were excluded from the study. Using an expected outcome of 32.9%, being the prevalence of raised blood pressure among adolescents in a similar previous study,[12] and a design effect of 2 because of the hierarchical sampling technique used, the sample size was initially calculated to be 678. After adjusting for a 10% non-response rate, the sample size became 746. However, 1185 respondents were recruited.

Sampling technique

Respondents were selected using a five-stage multi-stage sampling technique. At the first stage, two local government areas (LGAs) were selected from the 30 LGAs in the state using simple random sampling technique (SRST), and two wards were selected from the selected LGAs at the second stage also using SRST. Five enumerations areas (EAs) each were selected from each ward at the fourth stage and 60 households were selected from each EA at the fifth stage using systematic sampling technique. Respondents were selected from the selected households until the sample size was met.

Data collection instruments and methods

A structured questionnaire was used as the research instrument with sections on the individual characteristics, family/household characteristics, anthropometric assessment and blood pressure measurements. Digital bathroom weighing scale was used for weight, stadiometer for height and digital sphygmomanometer for the blood pressure measurements. A semi-quantitative food frequency questionnaire (sFFQ) which has been previously used among similar respondents in the same study location[22,23] was used to collect data on the frequency of consumption of different food types/groups. Physical activity was assessed using the adapted physical activity questionnaire for older children and adolescents by Kowalski et al.[32] Pubertal stages were assessed using Tanner staging[33] method.

Data collection was done using interviewer method. Ten research assistants (five males and five females) who were literate and had experience with data collection were recruited and trained for data collection. The guidelines provided by the International Society for the Advancement International Society for the Advancement of Kinanthropometry [34] were followed for weight and height measurements. For the blood pressure measurements, the respondents and their mothers were made to sit comfortably on a chair and the sphygmomanometer machine placed on a table about the level of the heart. The cuffs were wrapped smugly around the forearm of the of the respondents and the blood pressure readings were taken.

Outcome variables

The guideline for screening high blood pressure (BP) in children and adolescents by the American Academy of Pediatrics was used.[35] However, the term "raised blood pressure" and not "hypertension" was adopted in this study because some considerations for the diagnosis of hypertension in children was not followed in this study. A major one being that two additional auscultatory measurements were advised, and the average taken of the three measurements used, but auscultatory measurements were not taken for this study. Raised BP was defined as;

For 6 – 12 years:

stage 1: ⩾95th percentile to <95th percentile + 12 mmHg, or 130/80 to 139/89 mmHg (whichever is lower)

stage 2: ⩾95th percentile + 12 mmHg, or ⩾140/90 mmHg

For 13 – 19 years:

Stage 1: 130/80 to 139/89 mmHg

Stage 2: ⩾140/90 mmHg

Stages 1 and 2 were merged as raised BP for the inferential analysis.

Explanatory variables

The main explanatory variables were dietary patterns, obesity, physical activity and mothers blood pressure, but adjustment was made for other factors at individual, household and community levels. (Table 1) A meticulous and comprehensive review of the literature was undertaken, and the confounding variables included in this study were chosen based on factors consistently reported in comparable studies.

Data analysis

All the variables were initially described using tables and figures. A cross-tabulation was done to test the association between blood pressure groups and explanatory variables using the Pearson chi-square test. Multivariate analysis generated 95% confidence intervals and adjusted odds ratios using binary logistic regression with adjustments made for individual, household, and community level factors using five models. Model 0 was the unadjusted/crude model, Model 1 was the main outcome variables + the individual level characteristics (age, sex, ethnicity, religion, puberty staging), Model 2 had main explanatory variables + household level characteristics (marital status, family setting, mothers' educational status, fathers' educational status and the household wealth index), Main outcome variables + the community level factor (residence) was Model 3 and in the full model (Model 4) all the explanatory variables were included. All the analyses were done using STATA version 17, and statistical significance was set at $p < 0.05$. Diagnostics revealed no multi-collinearity with Variance inflation factor (VIF) ranging from 1.018 to 2.646. A meticulous data management strategy was used with data collected using data collection software RedCap[37] installed on designated tablets, with a data manager monitoring data collection and upload at the backend in real time, hence making missing data negligible.

RESULTS

The mean age of the respondents (the children) is 10.77 ± 3.45 years with 632 (53.33%) females and 553 (46.67%) males. Majority of the respondents were of the Yorubas (97.97%), Christians (68.35%) and from urban communities (60.76%). Majority of the parents were well educated (78.15% of mothers and 82.86% of fathers has at least secondary school education) and were currently in a union (85.49%) in monogamous family settings (93.67%).

The overall prevalence rate of raised blood pressure among the study participants was 20.1%, (Figure 1). Table 1 shows the distribution of explanatory variables across the categories of the outcome variables. At the bivariate level, the RBP had statistically significant associations with meat and poultry dietary pattern (p=0.007), mothers' SBP (p= <0.001), and mothers' DBP (p=0.001), but its associations with obesity, physical activity, and other dietary patterns were not statistically significant (p>0.05) (Table 1).

Table 2 shows the rotated component matrix after principal component analysis showing positive loadings ⩾ 0.35 for the three dietary patterns. The diversified dietary pattern as the name suggests has high loadings from most of the food groups. Meat and poultry dietary pattern have distinctly high loadings for meat and poultry food groups. The sweet and sweetened drinks dietary pattern is defined by high positive loadings for snacks, sweets, sugar, and sugar-sweetened drinks.

Table 3 shows the association between dietary patterns, obesity, mothers' blood pressure, and raised blood pressure among the participants after controlling for individual,

Level	Variable	Description
Main explanatory variables	**Dietary patterns**	The 92 different food types initially assessed were collapsed into 27 food types/groups depending on relevance. Principal component analysis with Varimax rotation was used to determine the number of patterns which best represented the food intake of the population based on the Scree plot and eigenvalues greater than 1.0. The Kaiser - Meyer-Olkin value was 0.923 and the Bartlett's sphericity test had a $p < 0.001$, which were both statistically significant. Food groups with absolute loadings greater or equal to 0.35 were used to name the retained principal components/patterns. Three dietary patterns (DP) were extracted namely the "diversified", "meat and poultry" and "snacks and sweetened drinks" dietary patterns based on the food types/groups they highly consumed, a nd these explained 56% of the total variance .
	Obesity	Assessed using the Body mass index (BMI) -for-age reference values of the World Health Organization (WHO), [36] as below; 0. ⩽ 1 standard deviation (not obese) 1. > 1 standard deviation (overweight/obesity)
	Physical activity (PA)	PA scores were generated [32] and grouped into tertiles; Low, Medium, High
	Mothers systolic & diastolic blood pressure	Raised systolic blood pressure (SBP) (⩾ 140 mmHg), and raised diastolic blood pressure (DBP) (⩾ 90 mmHg)[2]
Individual	**Age**	10 – 13 (early adolescents), 14 – 16 (middle adolescents), 17 – 19 (late adolescents)
	Sex	Male, Female
	Ethnicity	Yoruba, Others
	Religion	Christianity, Islam, Traditional worship
	Pubertal staging	Stages 1, 2, 3, 4, 5
Household/ Family	**Marital status of parents**	Currently in a union, currently not in a union
	Family setting	Monogamous, Polygamous
	Mothers'/ Fathers' educational status	Nil, Primary, Secondary, Higher
	Household wealth index	Selected household possessions and housing quality were used to generate a wealth index score using principal component analysis.[36] The scores were categorized into quintiles, namely; Poorest, Poorer, Middle, Richer, Richest
Community	**Residence**	Rural, Urban

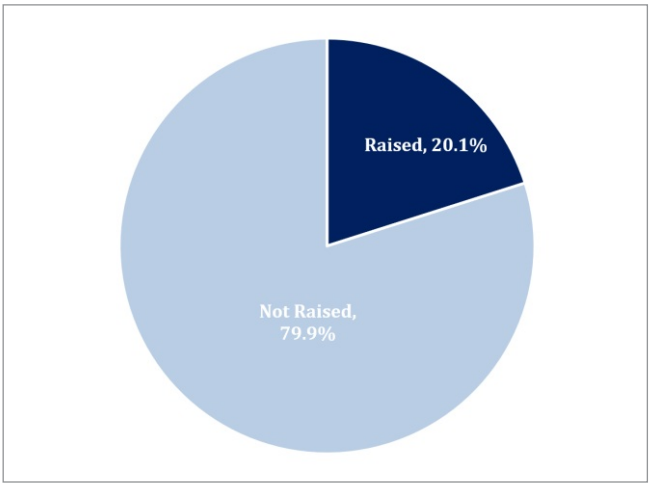

Figure 1: Prevalence of Raised Blood Pressure (BP) among 6 – 19-year-olds (N = 1185)

household, and community-level factors using binary logistic regression analysis. In the unadjusted model, (Model 0), meat and poultry dietary pattern (quartile 4 vs 1: OR: 2.0; p=0.001; 95% CI: 1.3, 3.0), mothers' SBP (not raised vs raised: OR: 2.2; p<0.001; 95% CI: 1.5, 3.1), mothers' DBP (not raised vs raised: OR: 1.7; p=0.002; 95% CI: 1.2, 2.3) and age (preadolescents vs middle adolescents: OR: 0.2; p<0.001; 95% CI: 0.1, 0.4) had statistically significant variations from their reference groups. After adjusting for individual characteristics (Model 1), it was such that meat and poultry dietary pattern (quartile 4 vs 1: OR: 1.8; p=0.007; 95% CI: 1.2, 2.9), mother's SBP (not raised vs raised: OR: 1.9; p<0.001; 95% CI: 1.2, 3.0), and age (preadolescents vs middle adolescents: OR: 0.2; p<0.001; 95% CI: 0.1, 0.3) had statistically significant variations with their reference group. When household characteristics were adjusted for (Model 2),

Table 1: Distribution of the explanatory variables across categories of the Outcome variable (blood pressure) among 6 – 19-year-olds (N = 1185)

Variables	Blood pressure (%)		p-value
	Not raised (n = 947)	Raised (n = 238)	
Diversified DP			
Quartile 1	239 (80.47)	58 (19.53)	0.262
Quartile 2	232 (78.38)	64 (21.62)	
Quartile 3	229 (77.36)	67 (22.64)	
Quartile 4	247 (83.45)	49 (16.55)	
Meat & Poultry DP			
Quartile 1	254 (85.52)	43 (14.48)	***0.007**
Quartile 2	242 (81.76)	54 (18.24)	
Quartile 3	229 (77.36)	67 (22.64)	
Quartile 4	222 (75.00)	74 (25.00)	
Snacks & Sweetened drinks DP			
Quartile 1	243 (81.82)	54 (18.18)	0.763
Quartile 2	235 (79.39)	61 (20.61)	
Quartile 3	232 (78.38)	64 (21.62)	
Quartile 4	237 (80.07)	59 (19.93)	
Obesity			
Not obese	821 (80.57)	198 (19.43)	0.164
obese	126 (75.90)	40 (24.10)	
Physical Activity			
Low	373 (80.39)	91 (19.61)	0.921
Medium	353 (79.33)	92 (20.67)	
High			
Mothers' SBP			
Not raised	813 (82.20)	176 (17.80)	***<0.001**
Raised	132 (68.04)	62 (31.96)	
Mothers' DBP			
Not raised	733 (81.99)	161 (18.01)	***0.001**
Raised	212 (73.36)	77 (26.64)	
Age group			
Pre-adolescent	367 (74.59)	125 (25.41)	***<0.001**
Early adolescents	330 (79.14)	87 (20.86)	
Middle adolescents	175 (93.58)	12 (6.42)	
Late adolescents	75 (84.27)	14 (15.73)	
Sex			
Male	452 (81.74)	101 (18.26)	0.143
Female	495 (78.32)	137 (21.68)	
Ethnicity			
Yoruba	928 (79.93)	233 (20.07)	0.926
[a]Others	19 (79.17)	5 (20.83)	
Religion			
Christianity	653 (80.62)	157 (19.38)	0.547
Islam	287 (78.20)	80 (21.80)	
Traditional	7 (87.50)	1 (12.50)	
Pubertal stage			
Stage 1	215 (79.93)	54 (20.07)	0.892
Stage 2	325 (79.08)	86 (20.92)	
Stage 3	269 (80.06)	67 (19.94)	
Stage 4	107 (82.31)	23 (17.69)	
Stage 5	24 (75.00)	8 (25.00)	
Marital status			
Currently in a union	804 (79.37)	209 (20.63)	0.254
Currently not in a union	143 (83.14)	29 (16.86)	
Family setting			
Monogamous	880 (79.28)	230 (20.72)	***0.035**
Polygamous	67 (89.33)	8 (10.67)	
Mothers' educational status			
Nil	68 (82.93)	14 (17.07)	0.814
Primary	138 (77.97)	39 (22.03)	
secondary	341 (79.67)	87 (20.33)	
higher	400 (80.32)	98 (19.68)	
Fathers' educational status			
Nil	80 (80.00)	20 (20.00)	0.828
Primary	79 (76.70)	24 (23.30)	
Secondary	272 (80.95)	64 (19.05)	
Higher	516 (79.88)	130 (20.12)	
Household wealth index			
Poor	277 (82.69)	58 (17.31)	0.124
Middle	282 (76.63)	86 (23.37)	
Rich	388 (80.50)	94 (19.50)	
Residence			
Rural	376 (80.86)	89 (19.14)	0.514
Urban	571 (79.31)	149 (20.69)	

*Statistically significant; DP – Dietary patterns; BP – Blood pressure; SBP – Systolic blood pressure; BP – Diastolic blood pressure;
[a]Others here refer to Hausas, Igbos and other Nigerian ethnic groups

it was such that meat and poultry dietary pattern (quartile 1 vs quartile 4: OR: 1.9; p=0.004; 95% CI: 1.2, 3.0) and mother's SBP (not raised vs raised: OR: 1.8; p=0.005; 95% CI: 1.2, 2.8) had statistically significant variations with their reference groups. After adjusting for community level factors (Model 3), meat and poultry dietary pattern (quartile 1 vs quartile 4: OR: 1.8; p=0.006; 95% CI: 1.2, 2.8) and mother's SBP (not raised vs raised: OR: 1.8; p=0.008; 95% CI: 1.2, 2.7) had statistically significant variations from their respective reference groups.

In the final model (Model 4), after all explanatory variables were adjusted for, those in quartile 4 of the meat and poultry dietary pattern had 90% higher odds of having raised blood pressure than those in quartile 1 (OR: 1.9; p=0.004; 95% CI: 1.2, 3.1). Participants whose mothers had raised SBP had 90% higher odds of having raised blood pressure than those whose mothers did not have raised SBP (OR: 1.9; p=0.004; 95% CI: 1.2, 3.1). Middle adolescents had 80% lesser odds of having raised blood pressure than preadolescents (OR: 0.2; p<0.001; 95% CI: 0.1, 0.3)

DISCUSSION

In this study, the overall prevalence rate of raised blood pressure was 20.1%. This prevalence is relatively high especially in the context of Nigeria as a low-income country and one of the world's malnutrition capitals where the double burden of malnutrition is still prevalent.[38,39] Considering that the study area- Osun state- is not even one of the states

Table 2: Rotated Component Matrix after Principal Component Analysis showing positive loadings ⩾ 0.35 for the three Dietary Patterns

Food type/Group	Diversified	Meat & Poultry	Snacks & Sweetened drinks
Sugar sweetened drinks	0.230	0.093	0.693
Natural fruit juice	0.080	0.572	-0.028
Milk products	0.313	0.478	0.522
Locally made non -alcoholic drink	0.099	0.588	-0.059
Red meat (beef, lamb, pork, goat meat)	0.518	0.275	-0.022
Fish	0.613	0.238	0.378
Poultry	0.244	0.576	0.223
Eggs	0.224	0.399	0.353
Organ meat and offal	0.221	0.540	-0.006
Cow skin	0.304	0.330	0.212
White meat (snail, rabbit)	0.112	0.469	0.328
Bush meat	0.059	0.545	0.225
Pastries or fried snacks	0.003	0.186	0.627
Baked or roasted snacks	0.242	0.340	0.653
Nuts	0.510	0.122	0.437
Cereals and grains	0.543	0.307	0.029
Baked cereal (bread)	0.467	0.245	0.134
Refined cereals	0.363	-0.018	0.313
Legumes and products	0.694	0.078	0.055
Roots and tubers	0.710	0.153	0.205
Whole fruits	0.298	0.597	0.513
Leafy vegetables	0.439	0.496	0.246
Other vegetables	0.536	0.329	0.277
Condiments	0.741	0.088	0.226
Sugar, sugar cane and honey	0.552	0.290	0.425
Candies and sweets	0.218	-0.189	0.551
Fats and oils	0.624	0.105	0.212

that can be rated as highly industrialized, this is a disturbing trend. However, the prevalence of RBP is expectedly higher in high-income countries. Prevalence rates of RBP ranging from 24.6% to 25.8% have been reported in studies in children aged 6 to 17 years from China, the US, and in an international study involving Poland, Tunisia, and some Asian countries.[40,41] In Africa, the prevalence of raised blood pressure ranges from 0·2–50.5%.[42-55]

The prevalence of RBP from our study falls within the range (2.5-26.7%) of what other scattered studies in Nigeria have reported.[2,25,40,46,47,56] However, there may be a geographical disparity in the prevalence of RBP in Nigeria. This may be related to the level of urbanization in different areas. Lagos (14.5%-18.5%) and Ogun (19.3%) states seemed to have a higher prevalence of RBP (3,25) compared to other Southern states like Oyo-12.8% (79) and Northern states 3.0% (43,57). The difference in RBP prevalence per state may be due to the faster rate of urbanization and consequently nutrition transition in cities like Lagos. While Lagos and Ogun currently seem to have the highest prevalence of RBP, the average values that are now being reported in other states have been reported in these states about 10 years ago.[65] This shows a precedent for what RBP prevalence might look like countrywide in a few years if no intervention is implemented.

In this study, mothers' SBP was found to have a significant association with RBP in children and adolescents. Participants whose mothers had raised SBP had 90 percent higher odds of having RBP than those whose mothers did not have raised SBP. Our finding correlates with global patterns which report an association between genetics and RBP in children. In Asia. children with hypertensive parents had a substantially higher risk of developing RBP. Specifically, children with one hypertensive parent had twice the odds, while those with both parents hypertensive had over four times the odds of developing RBP compared to children with non-hypertensive parents.[58,59] Similar findings were observed in Europe, where both maternal and paternal blood pressure were positively correlated with childhood blood pressure.[60,61] Given the association between genetics and childhood hypertension, there is a need for comprehensive risk assessments that include family health history.[62] Early intervention and lifestyle modifications in families with a history of RBP may therefore mitigate long-term health risks for children and adolescents. This may be a crucial step in hypertension prevention and management.

A study in Southern Nigeria corroborates our finding[58] with reports of a high level of hypertension in school children with a family history of RBP. However, other studies in Southern

Table 3: Association between Dietary Patterns, Obesity, Mothers' blood pressure and Raised Blood Pressure among 6 – 19-year-olds after controlling for individual, household and community level factors using binary logistic regression analysis (N = 1185)

	Model 0				Model 1				Model 2				Model 3				Model 4			
	OR	95% CI		p	OR	95% CI		p	OR	95% CI		p	OR	95% CI		p	OR	95% CI		p
Diversified DP																				
Quartile 1																				
Quartile 2	1.1	0.8	1.7	0.529	1.2	0.8	1.8	0.388	1.2	0.8	1.9	0.312	1.2	0.8	1.9	0.318	1.2	0.8	1.9	0.354
Quartile 3	1.2	0.8	1.8	0.354	1.2	0.8	1.8	0.378	1.2	0.8	1.8	0.356	1.2	0.8	1.8	0.350	1.2	0.8	1.9	0.360
Quartile 4	0.8	0.5	1.2	0.347	0.9	0.6	1.5	0.807	1.0	0.6	1.5	0.830	0.9	0.6	1.5	0.741	1.0	0.6	1.5	0.859
Meat & Poultry DP																				
Quartile 1																				
Quartile 2	1.3	0.9	2.0	0.216	1.4	0.9	2.2	0.149	1.3	0.8	2.1	0.269	1.3	0.8	2.1	0.260	1.4	0.9	2.3	0.156
Quartile 3	1.7	1.1	2.6	0.011	1.8	1.1	2.9	0.011	1.8	1.1	2.8	0.012	1.7	1.1	2.7	0.019	1.9	1.2	3.0	0.008
Quartile 4	2.0	1.3	3.0	0.001	1.8	1.2	2.9	0.007	1.9	1.2	3.0	0.004	1.8	1.2	2.8	0.006	1.9	1.2	3.1	0.004
Snacks & Sweetened drinks DP																				
Quartile 1																				
Quartile 2	1.2	0.8	1.8	0.455	1.2	0.8	1.9	0.319	1.2	0.8	1.9	0.379	1.2	0.8	1.8	0.426	1.3	0.8	2.0	0.277
Quartile 3	1.2	0.8	1.9	0.295	1.3	0.8	2.0	0.248	1.3	0.8	2.0	0.231	1.3	0.8	1.9	0.304	1.4	0.9	2.1	0.167
Quartile 4	1.1	0.7	1.7	0.587	1.4	0.9	2.1	0.188	1.3	0.8	2.0	0.237	1.3	0.8	2.0	0.271	1.4	0.9	2.3	0.134
Obesity																				
Not obese																				
obese	1.3	0.9	1.9	0.165	1.2	0.8	1.9	0.348	1.4	1.0	2.2	0.08	1.4	0.9	2.1	0.091	1.2	0.8	1.9	0.339
Physical Activity																				
Low																				
Medium	1.1	0.8	1.5	0.690	1.1	0.7	1.5	0.769	1.0	0.7	1.4	0.959	1.0	0.7	1.4	0.934	1.1	0.8	1.5	0.673
High	1.0	0.7	1.5	0.917	1.0	0.7	1.6	0.873	0.9	0.6	1.4	0.653	0.9	0.6	1.4	0.758	1.1	0.7	1.7	0.786
Mothers' SBP																				
Not raised																				
Raised	2.2	1.5	3.1	1<0.00	1.9	1.2	3.0	0.004	1.8	1.2	2.8	0.005	1.8	1.2	2.7	0.008	1.9	1.2	3.1	0.004
Mothers' DBP																				
Not raised																				
Raised	1.7	1.2	2.3	0.002	1.2	0.8	1.8	0.423	1.2	0.8	1.8	0.319	1.2	0.8	1.8	0.325	1.2	0.8	1.7	0.479
Age group																				
Preadolescents																				
Early adolescents	0.8	0.6	1.1	0.107	0.7	0.5	1.0	0.071									0.7	0.5	1.0	0.069
Middle adolescents	0.2	0.1	0.4	<0.001	0.2	0.1	0.3	<0.001												<0.001
Late adolescents	0.5	0.3	1.0	0.052	0.4	0.2	0.9	0.018									0.2	0.1	0.3	0.026
Sex																				
Male																				
Female	1.2	0.9	1.7	0.144	1.3	1.0	1.8	0.060									1.4	1.0	1.9	0.037
Ethnicity																				
Yoruba																				
Others	1.0	0.4	2.8	0.926	1.0	0.4	2.9	0.949									1.0	0.3	2.9	0.997
Religion																				
Christianity																				
Islam	1.2	0.9	1.6	0.339	1.1	0.8	1.6	0.433									1.2	0.8	1.6	0.338
Traditional	0.6	0.1	4.9	0.627	0.7	0.1	6.0	0.732									1.0	0.1	10.	0.978
Pubertal stage																				
Stage 1																				
Stage 2	1.1	0.7	1.5	0.789	1.0	0.7	1.5	0.86									1.0	0.7	1.6	0.872
Stage 3	1.0	0.7	1.5	0.967	1.1	0.7	1.7	0.739									1.1	0.7	1.7	0.773
Stage 4	0.9	0.5	1.5	0.572	1.2	0.6	2.1	0.632									1.1	0.6	2.1	0.742
Stage 5	1.3	0.6	3.1	0.516	2.1	0.8	5.6	0.142									2.2	0.8	5.9	0.127
Marital status																				
In a union																				
Not in a union	0.8	0.5	1.2	0.255					0.8	0.5	1.2	0.263					0.8	0.5	1.3	0.364
Family setting																				
Monogamous																				
Polygamous	0.5	0.2	1.0	0.040					0.4	0.2	0.9	0.03					0.5	0.2	1.0	0.064

Table 3 Contd.

	Model 0				Model 1				Model 2				Model 3				Model 4			
	OR	95% CI		p	OR	95% CI		p	OR	95% CI		p	OR	95% CI		p	OR	95% CI		p
Mothers' education																				
Nil																				
Primary	1.4	0.7	2.7	0.359					1.4	0.6	3.2	0.400					1.2	0.5	2.8	0.639
secondary	1.2	0.7	2.3	0.499					1.4	0.6	3.1	0.450					1.2	0.5	2.8	0.726
higher	1.2	0.6	2.2	0.58					1.2	0.5	2.8	0.754					0.9	0.4	2.3	0.864
Fathers' education																				
Nil																				
Primary	1.2	0.6	2.4	0.569					0.9	0.4	2.0	0.777					0.9	0.4	2.1	0.849
Secondary	0.9	0.5	1.6	0.832					0.7	0.3	1.4	0.312					0.7	0.3	1.5	0.319
Higher	1.0	0.6	1.7	0.977					0.7	0.3	1.5	0.367					0.7	0.3	1.5	0.337
Household wealth index																				
Poor																				
Middle	1.5	1.0	2.1	0.048					1.4	1.0	2.2	0.084					1.5	1.0	2.3	0.062
Rich	1.2	0.8	1.7	0.429					1.3	0.8	2.1	0.273					1.4	0.8	2.4	0.182
Residence																				
Rural																				
Urban	1.1	0.8	1.5	0.514									1.1	0.8	1.5	0.704	1.1	0.7	1.8	0.680

R- reference variable; CI – confidence interval; p – p-value

[a]Model 0 is the empty model showing crude/unadjusted rates; [b]Model 1 adjusted for individual characteristics, which include age, sex, ethnicity, religion and puberty staging, [c]Model 2 adjusted for the household characteristics, which are marital status, family setting, mothers' education, fathers' education and the household wealth index; [d]Model 3 adjusted for community characteristic, which is the residence; [e]Model 4 is the full model that adjusted for all the explanatory variables

Nigeria reported the absence of an association between parents' history of RBP and RBP in children.[47,60] A possible explanation for this disparity in reports may be due to the methodology employed in these studies. The parents' BP in these other studies were self-reported values and not measured by the researchers. This may have opened the result up to the risk of bias possibly due to the lack of awareness of most parents of their hypertensive status as observed in a systematic review.[59] In our study, however, the blood pressure of the mothers was measured by the same research assistants, within the same study setting. This ensures the accuracy and validity of the reported BP. This is a strength that lends credibility to our study.

This study found statistically significant associations between RBP and a dietary pattern that was dominated by the consumption of meat and poultry. Adolescents who had a high compliance with the meat and poultry-dominated dietary pattern had higher odds of RBP compared to those who did not. A similar study by Shokunbi et al.[56] conducted in Lagos reported that approximately 60% of hypertensive adolescents had a meat and poultry dominated dietary pattern four to six times a week.[56] This meat and poultry dominated dietary pattern is similar to the Westernized dietary pattern which is also dominated by a high proportion of red meat and has been associated with a high rate of non-communicable diseases globally.[63-66] Researchers in Greece found an association between high consumption of cheese and red processed meat and RBP (with an odds ratio of 1.15).[67] Similarly, in Australian adults, a meat and poultry dominated dietary pattern was linked to higher systolic blood pressure. This pattern was also associated with higher energy and sodium intake.[68] A reduction in this dietary pattern may be a crucial step in mitigating the rising trend of RBP in children and adolescents.

Our study shows a positive association between RBP and obesity. Although this association was not significant, the bivariate analysis showed that a higher proportion of respondents who were obese had RBP (24.1%) compared to those who were not obese (19.4%). The lack of significant association may be due to the sample size used in this study. The direction of association, however, corroborates the findings from other studies that have established a positive association between RBP and obesity globally[69,70] and in Africa.[71-76] African studies found obesity to be positively associated with RBP with obese children having six times more likelihood of having RBP compared to those with normal weight.[76] An Ugandan study even reported hypertension in 70.0% of children with obesity.[77] From these results, we can infer a direct positive association between RBP in children and childhood obesity. In Nigeria as well, it has been established that overweight and obese children[78-80] exhibit higher systolic and diastolic BP compared to their healthy-weight peers. In a research conducted among adolescents in Lagos, all of the obese students had high SBP, highlighting the strong association between obesity and RBP.[80] These observations align with global patterns, where nutrition transition is driving the rise of childhood obesity and RBP.

This study is not without some limitations. Because of its cross-sectional study design, we could not establish causality. We could not define hypertension among the children because some of the conditions for defining hypertension were not satisfied. The conditions include interfacing with the children twice to measure their blood pressure at least 6 hours apart, hence why we used the term RBP. Furthermore, the blood pressure measurement was taken in a community setting and not in clinical settings, therefore we may not be able to rule out some possible errors.

CONCLUSION

In conclusion, the prevalence of raised blood pressure among children 6-19 years was 20.1%. Meat and poultry dominated dietary pattern and mother's raised systolic blood pressure had positive statistically significant associations with raised blood pressure among the children/adolescents. Obesity also showed a positive association with RBP, though it was not statistically significant. These findings emphasize the association of nutrition transition and family history in the development of raised blood pressure among children and adolescents in Nigeria. Efforts should be made to address RBP in Nigerian children and adolescents through targeted interventions.

DECLARATIONS

Abbreviations

BMI: Body mass index; BP: Blood pressure; CI: Confidence interval; CVDS: Cardiovascular diseases; DBP: Diastolic blood pressure; HICs: High-income countries; HT: Hypertension; LGA: Local government area: LMIC: Low and middle-income countries; NCDs: Non-communicable diseases; OR: Odds ratio; RPB: Raised blood pressure; sFFQ: Semi-quantitative food frequency questionnaire; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; SSA: Sub Saharan Africa; WHO: World Health Organization;

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Authors' contributions: Both authors were involved in the conception of the research idea and topic. MAO wrote the background of the study and AAA wrote the methodology section. Both authors were involved in data collection and data entry. AAA analyzed the data, and together with MAO wrote the results and discussion sessions. Both authors read and approved the final version of the manuscript.

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate: Ethical clearance was obtained from the Ethical Review Committee, Institute of Public Health, Obafemi Awolowo University, Ile-Ife. The participants' information sheet was given to the parents and the adolescents who were 18 years or above. Important information on the participants' information sheet included that the information volunteered will be kept confidential as all questionnaires were coded without names or addresses of respondents. It also emphasized that participants were free to opt-out if they were not comfortable with the information in the questionnaire. Informed written consent to participate was then obtained from the parents and adolescents who were 18 years and above, while assent was obtained from adolescents who were less than 18 years of age.

Consent for publication: Not applicable.

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REFERENCES

1. Omisore A, Omisore O, Abioye-kuteyi EA, Bello I, Olowookere S. In-school adolescents' weight status and blood pressure profile in South-western Nigeria: urban-rural comparison. BMC Obes. 2018 Jan;5(1).
2. World Health Organization (WHO). Hypertension [Internet]. 2023. Available from: https://www.who.int/news-room/fact-sheets/detail/hypertension
3. Atoh I, Ezeogu J, Okeke C, Umeh S, Ekure E, Omokhodion S, et al. High blood pressure pattern amongst adolescents in Lagos, South West Nigeria. [Internet]. Vol. 44, Pan Afr Med J. 2023. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10362662/
4. Azegami T, Uchida K, Tokumura M, Mori M. Blood Pressure Tracking From Childhood to Adulthood. Front Pediatr. 2021;9(785356).
5. Yang L, Sun J, Zhao M, Liang Y, Bovet P, Xi B. Elevated blood pressure in childhood and hypertension risk in adulthood: a systematic review and meta-analysis. J Hypertens. 2020;38(12):2346–2355.
6. Gartlehner G, Vander-Schaaf E, Orr C, Kennedy S, Clark R, Viswanathan M. Screening for Hypertension in Children and Adolescents: Systematic Review for the U.S. Preventive Services Task Force. [Internet]. 2020. Available from: http://www.ncbi.nlm.nih.gov/books/NBK564973/
7. Hu J, Ding Z, Han D, Hai B, Lv H, Yin J, et al. Prevalence of hypertension and related risk factors among children and adolescents at three separate visits: A large school-based study in China. Front Pediatr. 10:(976317).
8. Pledger S, Ahmadizar F. Gene-environment interactions and the effect on obesity risk in low and middle-income countries: a scoping review. Front Endocrinol. 2023;14:(1230445).
9. Crouch S, Soepnel L, Kolkenbeck-Ruh A, Maposa I, Naidoo S, Davies J, et al. Paediatric Hypertension in Africa: A Systematic Review and Meta-Analysis. [Internet]. Vol. 43, eClinicalMedicine. 2022. Available from: https://www.thelancet.com/journals/eclinm/article/PIIS2589-5370(21)00510-1/fulltext
10. Hoffman D, Posluszny H. Nutrition transition, diet change, and its implications. In: Encyclopedia of Human Nutrition: Volume

1-4, Fourth Edition . Elsevier [Internet]. 2023. p. 435–443. Available from: https://www.researchwithrutgers.com/en/publications/nutrition-transition-diet-change-and-its-implications

11. Popkin B, Ng S. The nutrition transition to a stage of high obesity and noncommunicable disease prevalence dominated by ultra-processed foods is not inevitable. Obes Rev. 2022;23(1):e13366.
12. Adeomi AA, Adelusi IO, Adedeji PO, Awofeso AE. Nutritional status and Cardiometabolic health among adolescents ; findings from southwestern Nigeria. BMC Nutr. 2019;5(45):1–8.
13. Steyn NP, Mchiza ZJ. Obesity and the nutrition transition in Sub-Saharan Africa. Ann N Y Acad Sci. 2014;1311(1):88–101.
14. Lister N, Baur L, Felix J, Hill A, Marcus C, Reinehr T, et al. Child and adolescent obesity. Nat Rev Dis Prim. 2023;9(1):1–19.
15. Loos R, Yeo G. The genetics of obesity: from discovery to biology. Nat Rev Genet. 2022;23(2):120–133.
16. Liu J, Tse LA, Liu Z, Rangarajan S, Hu B, Yin L, et al. Predictive Values of Anthropometric Measurements for Cardiometabolic Risk Factors and Cardiovascular Diseases Among 44 048 Chinese. J Am Heart Assoc. 2019;8(16).
17. Ewald D, Haldeman L. Risk Factors in Adolescent Hypertension. Glob Pediatr Heal. 2016;3(2333794X15625159).
18. Wójcikc M, Alvarez-Pitti J, Kozioł-Kozakowska A, Brzeziński M, Gabbianelli R, Herceg-Čavrak V, et al. Psychosocial and environmental risk factors of obesity and hypertension in children and adolescents—a literature overview [Internet]. Vol. 10, Front Cardiovasc Med. 2023. Available from: https://www.frontiersin.org/articles/10.3389/fcvm.2023.1268364
19. Giuseppina RU, Cirillo G, Rondinelli G, Sanchez G, Marzuillo P, Guarino S, et al. Increases the Risk of Hypertension in Children and Adolescents with Obesity [Internet]. Genes. 2023. Available from: https://www.mdpi.com/2073-4425/14/8/1618
20. Wühl E. Hypertension in Childhood Obesity. Acta Paediatr. 2018;24(108.).
21. Batisky D. Obesity and Hypertension: Clinical Aspects. In: Flynn JT, Ingelfinger JR, Redwine KM, editors. Pediatric Hypertension [Internet]. Cham: Springer International Publishing [Internet]. 2018. p. 365–383. Available from: https://doi.org/10.1007/978-3-319-31107-4_17
22. Adeomi A, Olodu M, Akande R, Yaya S, Adediti A, Ajibade R. Adolescent Obesity and its Association with Socio-Demographic Profile, Lifestyle Factors, Dietary and Physical Activity Patterns.pdf. West Afr J Med. 2022;39(2):119–26.
23. Adeomi AA, Fatusi A, Klipstein-grobusch K. Food Security , Dietary Diversity , Dietary Patterns and the Double Burden of Malnutrition among School-Aged Children and Adolescents in Two Nigerian States. Nutrients [Internet]. 2022;14(4):789. Available from: https://doi.org/10.3390/nu14040789
24. Hult M, Tornhammar P, Ueda P, Chima C, Bonamy A, Ozumba B, et al. Hypertension, Diabetes and Overweight: Looming Legacies of the Biafran Famine. PLOS ONE. 2010;5(10): e13582.
25. Oduwole AA, Ladapo TA, Fajolu IB, Ekure EN, Adeniyi OF. Obesity and elevated blood pressure among adolescents in Lagos, Nigeria: A cross-sectional study. BMC Public Health [Internet]. 2012 [cited 2018 Apr 5];12(1):1. Available from: BMC Public Health
26. Lassi Z, Moin A, Bhutta Z. Nutrition in Middle Childhood and Adolescence. In: Bundy DAP, Silva N de, Horton S, Jamison DT, Patton GC, editors. Child and Adolescent Health and Development, 3rd ed. Washington (DC): The International Bank for Reconstruction and Development / The World [Internet]. 2017. Available from: http://www.ncbi.nlm.nih.gov/books/NBK525242/
27. Ogunniyi M, Commodore-Mensah Y, Ferdinand K. Race, Ethnicity, Hypertension, and Heart Disease: JACC Focus Seminar. J Am Coll Cardiol. 2021;78(24):2460–2470.
28. Ortega L, Sedki E, Nayer A. Hypertension in the African American population: A succinct look at its epidemiology, pathogenesis, and therapy. Nefrol Engl Ed. 2015;35(2):139–145.
29. Ostchega, Fryar C, Nwankwo T, Nguyen D. Hypertension Prevalence Among Adults Aged 18 and Over: United States, 2017–2018. National Center for Health Statistics. [Internet]. 2020. Available from: https://www.cdc.gov/nchs/products/databriefs/db364.htm
30. Organization WH. Noncommunicable diseases. Available from: https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases. [Accessed 16 September 2023].
31. Zhou B, Perel P, Mensah G, Ezzati M. Global epidemiology, health burden and effective interventions for elevated blood pressure and hypertension. Nat Rev Cardiol. 2021;18(11):785–802.
32. Kowalski KC, Ph D. The Physical Activity Questionnaire for Older Children (PAQ-C) and Adolescents (PAQ-A) Manual. Recreation. 2004;(August).
33. Emmanuel M, Bokor B. Tanner Stages. In: StatPearls. Treasure Island (FL): StatPearls Publishing [Internet]. 2020 [cited 2021 Mar 4]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470280/
34. International Society for the Advancement of Kinanthropometry. International standards for anthropometric assessment. 2001;53–5.
35. Flynn JT, Kaelber DC, Baker-Smith CM, Blowey D, Carroll AE, Daniels SR, et al. Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. Pediatr Off J Am Acad Pediatr. 2017;140(3):1–72.
36. de Onis Mercedes, Onyango AW, Borghi E, Siyam A, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ. 2007;85(9):660–7.
37. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap) - A metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inf. 2009;42(2):377–81.
38. John C, Poh B, Jalaludin M, Michael G, Adedeji I, Oyenusi E, et al. Exploring disparities in malnutrition among under-five children in Nigeria and potential solutions: a scoping review. [Internet]. Vol. 10, Front Nutr. 2023. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10796494/
39. Children Investment Fund Foundation (CIFF). One million malnourished children treated in Nigeria. [Internet]. 2024. Available from: https://ciff.org/impact/one-million-

malnourished-children-treated-nigeria/

40. Ejike C. Prevalence of Hypertension in Nigerian Children and Adolescents: A Systematic Review and Trend Analysis of Data from the Past Four Decades. J Trop Pediatr. 2017;63(3):229–241.
41. Yang L, Kelishadi R, Hong Y, Khadilkar A, Nawarycz T, Krzywińska-Wiewiorowska M, et al. Impact of the 2017 American Academy of Pediatrics Guideline on Hypertension Prevalence Compared With the Fourth Report in an International Cohort. Hypertens Dallas Tex. 2019;74(6):1343–8.
42. Ajite A, Aladekomo T, Aderounmu T, Olowu W. Burden of Hypertension and Abnormal Glomerular Permeability in Hypertensive School Children. Nephro-Urol. 2016;8(4):e37568.
43. Umar A, Mustafa A, Muuta I. Prevalence of elevated blood pressure among primary school children in Kano Metropolis, Nigeria [Internet]. 2016. Available from: https://journals.lww.com/nijc/fulltext/2016/13010/prevalence_of_elevated_blood_pressure_among.11.aspx
44. Odunaiya N, Louw Q, Grimmer K. Are lifestyle cardiovascular disease risk factors associated with pre-hypertension in 15–18 years rural Nigerian youth? A cross sectional study. BMC Cardiovasc Disord. 2015;15((1):):144.
45. Silva A, Rodrigues S, Baldo M, Mill J, Silva A, Capingana D, et al. Cardiovascular risk factors in pre-pubertal schoolchildren in Angola. Cardiovasc J Afr. 27((5):):315–21.
46. Sekyere A. Prevalence of Hypertensive Disorders, Associated Risk Factors and Effect of Specific Organ Function among Adolescents in Some Selected Senior High Schools in Ashanti Region of Ghana [Internet]. Kwame Nkrumah University of Science and Technology; 2018. Available from: http://oatd.org/oatd/record?record=oai%5C%3Ahttp%5C%3A%5C%2F%5C%2Fir.knust.edu.gh%5C%3A123456789%5C%2F11049
47. Hassan N, El-Ashmawi A, El-Masry S, Zarouk W, Mira M, El-Saeed G, et al. Metabolic syndrome in a sample of Egyptian adolescent girls and its association with apolipoprotein E. J Paediatr Child Heal. 2019;55(11):1344–50.
48. Aounallah-Skhiri H, El-Ati J, Traissac P, Ben-Romdhane H, Eymard-Duvernay S, Delpeuch F, et al. Blood pressure and associated factors in a North African adolescent population. a national cross-sectional study in Tunisia. BMC Public Heal. 2012;12(1):98.
49. Awotidebe A, Monyeki M, Moss S, Strydom G, Amstrong M, Kemper H. Relationship of adiposity and cardiorespiratory fitness with resting blood pressure of South African adolescents: the PAHL Study. J Hum Hypertens. 2016;30((4):):245–251.
50. Ellenga-Mbolla B, Okoko A, Mabiala-Babela J, Ekouya-Bowassa G, Gombet T, Kimbally-Kaky S, et al. Prehypertension and Hypertension among Schoolchildren in Brazzaville, Congo. Int J Hypertens. 2014;2014(803690).
51. Kidy F, Rutebarika D, Lule S, Kizza M, Odiit A, Webb E, et al. Blood pressure in primary school children in Uganda: a cross-sectional survey. BMC Public Health. 2014;14((1):):1223.
52. Odetunde O, Neboh E, Chinawa J, Okafor H, Odetunde O, Ezenwosu O, et al. Elevated arterial blood pressure and body mass index among Nigerian preschool children population. [Internet]. Vol. 14:, BMC Pediatrics. 2014 [cited 2023 Jul 27]. Available from: https://bmcpediatr.biomedcentral.com/articles/10.1186/1471-2431-14-64
53. Kagurac J, Adair L, Musa M, Pettifor J, Norris S. Blood pressure tracking in urban black South African children: birth to twenty cohort. BMC Pediatr. 2015;15((1):):78.
54. Nkeh-Chungag BN, Sekokotla AM, Sewani-Rusike C, Namugowa A, Iputo JE. Prevalence of hypertension and Pre-Hypertension in 13-17 year old adolescents living in Mthatha-South Africa: A cross-sectional study. Cent Eur J Public Health [Internet]. 2015;23(1):59–64. Available from: https://doi.org/10.21101/cejph.a3922
55. Owoeye O, Olawale O, Tella B, Ajuluchukwu J, Akinbo S. Prevalence of Hypertension and Pre-hypertension in Male Adolescent Football: A Cross-Sectional Cohort Study of Nigerian Players. Am J Hypertens Res. 2013;1(1):26–8.
56. Shokunbi O, Ukangwa N. Relationship of blood pressure status, dietary factors and serum electrolytes of in-school adolescents in Ilishan-Remo, Ogun State, Nigeria. Afr Heal Sci. 2021;21((4):):1754–63.
57. Ibrahim O, Afolabi J, Adedoyin O, Ojuawo A. Prevalence and risk factors for hypertension among school children in Ilorin, Northcentral Nigeria. J Fam Community Med. 2019;26((3):):181.
58. Okoh B, Alikor E. Childhood hypertension and family history of hypertension in primary school children in Port Harcourt. Niger J Paediatr. 2013;40((2):):184–188.
59. Adeloye D, Basquill C, Aderemi A, Thompson J, Obi F. An estimate of the prevalence of hypertension in Nigeria: a systematic review and meta-analysis. J Hypertens. 2015;33:230–42.
60. Deng R, Lou K, Zhou S, Li X, Dong B, Ma J, et al. Associations of parental reproductive age and elevated blood pressure in offspring: An observational study. [Internet]. Vol. 11, Front Pediatr. 2023. Available from: https://www.frontiersin.org/articles/10.3389/fped.2023.990725
61. Amritanshu K, Kumar A, Pathak A, Garg N, Banerjee D. Prevalence and risk factors associated with hypertension in children and adolescents. Pediatr Oncall J. 12((2):):40–43.
62. Bloetzer C, Paccaud F, Burnier M, Bovet P, Chiolero A. Performance of parental history for the targeted screening of hypertension in children. J Hypertens. 2015;33((6):):1167.
63. Clemente-Suárez V, Beltrán-Velasco A, Redondo-Flórez L, Martín-Rodríguez A, Tornero-Aguilera J. Global Impacts of Western Diet and Its Effects on Metabolism and Health: A Narrative Review. [Internet]. Vol. 15, Nutrients. 2023. Available from: https://www.ncbi.nlm.nih.gov/ pmc/articles/PMC10302286/
64. Roman G, Rusu A, Graur M, Creteanu G, Morosanu M, Radulian G, et al. Dietary patterns and their association with obesity: a cross-sectional study. Acta Endocrinol Buchar. 2019;15((1):):86–95.
65. Fedacko J, Takahashi T, Singh R, Pella D, Chibisov S, Hristova K, et al. Western diets and risk of non-communicable diseases. 2022;3–21.
66. Różańska D, Kujawa K, Szuba A, Zatońska K, Regulska-Ilow B. Dietary Patterns and the Prevalence of Noncommunicable Diseases in the PURE Poland Study Participants. Nutrients. 2023;15(3524.).
67. Farajian P, Panagiotakos D, Risvas G, Micha R, Tsioufis C, Zampelas A. Dietary and lifestyle patterns in relation to high

blood pressure in children: The GRECO study. J Hypertens. 2015;33.

68. Margerison C, Riddell L, McNaughton S, Nowson C. Associations between dietary patterns and blood pressure in a sample of Australian adults. Nutr J. 2020;19((1):):5.
69. Wieniawski P, Werner B. Epidemiology of Obesity and Hypertension in School Adolescents Aged 15–17 from the Region of Central Poland—A Cross-Sectional Study. Int J Env Res Public Heal. 2021;18((5):):2394.
70. Kuciene R, Dulskiene V. Associations between tri-ponderal mass index, body mass index, and high blood pressure among children and adolescents: a cross-sectional study. Sci Rep. 2023;13((1):):18148.
71. Kruger R, Kruger H, Monyeki M, Pienaar A, Roux S, Gafane-Matemane L, et al. A demographic approach to assess elevated blood pressure and obesity in prepubescent children: the ExAMIN Youth South Africa study. J Hypertens. 2021;39((11)):2190–2199.
72. Afaa T, H Seneadza N, Ameyaw E, Rodrigues O. Blood pressure profile, prevalence of hypertension and associated familial factors in school children in Accra, Ghana. Niger J Clin Pr. 2022;25((4):):386–390.
73. Sungwa E, Kibona S, Dika H, Laisser R, Gemuhay H, Kabalimu T, et al. Prevalence and factors that are associated with elevated blood pressure among primary school children in Mwanza Region, Tanzania. Pan Afr Med J. 37:(283).
74. Akinbodewa A, Adejumo A, Lamidi O, Adeyemi O. Clustering of Cardiometabolic Risk Factors among Children and Adolescents in a Rural Community in Ondo, Southwest Nigeria. J Trop Pediatr. 2020;66((4):):366–376.
75. Oluwayemi I, Oyedeji O. A ten-year review of childhood obesity in a teaching hospital, South West Nigeria. Niger J Clin Pr. 2021;24((6):):841–846.
76. Noubiap J, Essouma M, Bigna J, Jingi A, Aminde L, Nansseu J. Prevalence of elevated blood pressure in children and adolescents in Africa: a systematic review and meta-analysis. Lancet Public Heal. 2017;2((8):):e375–86.
77. Lule SA, Namara B, Akurut H, Muhangi L, Lubyayi L, Nampijja M, et al. Are birthweight and postnatal weight gain in childhood associated with blood pressure in early adolescence? Results from a Ugandan birth cohort - PMC [Internet]. 2019. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6380421/
78. Adetunji A, Adeniran K, Alikah S, Akpede G. Prevalence of over-nutrition and elevated blood pressure among primary school children in non-urban areas of mid-western Nigeria. Int J Gastroenterol Hepatol Transpl Nutr. 2017;2((4):):13.
79. Ajayi IO, Asinobi A, Afolabi N, Ayede I, Kadiri S, Bamgboye EA, et al. Blood pressure pattern and hypertension related risk factors in an urban community in Southwest Nigeria: The Mokola hypertension initiative project, Ibadan, Nigeria. Int J Epidemiol [Internet]. 2015;44(suppl 1):i140. Available from: https://doi.org/10.1093/ije/dyv096.153
80. Afolabi B, Holdbrooke S. Obesity, Dyslipidemia and other Risks Factors for Metabolic Syndrome among Indigenous Black African Secondary School Students in Lagos, Nigeria. [Internet]. Qeios. 2023. Available from: https://www.qeios.com/read/S522VG