

Risk of dyslipidemia among children undergoing routine medical examinations in a secondary health care facility in Benin City, Edo State

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Abstract

Dyslipidemias in children are a diverse group of disorders that include monogenic disorders as well as dyslipidemias caused by a variety of factors. Although cholesterol levels in healthy children differ with age, a potential link to the development of dyslipidemia may be important to determine the likelihood of an early diagnosis. In this cross-sectional study, 220 seemingly healthy children aged 1 to 12 years were studied in Benin City, Nigeria, to determine the pattern of lipid profile. An enzymatic method was used to analyze serum lipids from blood samples obtained from the participants. The level of dispersion of data needed to assess the risk of early childhood dyslipidemia was described using the 95th percentile scale. In the 1-3 years old age group, at least 95 percent of the boys had total cholesterol levels below 132 mg/dL, compared to 124

mg/dL among the girls of the same age. Similarly, total cholesterol levels in the 7-9 year old age group were 127 mg/dL in boys and 110 mg/dL in girls. These levels could serve as a guideline for children of the study's age group who appear to be in good health. Elevated triglycerides levels were found in male children under the age of three years, as well as in the 10-12 age brackets. Increases in triglycerides in the girls, on the other hand, were not age- or time-dependent. In general, the lipid profiles shown in the results were low, particularly in the 4-6 year old age group. A significant modifiable risk factor for cardiovascular disease in children is elevated lipid levels. The results of this study demonstrate the importance of routinely screening children for dyslipidemia. Elevated lipid levels are a major modifiable risk factor for cardiovascular disease in children. The findings of this research can be used as a basis for screening children for dyslipidemia because it provides a 95th percentile in lipid profiles of seemingly healthy children.

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Introduction

Dyslipidaemia is becoming a major public health issue around the world. Despite the fact that it is a preventable significant risk factor for coronary heart disease, it is the eighth leading cause of death in Nigeria.¹ Previously, dyslipidaemia was thought to be rare among black people in comparison to the rest of the world, but recent studies indicate that it is extremely common in Nigeria, with a consistent trend of low high density lipoprotein cholesterol (HDL-C) and elevated low density lipoprotein cholesterol (LDL-C) levels.²

This pathology has been established as a critical aetiological factor in cardiovascular disease growth. Cardiovascular disorders have been shown to start in children, and endothelial damage has been linked to lipid abnormalities in the first few years of existence.³⁻⁵ Unhealthy eating habits, lack of physical activity, and abnormal weight gain have all been linked to dyslipidemia in children.⁶

Variations in serum lipid profile levels have been found in studies of children from various countries.^{7,8} These studies have indicated that before puberty, serum lipids have an age and geographical pattern of distribution. Furthermore, in developed countries, only a few laboratories have reference values for serum lipids in children. Serum lipid concentration and the risk of dyslipidaemia in children are not routinely tested in most Nigerian clinics. Given the role of dyslipidaemia in the development of cardiovascular diseases later in life, this is a dangerous pattern. The study's aim was to determine the trend of serum lipid profile levels among seemingly healthy children in Benin City in order to determine the risk of dyslipidemia.

Materials and Methods

Participants

A cross-sectional analysis was conducted on 220 children who presented to the central hospital's paediatric out-patient department in Benin City. Many of the children who were enlisted seemed to be in good health and were between the ages of one and twelve. Those who had symptoms of a febrile condition, as well as diabetes, renal, or hepatic disease, were not allowed to participate in the study. With minimal clothing on, the participants' weights were assessed using a 6AA battery operated digital scale. A collapsible seca®217 stadiometer was also used to assess the participants' height. A seca®416 infantometer was used to measure the heights of children under the age of two. The waist circumference was calculated at the midpoint between the last palpable rib and the tip of the iliac crest with a flexible non-elastic tape (Seca®201).

A venipuncture was performed, and approximately 2 mL of blood was collected into a plain tube. The entire blood was able to clot and retract before being centrifuged for 15 minutes at 3000 rpm. With a Pasteur pipette, the serum was collected into 5ml plain tubes and stored at -20°C before biochemical analysis was performed. The lipid analysis was carried out using an enzymatic approach,⁹ with reagents supplied by Randox Laboratory Limited and the standard operating assay technique used.

Ethical clearance

Ethical approval was obtained from the Edo State Ministry of Health (Reference: HA-737/42, dated 3rd June, 2020).

Statistical Analysis

Results of this study were subjected to analyses of variance at a 95% confidence interval. The 95th percentile was utilized to assess the risk of early childhood dyslipidemia. Bivariate correlation was employed to understudy relationship between lipid profiles and body weight characteristics. The SPSS version 21 software was used to perform statistical analyses.

Results

The anthropometric data of study population is presented (Table 1). Four different age categories were presented for both male and female genders. The boys and girls within the 10-12 years categories had body weights ranging from 30.3-33.9 kg,

compared to 11.5-14.6 kg in the 1-3 years age category. Generally, waist circumference ranged from 53.2-62.9 cm. Similarly, Mid Upper Arm Circumference (MUAC) was 12.9-19.4 cm. The BMI of the study participants were highly dispersed. The median value for boys was 14.5 and 14.7 for girls (Figure 1). The modal values for both gender were 14.5 and 12.00 respectively. No significant differences in systolic and diastolic Blood Pressure (bp) irrespective of age and gender among the study population (Figure 2).

Table 1. Anthropometric data of study population.

Gender	Age category (years)	Weight (kg)	Waist circumference (cm)	MUAC (cm)
Boys	1-3	11.5±2.5	53.8±4.3	13.2±1.3
	4-6	17.2±4.5	58.5±3.7	13.9±1.6
	7-9	22.3±4.8	60.5±3.5	14.2±5.1
	10-12	30.3±5.0	62.3±4.6	19.4±2.0
	p-value	<0.001	0.001	0.007
Girls	1-3	14.6±7.9	53.2±5.2	12.9±6.3
	4-6	16.2±4.7	58.7±2.4	13.2±4.3
	7-9	23.5±6.9	61.1±6.4	14.0±5.2
	10-12	33.9±8.3	62.9±4.6	17.8±4.2
	p-value	<0.001	0.149	0.727

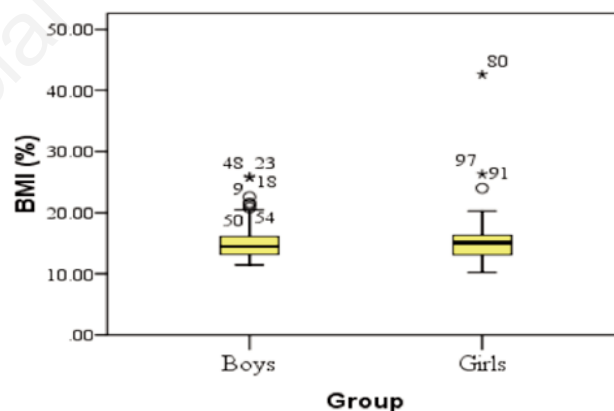


Figure 1. BMI of the study participants.

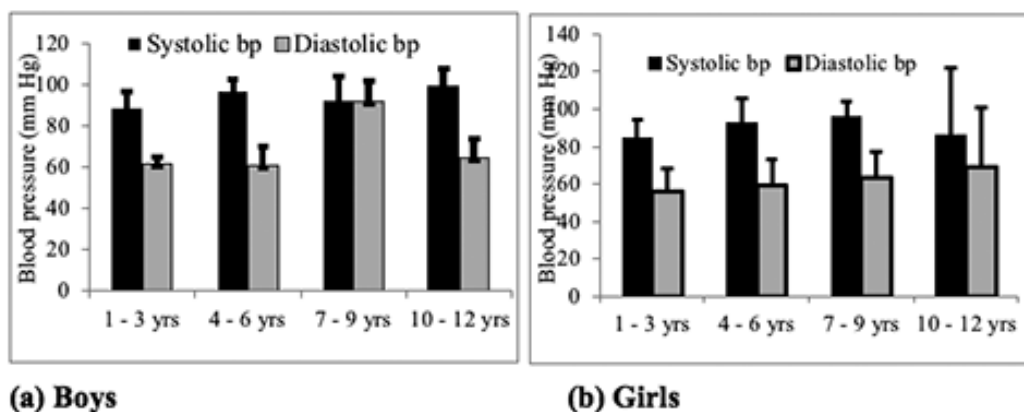


Figure 2. Blood pressure data of the study population.

Results showed that for the male child, significant increases in triglycerides were observed at periods below 3 years as well as in the 10-12 years category (Table 2). Whereas in the girl child, increases in triglycerides was not age- and time-dependent. Generally, lipid profiles as presented in the results, were at the least especially with the 4-6 years age bracket. Based on gender, bivariate correlation between systolic bp and waist circumference ($R = 0.39$, $p = 0.003$) and MUAC respectively ($R = 0.30$, $p = 0.027$) among the boys as well among the girls (Table 3). Table 4 presents the bivariate correlation between BMI, waste circumference and mid-upper arm circumference on lipid profile and blood pressure of the respondents separated by age category. Significant positive correlation existed between BMI and systolic bp ($R = 0.49$, $p = 0.018$) as well as between BMI and diastolic bp ($R = 0.47$, $p = 0.022$) among the boys. Notably, significant correlation occurred between waste circumference and diastolic bp ($R = 0.38$, $p = 0.016$) among the boys. No observable correlation among analytes and blood pressure levels measured ($p > 0.05$).

The results of the 95th percentile value for parameters measured for participants based on age category and gender has been presented. At least 95% of the boys in the study had total cholesterol levels within 132 mg/dL in the 1-3 years age category compared 124mg/dL among the girls of same age. Similarly, total

cholesterol within the 7-9 years age category was 127 mg/dL among the boys compared to 110 mg/dL for the girls (Table 5).

Significant distinctions in the distribution of lipid profiles as well as blood pressures among both genders were evidenced as provided by their chi-squared distribution ($p < 0.05$) (Table 5). Going by their respective mean ranks, it was observed that total cholesterol for boys were relatively higher (rank 5.25) compared to those of the girls within the age brackets sampled (rank 3.75). Similarly, higher levels of HDL cholesterol were observed in the boys. However, higher levels of triglycerides, LDL cholesterol, NHDL cholesterol, VLDL cholesterol were observed in the girls than in the boys. No distinction in systolic bp between the two genders was observed.

Discussion

There are a variety of ways to assess a person's risk of dyslipidemia and atherosclerosis, even if they appear to be in good health. The risk factors linked to lipid profiles are extremely significant. This research looked at the lipid profiles of seemingly healthy boys and girls (ages 1 to 12) with the goal of assessing lipid concentration, progression and its relationship with sex. In a previous study

Table 2. Serum lipid profile levels in the study population.

Gender	Age (years)	(n)	Total cholesterol	Triglycerides	HDL cholesterol	LDL cholesterol	NHDL cholesterol	VLDL
Boys	1-3	22	88.4±25.5	70.8±23.9	39.0±7.6	34.8±16.6	49.4±20.3	14.2±4.8
	4-6	12	69.8±25.7	50.9±20.8	34.2±8.4	25.1±16.5	35.7±18.8	10.2±4.2
	7-9	14	79.0±22.2	58.2±19.9	37.7±7.8	28.9±13.1	41.3±15.6	11.6±4.0
	10-12	7	87.3±25.1	77.6±32.6	40.0±9.6	31.3±12.1	47.3±17.4	15.5±6.5
	p-value		0.191	0.044	0.337	0.345	0.202	0.044
Girls	1-3	21	83.6±24.1	68.1±23.4	37.5±7.7	32.1±13.9	46.0±17.7	13.6±4.7
	4-6	15	69.8±25.3	53.5±26.7	32.8±9.3	25.3±13.0	37.0±17.8	10.7±5.3
	7-9	11	95.5±32.3	81.5±41.5	38.5±8.8	40.1±19.2	57.0±24.6	16.3±8.3
	10-12	8	75.6±19.2	48.9±22.8	36.5±3.8	28.8±12.9	39.1±17.0	9.8±4.6
	p-value		0.086	0.043	0.252	0.097	0.064	0.043

VLDL very low density lipoprotein.

Table 3. Bivariate correlation between BMI, waste circumference and mid-upper arm circumference on lipid profile and blood pressure of the respondents separated by gender.

Parameter		Boys				Girls			
		age grp	BMI	Waist circ	MUAC	age grp	BMI	Waist circ	MUAC
Total cholesterol	R	-0.073	-0.046	-0.163	0.018	-0.073	-0.046	-0.163	0.018
	p-value	0.594	0.736	0.234	0.898	0.594	0.736	0.234	0.898
Tryglyceride	R	-0.028	0.017	-0.145	0.175	-0.028	0.017	-0.145	0.175
	p-value	0.839	0.9	0.29	0.202	0.839	0.9	0.29	0.202
HDL Cholesterol	R	0.005	0.116	-0.082	0.112	0.005	0.116	-0.082	0.112
	p-value	0.971	0.398	0.552	0.416	0.971	0.398	0.552	0.416
LDL Cholesterol	R	-0.12	-0.146	-0.18	-0.094	-0.12	-0.146	-0.18	-0.094
	p-value	0.385	0.286	0.188	0.495	0.385	0.286	0.188	0.495
NHDL Cholesterol	R	-0.1	-0.112	-0.182	-0.025	-0.1	-0.112	-0.182	-0.025
	p-value	0.467	0.415	0.183	0.858	0.467	0.415	0.183	0.858
VLDL Cholesterol	R	-0.028	0.017	-0.145	0.175	-0.028	0.017	-0.145	0.175
	p-value	0.839	0.9	0.29	0.202	0.839	0.9	0.29	0.202
Systolic bp	R	0.320*	0.05	0.388*	0.297*	0.320*	0.05	0.388*	0.297*
	p-value	0.017	0.718	0.003	0.027	0.017	0.718	0.003	0.027
Diastolic Bp	R	0.083	-0.007	0.293*	0.103	0.083	-0.007	0.293*	0.103
	p-value	0.548	0.96	0.03	0.452	0.548	0.96	0.03	0.452

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

of Nigerian children under the age of five, Akuyam *et al.* found that serum total cholesterol levels decreased with age, with a greater decrease between the first and second years of life.¹⁰ In the current study, however, there were no significant differences in TC between the sexes as age progressed from 1 to 12 years. Shawar *et al.*¹¹ found a relatively high prevalence of hypercholesterolemia among young university students aged 16 to 30 at Arabian Gulf University. They reported that factors such as obesity, a fatty diet, and the epigenetics of their subjects may have led to the early hypercholesterolemia found by Shawar *et al.*¹¹ In the present study, however, obesity as a risk factor for dyslipidemia in children was minimal ($p > 0.05$).

Tables with age and gender-based percentiles for serum lipid profile levels in seemingly stable children on regular check-up visits in a secondary health facility are provided in this report. The current study found that blood lipid components differed by gender within specific age group, with the highest level occurring between the ages of 7 and 12. The total cholesterol levels of male children were higher than those of female children in the same age groups. Furthermore, the boys had higher HDL cholesterol levels. Triglycerides, LDL cholesterol, NHDL cholesterol, and VLDL cholesterol were all higher in the girls than in the boys. In a related

study, Martinez *et al.*¹² found that Total cholesterol, High Density Lipoprotein-Cholesterol, and Low Density Lipoprotein-Cholesterol levels did not vary significantly by sex until children were 12 years old. In puberty, however, they were substantially higher in girls than in boys. Triglycerides and Very Low Density Lipoprotein-Cholesterol levels, on the other hand, were higher in girls than in boys until they were 12 years old, after which there was no difference.

Although there was no significant link between lipid profiles and blood pressure in this study, Armstrong *et al.*¹³ found a link between a poor lipid profile and an increase in blood pressure, particularly when combined with other risk factors, conditions that favor the development of atherosclerosis in children. Patterns of change in blood lipid components with age differ significantly among gender and racial groups, according to Dai *et al.*¹⁴ Increased body fatness in children is found to be linked with a rise in blood lipid levels. Blood lipid levels should be assessed taking into account differences in age, gender, and race.

The key drawback of this research was that it took longer to achieve the sample population of 220 participants, owing to most parents' refusal to volunteer permission for their children to be included in the study.

Table 4. Bivariate correlation between BMI, waste circumference and mid-upper arm circumference on lipid profile and blood pressure of the respondents separated by age category.

		1-3 years			4-6 years		7-9 years		10-12 years			BMI	Waist_circ	MUAC
		BMI	Waist_circ	MUAC	BMI	Waist_circ	MUAC	BMI	Waist_circ	MUAC				
Tchol	R	-0.002	-0.159	-0.172	-0.205	-0.235	0.009	-0.162	0.073	-0.116	0.062	0.343	0.299	
	p-value	0.988	0.333	0.294	0.349	0.281	0.968	0.449	0.733	0.591	0.834	0.231	0.299	
Tryg	R	0.041	-0.262	-0.186	-0.117	-0.192	0.11	-0.229	0.072	-0.077	0.073	0.301	0.277	
	p-value	0.802	0.107	0.257	0.595	0.38	0.616	0.282	0.738	0.720	0.803	0.296	0.338	
HDL_Cholesterol	R	0.112	-0.025	0.02	-0.066	-0.133	0.161	-0.102	0.139	0.001	0.148	0.111	0.132	
	p-value	0.497	0.88	0.905	0.765	0.546	0.463	0.635	0.518	0.996	0.614	0.705	0.653	
LDL_Cholesterol	R	-0.071	-0.162	-0.23	-0.275	-0.245	-0.101	-0.141	-0.013	-0.196	-0.019	0.407	0.318	
	p-value	0.669	0.324	0.158	0.204	0.261	0.647	0.511	0.953	0.358	0.947	0.148	0.267	
NHDL_Cholesterol	R	-0.049	-0.198	-0.234	-0.254	-0.263	-0.065	-0.174	0.044	-0.152	0.017	0.396	0.331	
	p-value	0.766	0.226	0.152	0.243	0.224	0.769	0.415	0.840	0.478	0.955	0.161	0.248	
VLDL_Cholesterol	R	0.041	-0.262	-0.186	-0.117	-0.192	0.11	-0.229	0.072	-0.077	0.073	0.301	0.277	
	p-value	0.802	0.107	0.257	0.595	0.38	0.616	0.282	0.738	0.720	0.803	0.296	0.338	
Sys_bp	R	0.123	0.045	-0.075	0.489*	0.344	0.34	0.222	0.044	0.086	0.353	0.318	-0.025	
	p-value	0.456	0.787	0.649	0.018	0.108	0.112	0.298	0.838	0.691	0.216	0.269	0.931	
Dia_Bp	R	0.035	0.383*	-0.028	0.474*	0.183	0.344	0.128	-0.108	0.101	0.349	0.294	-0.074	
	p-value	0.833	0.016	0.863	0.022	0.403	0.108	0.551	0.617	0.637	0.221	0.307	0.801	

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed). BMI body mass index, Waist. Circ waist circumference, MUAC Mid under arm circumference.

Table 5. 95th percentile value for lipid profiles of participants based on age category and gender

Parameters	Boys			Girls			Mean rank		χ^2	df	p-value		
	1-3 (years)	4-6 (years)	7-9 (years)	10-12	1-3	4-6	7-9	10-12				Boys	Girls
Total cholesterol	132.0	126.0	127.0	121.0	124.0	119.0	157.0	110.0	5.25	3.75	0.75	1	0.391
Triglycerides	109.3	95.0	103.0	126.0	108.0	110.0	149.0	81.0	4.25	4.75	0.08	1	0.773
HDL-Cholesterol	48.0	46.0	58.0	58.0	50.0	49.0	51.0	43.0	5.00	4.00	0.34	1	0.562
LDL-Cholesterol	68.1	69.0	48.0	47.0	54.0	52.0	82.0	50.0	4.00	5.00	0.33	1	0.565
NHDL-Cholesterol	89.3	81.0	69.0	63.0	74.0	73.0	106.0	67.0	4.25	4.75	0.08	1	0.774
VLDL	21.9	19.0	20.6	25.2	21.6	22.0	29.8	16.2	4.25	4.75	0.08	1	0.773

VLDL very low density lipoprotein.

Conclusions

The findings of this study have highlighted the importance of comprehensive routine dyslipidaemia screening among children. Regular screening will aid in determining the status and risk factors for dyslipidemia and atherosclerosis, allowing for early detection and treatment, and eventually lowering the risk of cardiovascular disease. Given the abundance of evidence in the literature connecting the incidence of dyslipidemia in children, it is imperative that children be screened early. As a result of providing a 95th percentile of lipid profiles of apparently healthy children, this may be used to test children for dyslipidemia.

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