PREVALENCE AND RISK FACTORS OF HYPERTENSION IN CHILDREN AGED 5 – 20 YEARS IN FOUR DISTRICTS OF JIMMA ZONE

By

FEKADU ABDISSA DENU, MD

A SENIOR PAPER TO BE SUBMITTED TO DEPARTMENT OF PEDIATRICS AND CHILD HEALTH, JIMMA UNIVERSITY COLLEGE OF PUBLIC HEALTH AND MEDICAL SCIENCES, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE SPECIALTY CERTIFICATE IN PEDIATRICS AND CHILD HEALTH.

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ADVISERS:

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ABSTRACT

Background: Unarguably hypertension is a major contributor to morbidity and mortality in adults not to mention the huge health care cost it poses to the economy. It is thought that adult hypertension might have its origin early in childhood and went undetected. Childhood blood pressure screening, particularly at schools is believed to fill this gap as also been recommended by the American heart association.

Objective: This study aimed at finding the prevalence of high blood pressure in apparently healthy school children and looking for the risk factors.

Subjects and Methods: A cross-sectional study design was conducted based on a secondary data collected primarily for the purpose of studying the prevalence of rheumatic heart disease in apparently healthy 2,000 school children and adolescents in four districts of Jimma zone. This current study addressed 1067 children sampled from the source population using a computer generated simple random sampling method after constructing sampling frame. The data for the study participants were retrieved from the data base by a trained research assistant and data was checked for completeness and consistency. Each variable in the data such as blood pressure, and body mass index was categorized based on the standard charts recommended by the world health organization. Data analysis was done by using SPSS for windows, version 16. The research undertaking was funded by Jimma University student research program.

Results: The prevalence of high blood pressure in the study population is 17.4%; whereas children with pre – hypertension accounted for 15.2% of the population studied. With regard to nutritional status, the prevalence of overweight and obesity are 2.4 % and 1%, respectively. The remaining children are either under-weight (15.3%) or normal (81.3%). Bivariable logistic regression analysis was done and all the background variables have a statistically significant association with the outcome variable, hypertension (Systolic, diastolic, or overall hypertension). Females and those in the age group 10-20 years are more likely to develop overall hypertension (AOR=1.53 and 1.68, p=0.010 and 0.006 & 95% CI of 1.11 – 2.11 and 1.16-2.43, respectively), and therefore sex and age group are the variables independently associated with the development of overall hypertension according to this study.

Conclusion: *The prevalence of hypertension in these apparently healthy school children is significantly high. There is a statistically significant positive association between all the independent variables with the presence of systolic, diastolic or overall hypertension. The fact that this blood pressure measurement was done once might give an impression that the actual prevalence will be low; even then this figure is so high that it is recommended to periodically screen school children for high blood pressure as that will open a window of opportunity to intervene before it is late. A more practical and achievable first step would be to at least conduct a routine blood pressure measurement for all children visiting pediatric outpatient and inpatient facilities, which is not happening at the moment; and it is the recommendation of this study to implement this strategy as it will pave the way for a more wider look in to the case.*

ACKNOWLEDGEMENTS

I would like to take this opportunity to extend my gratitude to the department of pediatrics and child health, Jimma University for offering me the opportunity to undertake this research project and for the support I am provided with right from the very beginning.

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I can't thank the *End Rheumatic Fever / Rheumatic Heart Disease – Ethiopia Project* Principal Investigator, Professor Abraham Haileamlak enough, for allowing me to use the original data for my current study.

Finally, Mr. Wondimu Daniel, a research assistant and echocardiography technician, deserves special mention, for his cooperation with the original data base working as a data retriever, and I am grateful.

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Chapter 1: INTRODUCTION

1.1 BACKGROUND: Systemic hypertension was previously considered exclusively the disease of adults, and therefore the data concerned with the normal values, defining hypertension, and study of the mechanisms involved have centered on the adult population. But the last two decades or so has seen a surge in pediatric hypertension mainly attributed to the rising childhood obesity and interest has grown in study of high blood pressure in children and adolescents (1).

In infants and young children, the prevalence of systemic hypertension is rare, less than 1%; and when it occurs is often secondary. But the prevalence rises as the child gets older; with 4% of the overall American youth having verified hypertension and 10% pre-hypertension. The increased prevalence corresponds with the obesity epidemic which is found in as much as 20% of American youth. The burden of pediatric hypertension goes well beyond childhood period as almost half of hypertensive adults had at least pre-hypertension blood pressure readings as children. This emphasizes the fact that high blood pressure tends to track its way in to adulthood, a concept called, blood pressure tracking and adds to the importance of blood pressure monitoring in children. This tracking is especially true for children with certain risk factors such as obesity and family history of hypertension (2, 3).

1.2 STATEMENT OF THE PROBLEM: Childhood hypertension is emerging as a global public health problem, and not just limited to the industrialized nations. A number of studies have demonstrated this, though the figures differ in different places. The values range from 2.2% in Switzerland school children to 21.5% of adolescents in one state of India. In majority of the cases obesity is to blame for the surge; and contrary to the previous thinking the obesity epidemic has evolved to affect the non-industrialized countries as well. In fact in just over a decade, three fourth of the world's obese population will be living in the non-industrialized parts of the globe.

It appears now that there is no need to look at the projected figures to appreciate the rising rates of childhood obesity in under developed countries; it has already taken place. For instance the figure stands at 18% for children aged 5-15 years in Nigeria (4); still in Africa, 14.1% of adolescents in Addis Ababa (3) and 2.7% of adolescents in Hawassa (5) are obese; this means that such countries have to deal with the so called double burden of malnutrition and the consequences thereof, the major one being hypertension. This is a proof that no country, developed or underdeveloped, is exempt from the obesity plague, and that hypertension remains to be a concern, as 10% of these obese children will eventually develop high blood pressures (1,6, 7).

There appears to be a paucity of studies on prevalence and determinants of childhood hypertension in most developing nations in general, and Ethiopia in particular. It is also true that blood pressure measurement is often over looked in general pediatric care; and school screening is not often done. Such activities are vital for early diagnosis of hypertension, which in turn is an important strategy in its control, effective treatment, and prevention of complications (1, 8, 9).

Chapter 2: LITERATURE REVIEW:

The definition of hypertension in children and adolescents is based on the normative distribution of blood pressure in healthy children. A child is said to have hypertension when either the systolic or the diastolic or both blood pressure reading is at or above the 95th percentile for age, sex and height on at least three separate occasions. Values between 90th and 95th percentile are labeled “high – normal” or pre-hypertension and warrants follow up because of possibility of eventual development of hypertension, especially in the presence of risk factors. Measurements need to be taken with appropriate sized cuffs and calm environment to avoid false readings. Children with higher readings in a clinic set up but normalize while at home are considered to have “white coat hypertension” and such diagnosis requires ambulatory blood pressure measurement for confirmation. It is the recommendation of the American heart association that every child aged 3 years and older should have blood pressure measured at least once a year or preferably at every health care episode. For children less than 3 years of age blood pressure measurement is conducted under selected circumstances such as history of prematurity, congenital heart disease, renal disease, and other illnesses associated with hypertension (2, 9,10).

The prevalence of pediatric hypertension worldwide is not well known, due to regional differences in the definition of high BP, the distribution of reference BP data, and the BP measurement methodology. Following the recommended three separate measurements in children with an initial BP measurement at or greater than 95th percentile, the world wide prevalence is expected to be 1 – 3 %. Using the above recommendation, a study involving over 14, 000 healthy children aged 3 to 18 years found a prevalence of 3.6 % for hypertension and 3.4 % for pre-hypertension. In the study, a higher rate of obesity is a factor associated with increased blood pressure reading. This observed prevalence will make high blood pressure in children and adolescents a global public health concern considering the fact that there is tracking of blood pressure readings from childhood to adult life. This is further supported by the finding that children and adolescents with blood pressure over 90th percentile for age have about three fold increased chance of being hypertensive adults compared with their peers with normal blood pressure (8, 9, 11, 12, 13).

Childhood hypertension has multifactorial causes. It could be either primary (essential) or secondary, the latter being high blood pressure which is a result of another disease process. In general, the younger the child it is more likely that the hypertension is secondary. Hypertension during early childhood may be due to renal disease, coarctation of the aorta, endocrine disorders, or medications. In older school-aged children and adolescents**,** primary hypertension becomes increasingly common. Secondary hypertension in children is most commonly due to renal abnormalities; with cardiovascular disease or endocrinopathies being additional etiologies. Endocrine diseases involving thyroid, parathyroid and adrenals are particularly associated with hypertension.

Renal diseases account for almost 90 % of secondary hypertension. The genesis of essential hypertension could be interplay of several factors including: Obesity, insulin resistance, activation of sympathetic nervous system, sodium homeostasis, renin-angiotensin system (RAS), vascular smooth muscle structure and reactivity, and genetic factors. Obesity in children is well known to be associated with hypertension. Data from a recent study covering 25,000 school children in the age group of 5–16 years reported increased prevalence of pre-hypertension and hypertension among overweight and obese children when compared to their non-overweight counterparts. Hypertension (first instance) was seen in 10.10% of normal weight, 17.34% of overweight and 18.32% of obese children in this study. Suggested mechanisms of obesity-related hypertension include insulin resistance, sodium retention, increased sympathetic nervous system activity, activation of renin-angiotensin- aldosterone system (RAAS), and altered vascular function (2, 11).

Many children with primary hypertension are asymptomatic and only identified on routine medical examination, emphasizing the need for blood pressure screening in healthy children and adolescents. Those with secondary hypertension may also be asymptomatic and present only with the features of underlying disease, unless the blood pressure is rising rapidly or is severe. For symptomatic ones, the presenting features vary widely with age; infants commonly come with cardiac failure and respiratory distress, in addition irritability and failure to thrive are also not uncommon. During childhood headache, nausea and facial weakness are common features. Coma and hypertensive encephalopathy develop in about 10 % of children. Subclinical target organ damage is another common presentation of children with essential hypertension such as left ventricular hypertrophy, which is found in up to 40% of hypertensive children. Other markers of end organ damage include micro –albuminuria, and hypertensive retinopathy. In light of these, evaluation of a child with hypertension should, therefore focus on thorough search for possible secondary cause, looking for co-morbidities, and screening for evidence of end organ damage. Because primary hypertension often co-exists with other cardiovascular risk factors, the medical history, physical examination and laboratory work up of these children must address factors like lipid profile and glucose intolerance (2, 5, 14).

Management of children with hypertension has to be individualized based on specific child presentation, stage of hypertension and presence of comorbidities among other things. It ranges from life style modification and long term drug therapy to emergency lifesaving therapies. Currently data are lacking to tell the long term outcome of childhood hypertension with regard to cardiovascular events in adults; however it is evident that vascular injuries do exist in the young with left ventricular hypertrophy being the commonest one. On top of the established vascular complications that occur with hypertension, currently there is emerging evidence that cognitive function is even adversely affected by elevated blood pressure in children (2, 12, 13).

Development of essential hypertension may be prevented or delayed through different interventions. Population approaches to prevention of primary hypertension can be achieved through school and community-based programs. Lifestyle interventions are more likely to be successful and the absolute reductions in risk of hypertension are likely to be greater when targeted in persons who are older and those who have a higher risk of developing hypertension compared with their counterparts who are younger or have a lower risk. However, prevention strategies applied early in life provide the greatest long-term potential for avoiding the precursors that lead to hypertension and elevated blood pressure levels and for reducing the overall burden of blood pressure related complications in the community. Among the recommended strategies, weight loss, reduced dietary sodium intake, and increased physical activity are considered the best proven interventions for prevention of hypertension (2, 15).

Implementation of preventive strategies at all levels requires the realization that childhood hypertension is a public health concern. Acknowledging childhood hypertension as a major public health problem paves the way for policy makers and that helps make the issue a priority area for further investigation and intervention. A prevalence figure therefore becomes necessary and serves as a platform on which population based programs can be launched and also justifies the urgency of the problem.

SIGNIFICANCE OF THE STUDY:

This study aims at determining the local prevalence of childhood hypertension for which data appears to be lacking. By so doing it may be used as a baseline data for further investigation in to the subject. It is also hoped to serve as a platform on which different interventional programs ranging from public awareness rising to active medical therapy can be carried out.

CONCEPTUAL FRAMEWORK:

The most important factors considered as predisposing to childhood hypertension are genetic susceptibility and obesity. In the case of adolescent's additional life style risks such as smoking, reduced exercise and illicit drug use also play a role in the causation and contribute to poor response to therapy. Variation in figures between dwellers of urban and rural areas has been noted possibly related to the difference in life style and activity level. In addition, comorbid medical conditions such as cardiovascular diseases, renovascular disorders and endocrinopathies may contribute to the development of hypertension and alter its course and treatment. Nevertheless, the cause for significant proportion of hypertensive children remains unclear and so termed essential hypertension. As for the secondary hypertension, either a single cause is identified or it results from interplay between different variables.

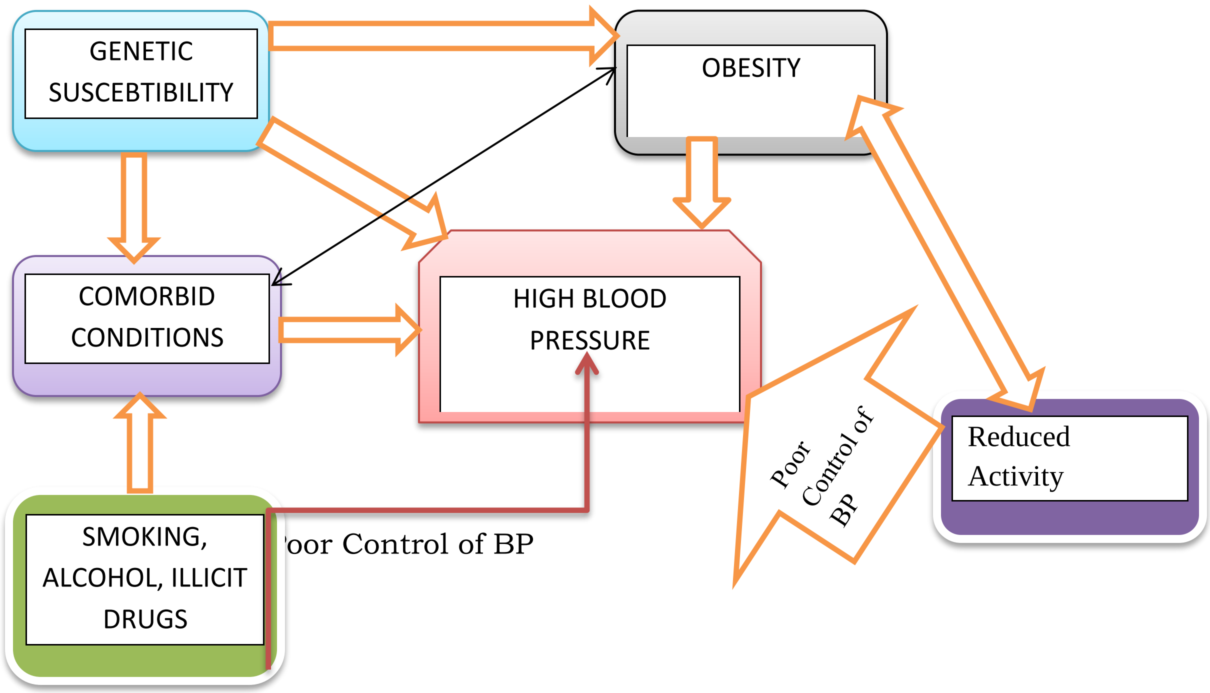

Figure: A schematic representation of factors contributing to the development of hypertension and altering its course.

Chapter 3: OBJECTIVES:

3.1 General Objective: to determine the prevalence of hypertension and associated factors in school children in four districts in Jimma zone.

3.2 Specific Objectives:

- To determine the prevalence of hypertension in school children in four districts in Jimma zone.
- To describe patterns of high blood pressure in different age group among children aged 5 to 20 years in four districts of Jimma zone.
- To identify factors associated with high blood pressure in school children in four districts in Jimma zone.

Chapter 4: METHODS AND MATERIALS

Secondary data was utilized to conduct the current study. The primary study was conducted on 2,000 children in four districts of Jimma zone for the purpose of determining the prevalence of rheumatic heart disease.

4.1 Study Design: Crossectional study design

4.2 Study period and area: The primary data was collected from four districts of Jimma zone (Kersa, Sokoru, Tiro Afeta and Omo Nada) from January 2012 to May 2013. The current study is based on data obtained from the primary study in April 2014. The data was retrieved by a research assistant.

4.3 Sampling Methods:

4.3.1 Sample size determination: The following formula is used to draw a sample from the population of 2,000.

$n = Z^2 p\,(1-p) / w^2$ (Given there is no previous similar study, p value of 50% and w of 3% is used).

$= (1.96)^2 0.5(1- 0.5) / (0.03)^2$

$= 3.84\ (0.5 \times 0.5) / 0.0009$

$= \underline{1067}$(Minimum sample size)

4.3.2 Sampling technique: sampling frame was made and simple random sampling used to select subjects for the study.

4.4 Data collection and measurement: The primary data was collected from apparently healthy school children. Interviews and physical examination were used as a means of data collection. Instruments such as blood pressure apparatus, weighing scale, stethoscope, and length measuring tools were used.

4.5 Study variables:

- 4.4.1 Independent variables: Age, Sex, Weight, Height, Body mass index, District.
- 4.4.2 Dependent variables: Blood pressure

4.6 Data processing and analysis: SPSS version 16.0 was used to analyze the secondary data. Descriptive analysis of variables like age, sex, weight, height was done using descriptive statistics like mean, median and proportion. Data was checked for normality of distribution. Then bivariable analysis was done for the outcome variables. The independent variables with p-values less than 0.25 during bivariable analysis were selected as candidates for multivariable analysis. Multivariable binary logistic regressions were fitted by using backward elimination technique. Association between dependent and independent variables was assessed using odds ratio (OR) and 95% Confidence Interval. Statistical Significance was declared at P value <0.05.

4.7 ETHICAL CONSIDERATION:

A written ethical approval was obtained from the University's ethical review board. Permission to use the secondary data was granted by the principal investigator of the primary study.

4.8 OPERATIONAL DEFINITIONS:

Hypertension: is defined as a blood pressure reading which is above the 95th percentile for the child's age, sex and height.

Body mass index (BMI): one measure of individuals nutritional status, expressed in terms of kilograms per meter square (Kg/m^2).

Normal BMI: a value between -2 SD and +1 SD on a WHO BMI for age Z-score chart.

Over weight: a BMI value of > +1 SD on a WHO BMI for age Z-score chart.

Obese: a BMI value of > +2 SD on a WHO BMI for age Z-score chart.

Thinness: a BMI value of < -2 SD on a WHO BMI for age Z-score chart.

Severe thinness: a BMI value of < -3 SD on a WHO BMI for age Z-score chart.

4.9 DISSEMINATION PLAN:

This research document is planned to be distributed to the department of pediatrics and child health, student research program (SRP), and the research advisors.

4.10 LIMITATIONS OF THE STUDY:

- Use of secondary data might have affected the final prevalence figure found, in that repeat measurement of raised blood pressures was not possible as the study is conducted long after the data collection period. This might be translated as the prevalence value of 17.40% as being beyond the actual figure expected had there been repeated measurement of the blood pressure for those subjects found to be hypertensive on the initial assessment.
- Figures from study based at schools may not represent the entire child population in the community.

Chapter 5: Results

Among the 1,067 subjects included in this study; 538 (50.42%) were females. The majority of the children, 694(65%) were in the age group 10 to 15 years, followed by those in the age group 5 to 9 years comprising 345 subjects (32.33%) - Table 1

TABLE 1: Distribution of study children showing background variables; age, sex, and nutritional status (n=1067).

VARIABLES		Frequency	Percent
AGE GROUP	5 to 9 years	345	32.33
	10 to 15 years	694	65.04
	16 to 20 years	28	2.63
SEX	Male	529	49.58
	Female	538	50.42
NUTRITIONAL STATUS	Underweight	163	15.28
	Normal	867	81.25
	Overweight	26	2.44
	Obese	11	1.03

With regard to nutritional status (indicated by body mass index, BMI), majority of the children studied are normal, 867 (81.30%); while 163 (15.30%) are under weight. Only 37 (3.40%) of the children fall under the category over weight and obese. There are more underweight males than females, and almost all of the cases are found in the age group 5 to 15 years. (Table 1)

It is important to note that even though the number of obese children is quiet small within the whole study subjects, more than 45% of those obese are accounted for by children in the age group 5 to 9 years. Similarly, all of those overweight children are below the age of 15 years.

Tables 2 through 7 depict the distribution of systolic blood pressure, diastolic blood pressure and over all presence of hypertension. As can be seen from the tables considerable number of children are found to be hypertensive; 110(10.30%), and 155(14.50%) of the subjects have systolic and diastolic hypertension, respectively.

Taking subjects with either systolic or diastolic hypertension together makes children with elevated blood pressure 185 (17.40%) of the total population studied.

It is also remarkable that 162 (15.20%) of the total children are pre – hypertensive, which adds an emphasis to the importance of this and similar studies in identifying children at risk of developing hypertension. Such children are potential targets of preventive strategies aimed at preventing or delaying the occurrence of hypertension.

Close to 75% of the hypertensive children are found in the age group 10 to 15 years in both sexes.

Comparing sexes there are more female children with hypertension 110(59.46%).

Table 2: Distribution of systolic blood pressure of study children

Systolic Blood Pressure (SBP)	Frequency	Percent	Cumulative Percent
Normal systolic blood pressure	829	77.7	77.7
Pre hypertension (Systolic)	128	12.0	89.7
Stage 1 systolic hypertension	108	10.1	99.8
Stage 2 systolic hypertension	2	0.2	100.0
Total	1067	100.0	

Table 3: Distribution of diastolic blood pressure of study children

Diastolic Blood Pressure (DBP)	Frequency	Percent	Cumulative Percent
Normal diastolic blood pressure	765	71.7	71.7
Pre hypertension (Diastolic)	147	13.8	85.5
Stage 1 diastolic hypertension	154	14.4	99.9
Stage 2 diastolic hypertension	1	0.1	100.0
Total	1067	100.0	

Table 4: Distribution of overall presence of hypertension (either systolic or diastolic) in the study children

Presence of Hypertension	Frequency	Percent	Cumulative Percent
No hypertension	720	67.5	67.5
Pre hypertension	162	15.2	82.7
Stage 1 hypertension	182	17.1	99.7
Stage 2 hypertension	3	0.3	100.0
Total	1067	100.0	

Table 5: Distribution of systolic blood pressure of the study children by age, sex and BMI:

Variables	NORMAL SBP		PRE-Hypertension (SBP)		STAGE 1 Hypertension (SBP)		STAGE 2 Hypertension (SBP)	
	No	%	No	%	No	%	No	%
Age group								
5-9 YRS	291	27.27	26	2.44	27	2.53	1	0.09
10-20 YRS	538	50.42	102	9.56	81	7.59	1	0.09
Sex								
Female	408	38.24	64	6.00	65	6.09	1	0.09
Male	421	39.46	64	6.00	43	4.03	1	0.09
BMI								
Underweight /Normal	810	75.91	120	11.25	98	9.18	2	0.19
Overweight /Obese	19	1.78	8	0.75	10	0.93	0	0.00

Table 6: Distribution of diastolic blood pressure (DBP) of the study children by age, sex & BMI:

Variables	NORMAL DBP		PRE-Hypertension (DBP)		STAGE 1 Hypertension (DBP)		STAGE 2 Hypertension (DBP)	
	No	%	No	%	No	%	No	%
Age group								
5-9 YRS	269	25.21	44	4.12	31	2.91	1	0.09
10-20 YRS	496	46.48	103	9.65	123	11.53	0	0.00
Sex								
Female	364	34.11	82	7.69	91	8.53	1	0.09
Male	401	37.58	65	6.09	63	5.90	0	0.00
BMI								
Underweight /Normal	747	70.00	137	12.84	145	13.59	1	0.09
Overweight /Obese	18	1.69	10	0.94	9	0.85	0	0.00

Table 7: Distribution of overall presence of hypertension (either systolic or diastolic) by age, sex and BMI:

Variables	NO HYPERTENSION		PRE-HPERTENSION		STAGE 1 HYPERTENSION		STAGE 2 HYPERTENSION	
	No	%	No	%	No	%	No	%
Age group								
5-9 YRS	253	23.71	49	4.59	41	3.84	2	0.19
10-20 YRS	467	43.76	113	10.59	141	13.21	1	0.09
Sex								
Female	345	32.33	83	7.78	108	10.12	2	0.19
Male	375	35.15	79	7.40	74	6.94	1	0.09
BMI								
Underweight /Normal	702	65.79	154	14.43	171	16.02	3	0.28
Overweight /Obese	18	1.69	8	0.75	11	1.03	0	0.00

Tables 8 through 13 present associations between the dependent variable (blood pressure) and background variables; age group, sex and body mass index (BMI). The crude and adjusted odds ratios with corresponding 95% confidence interval (95% CI) and p-values are indicated.

Table 8: Association between the background variables (age, sex and BMI) and systolic blood pressure (Showing COR)

Variables	Systolic Hypertension			COR*	95% C.I	P-Value
	YES	NO	Total			
AGE GROUP						
5-9 years	28	317	345	1		
10-20 years	82	640	722	1.45	0.93 – 2.27	0.11**
TOTAL	110	957	1067			
SEX						
Female	66	472	538	1		
Male	44	485	529	1.54	1.03 – 2.30	0.04
TOTAL	110	957	1067			
BMI						
Underweight /Normal	100	930	1030	1		
Overweight /Obese	10	27	37	3.44	1.62 – 7.32	0.001
TOTAL	110	957	1067			

*Crude odds ratio

**Considered candidate for multivariable analysis

Table 9: Association between the background variables (age, sex and BMI) and systolic blood pressure (Showing AOR)

Variables	Systolic Hypertension			AOR*	95% C.I	P-Value
	YES	NO	Total			
SEX						
Female	66	472	538	1		
Male	44	485	529	1.53	1.02 – 2.29	0.04
TOTAL	110	957	1067			
BMI						
Underweight /Normal	100	930	1030	1		
Overweight /Obese	10	27	37	3.42	1.60 – 7.29	0.001
TOTAL	110	957	1067			

*Adjusted odds ratio; adjusted for age group.

Table 10: Association between the background variables (age, sex and BMI) and diastolic blood pressure (Showing COR)

Variables	Diastolic Hypertension			COR	95% C.I	P-Value
	YES	NO	Total			
AGE GROUP						
5-9 years	32	313	345	1		
10-20 years	123	599	722	2.01	1.33 – 3.03	0.001
TOTAL	155	912	1067			
SEX						
Female	92	446	538	1		
Male	63	466	529	1.53	1.08 – 2.16	0.017
TOTAL	155	912	1067			
BMI						
Underweight / Normal	146	884	1030	1		
Overweight / Obese	9	28	37	1.95	0.90 – 4.21	0.09*
TOTAL	155	912	1067			

***Considered candidate for multivariable analysis

Table 11: Association between the background variables (age, sex and BMI) and diastolic blood pressure (Showing AOR) – Adjusted for BMI

Variables	Diastolic Hypertension			AOR	95% C.I	P-Value
	YES	NO	Total			
AGE GROUP						
5-9 years	32	313	345	1		
10-20 years	123	599	722	1.98	1.31 – 2.30	0.001
TOTAL	155	912	1067			
SEX						
Female	92	446	538	1		
Male	63	466	529	1.50	0.99 – 2.01	0.022
TOTAL	155	912	1067			

Table 12: Association between the background variables (age, sex and BMI) and overall presence of hypertension (Showing COR)

Variables	Has Hypertension			COR	95% C.I	P-Value
	YES	NO	Total			
AGE GROUP						
5-9 years	43	302	345	1		
10-20 years	142	580	722	1.72	1.20 – 2.50	0.004
TOTAL	185	882	1067			
SEX						
Female	110	428	538	1		
Male	75	454	529	1.56	1.13 – 2.15	0.007
TOTAL	185	882	1067			
BMI						
Underweight /Normal	174	856	1030	1		
Overweight /Obese	11	26	37	2.08	1.01 – 4.29	0.047
TOTAL	185	882	1067			

Table 13: Association between the background variables (age, sex and BMI) and overall presence of hypertension (Showing AOR)

Variables	Has Hypertension			AOR	95% C.I	P-Value
	YES	NO	Total			
AGE GROUP						
5-9 years	43	302	345	1		
10-20 years	142	580	722	1.68	1.16 – 2.43	0.006
TOTAL	185	882	1067			
SEX						
Female	110	428	538	1		
Male	75	454	529	1.53	1.11 – 2.11	0.010
TOTAL	185	882	1067			
BMI						
Underweight /Normal	174	856	1030	1		
Overweight /Obese	11	26	37	1.98	0.95 – 4.11	0.068*
TOTAL	185	882	1067			

***The association of BMI with overall hypertension is marginally significant.**

Chapter 6: Discussion

The prevalence of hypertension in these 1067 study subjects sampled out from a total of 2004 apparently healthy school children is 17.40%. It has to be pointed out that owing to the purpose of the primary study not being studying hypertension, repeated measurement was not undertaken. This might put the current prevalence figure somehow beyond the actual figure that would have been observed with successive measurements. In a similar study conducted to screen school children for presence of hypertension, 8.90% of the children had blood pressure over the 95th percentile; and when a third measurement was undertaken only 1.20% continued to have blood pressure in the hypertensive range (8).

Coming to this study, even though the prevalence found with a single measurement is higher and the actual figure expected is to be lower, we believe that the result that would have been found with repeat measurement would remain considerably significant.

As to the possible risk factors and associated conditions, weight, height, BMI, sex and age were the only available variables to study. Considering these variables binary logistic regression was used for analysis of correlation. All the background variables were checked for association with systolic, diastolic, and overall presence of hypertension. The independent variables, male sex and overweight/obesity were found to be positively associated with the presence of systolic hypertension, with AOR of 1.53, and 3.42 respectively; and these associations were statistically significant with the p-value for each is well below 0.05 as shown in table 9.

With regard to diastolic hypertension; age group of 10 years and above, and male sex have a statistically significant positive association, with AOR of 1.98, and 1.50 respectively; and the corresponding p-values are well below 0.05 (Table 11).

Considering the outcome variable overall presence of hypertension, age group of 10 years and above, and male sex are positively associated with AOR of 1.68 and 1.53. This association is statistically significant with p-values of 0.006 and 0.010, and the 95% C.I being 1.16-2.43 and 1.11-2.11, respectively. Here being overweight/obese has marginally significant association with overall presence of hypertension; with AOR of 1.98, p-value of 0.068 and the 95% C.I of 0.95-4.11 (Table 13). Therefore, it can be said that being male and being in the age group 10-20 years, carries 1.53 and 1.68 times more risk of developing hypertension, respectively and that among the background variables studied here, sex and age group are independently associated with the presence of hypertension. The positive association between overweight/obese is statistically significant only with systolic hypertension, and it fall short of having a statistically significant association with the overall presence of hypertension, only marginally.

Considering the higher rate of under nutrition in the nation as a whole and in the study area in particular, subjects with overweight or obesity didn't make up a significant portion of the studied children.

As a result, the established fact that overweight/obesity are strongly associated with higher blood pressure could not be found to be statistically significant in this study, with regard to the overall presence of hypertension. Besides the under nutrition stated earlier, the study area being mainly rural country side might have also contributed to lower rate of overweight/obesity in these children. The figure might have been different in an urban setting, where such conditions are commonly seen.

Otherwise, our finding that being male and having BMI of overweight/obesity having a statistically significant association with the presence of hypertension (either systolic or overall), is in agreement with established facts and other studies conducted on the subject.

Use of large sample size and measurement of blood pressure by a calibrated instrument and a trained professional may be considered as the strengths of this study. To our knowledge, such a screening study is the first of its kind in the nation, which also adds to the strength and more even to the importance of the study.

Further studies based in a different setting and with inclusion of more variables are needed to understand exactly where the country stands with regard to pediatric hypertension. This study may serve as a plat form for such proceedings.

Chapter 7: Conclusions and Recommendations

The prevalence of hypertension in these apparently healthy school children is significantly high. There is a statistically significant positive association between male sex, age group 10-20 years and BMI of overweight/obesity, with the presence of systolic, diastolic, or overall hypertension. The fact that this blood pressure measurement was done once might give an impression that the actual prevalence will be low; even then this figure is so high that it is recommended to periodically screen school children for high blood pressure as that will open a window of opportunity to intervene before it is late. A more practical and achievable first step would be to at least conduct a routine blood pressure measurement for all children visiting pediatric outpatient and inpatient facilities, which is not happening at the moment; and it is the recommendation of this study to implement this strategy as it will pave the way for a more wider look in to the case.

Besides, we recommend undertaking of similar studies probably in an urban setting and more importantly with three measurement of blood pressure in order to have a more clear understanding of the prevalence as well as factors associated with pediatric hypertension in our nation.

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ANNEXES:

1) DATA COLLECTION FORMAT:

1) **Sociodemographics**:

Student Identification Number (Code): ---

Age (Years): ---------- Sex: ----------

Place of Residence: Zone: ---------------Woreda ------------------ Kebele ------------------

2) Anthropometric values:

Weight (Kgs): -------- Height (Meters): -------- Computed BMI (Kg/m^2): ---------

3) **Blood pressure (mmHg):** Systolic: ----------------- Diastolic: ---------------------

Systolic blood pressure percentile by height: ---------------------------------------

Diastolic blood pressure percentile by height: --------------------------------------