‘RURAL – URBAN’ COMPARISON OF THE KNOWLEDGE, PREVALENCE AND ASSOCIATED RISK FACTORS OF HYPERTENSION AMONG SECONDARY SCHOOL STUDENTS IN LAGOS STATE’

BY

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TO

A DISSERTATION SUBMITTED TO THE NATIONAL POSTGRADUATE MEDICAL COLLEGE OF NIGERIA IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF THE FINAL FELLOWSHIP OF THE MEDICAL COLLEGE IN PUBLIC HEALTH AND COMMUNITY MEDICINE

MAY, 2018
DECLARATION

I hereby declare that this dissertation titled ‘RURAL – URBAN COMPARISON OF THE KNOWLEDGE, PREVALENCE AND ASSOCIATED RISK FACTORS OF HYPERTENSION AMONG SECONDARY SCHOOL STUDENTS IN LAGOS STATE, NIGERIA.

Hereby submitted to the Faculty of Public Health, National Postgraduate Medical College of Nigeria, has been presented under appropriate supervision and has not been submitted by me in part or in full for any degree or examination at this or any other college/university and that all references have, to the best of my knowledge, been correctly reported.

It was written under the supervision of Dr. K AOdeyemiMPH, FMCPH

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DEDICATION

This dissertation is dedicated to all medical officers who decided to embark on residency programme late in their medical careers.
CERTIFICATION

This is to certify that this dissertation titled ‘RURAL – URBAN COMPARISON OF THE KNOWLEDGE, PREVALENCE AND ASSOCIATED RISK FACTORS OF HYPERTENSION AMONG SECONDARY SCHOOL STUDENTS IN LAGOS STATE.’ NIGERIA was written by Dr (Mrs.) Olayinka Olufunmilayo Coker under my direct supervision in the Department of Community Health and Primary Care, Lagos University Teaching Hospital Idi-Araba, Lagos State.

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ACKNOWLEDGEMENTS

I thank God for the gift of life, His great love for me and for the opportunity to write this dissertation.

I thank my late father Professor Adedayo Abegunde. He always believed in me. I thank my mother Mrs. M. B. Abegunde for her love and care for me from birth till date. I will also like to thank my siblings, Olu, Yemi, Kunle Wale and Sope Abegunde.

I thank my wonderful husband Dr. Rotimi Coker and lovely children Olamide and Mosope Coker for their love and support all through the years.

I thank all my course mates and other colleagues who have supported me while writing this dissertation.

A special thank you to the head of Department of Community Health and Primary care Lagos University Teaching Hospital Idi-Araba, Prof (Mrs.) O.A Abosede and my fantastic supervisors Dr (Mrs.) K.A Odeyemi and Dr. (Mrs.) O.O Odukoya for their constant encouragement and support in writing this dissertation. May God continue to bless you abundantly for your love and care for me during my residency training at your department.

I will also like to thank the following people for their help and support, Prof R.A Bello, Vice-chancellor, University of Lagos, Prof Duro Oni, Deputy Vice-chancellor, University of Lagos, Prof Toyin Ogundipe, Deputy Vice-chancellor, University of Lagos, Dr (Mrs.) TF Ipaye, Registrar, University of Lagos, Prof (Mrs.) Jane Ajuluchukwu, Chairman, Unilag medical center management board, Dr (Mrs.) R.A Apampa, Director Medical Services, University of Lagos, Prof Akin Osibogun, Prof AT Onajole, Prof Muyiwa Odisanya, Dr Y. Kuyinu, Dr B Oggunowo, Dr Alero Roberts, Dr T. Olufunlayo, Dr. F. Oridota, Dr Folu Olatona, Dr Abiola, Dr Oluchi Kamma-Okafor, Mr. Akinsola and other members of staff of the Department of Community Health and Primary Care Lagos University Teaching Hospital Idi-Araba,
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ABBREVIATIONS

ACAD    ACADEMIC
ADMIN   ADMINISTRATION
AIDS    ACQUIRED IMMUNE DEFICIENCY SYNDROME
BHS     BRITISH HEART SOCIETY
BMI     BODY MASS INDEX
BP      BLOOD PRESSURE
CVD     CARDIOVASCULAR DISEASE
DALYS   DISABILITY ADJUSTED LIFE YEARS
DASH    DIETARY APPROACHES TO STOP HYPERTENSION
DBP     DIASTOLIC BLOOD PRESSURE
ESC     EUROPEAN SOCIETY
HBP     HIGH BLOOD PRESSURE
HIV     HUMAN IMMUNODEFICIENCY VIRUS
HREC    HEALTH RESEARCH AND ETHICS COMMITTEE
IBM     INTERNATIONAL BUSINESS MACHINES
JNC     JOINT NATIONAL COMMITTEE ON THE PREVENTION
        DETECTION, EVALUATION AND TREATMENT OF HBP
JSS     JUNIOR SECONDARY SCHOOL
LGA     LOCAL GOVERNMENT AREA
NCD     NON COMMUNICABLE DISEASE
SBP     SYSTOLIC BLOOD PRESSURE
SSS     SENIOR SECONDARY SCHOOL
STEPS   TREATMENT STEPS FOR HYPERTENSION
TV      TELEVISION
UK      UNITED KINGDOM
UNAIDS  UNITED NATIONS PROGRAMMES ON HIV/AIDS
<table>
<thead>
<tr>
<th>USA</th>
<th>UNITED STATES OF AMERICA</th>
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<tbody>
<tr>
<td>VP</td>
<td>VICE PRINCIPAL</td>
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ABSTRACT

Hypertension is a significant contributor to morbidity and mortality. It is the most prevalent cardiovascular risk factor worldwide. Though generally believed to be a disease of adulthood, hypertension has been shown to start early in life. Adolescent hypertension can progress to adulthood. Early detection of hypertension may prevent complications. In Nigeria, the prevalence rate of adult hypertension ranges from 8% to 46% depending on the study target population, type of measurement and cut off value used for defining hypertension while the prevalence of adolescent hypertension ranges from 0.1% to 17.5%. Differences in prevalence rates in rural and urban areas exist for adults however data is sparse among adolescents.

Objective: The objective of this study was to determine and compare the knowledge, prevalence and associated risk factors for hypertension among students in secondary schools in rural and urban areas of Lagos state.

Methodology: The study was a cross sectional analytic study involving six hundred and seventy two students selected using the multistage sampling technique from sixteen secondary schools in two rural and two urban LGAs in Lagos state. Three hundred and thirty six students from rural and Three hundred and thirty six students from urban LGAs participated in the study. Interviewer administered questionnaires were used to collect data on the students’ knowledge of hypertension and the presence of its associated risk. Blood pressures and anthropometric measurements such as the height, weight, BMI, waist circumference and hip circumference of the participants were taken. A urine test was carried out on a subset of the participants to determine microalbuminuria. Data was analysed using SPSS version 20.0 Level of significance was set at p < 0.05.

Results: Majority of the students were 15 years and less. The mean age of the students was 14.4±2.2 years in the rural and 13.8±2.0 years in the urban areas, the difference in the ages
was found to be statistically significant with rural students being older. (p = 0.02) A higher proportion of the mothers of students in the urban schools had secondary and tertiary education 118 (35.1%), 145 (43.2%) in comparison to the mothers of the students in rural schools 111 (33.0%), 101 (30.1%) (p< 0.001) The awareness of hypertension among the rural 305 (90.8%) and urban 293 (87.2%) respondents was high (p = 0.139) The overall level of good knowledge among rural 160 (47.6%) and urban 157 (46.7%) respondents was low and no statistically significant difference was found between overall knowledge and the location of the schools (p = 0.435) The prevalence of hypertension was high among the respondents though significantly higher for the rural respondents 44 (13.1%) than the urban 26 (7.7%) (p = 0.023) Ever smoking, 29 (8.6%) urban and 16 (4.8%) rural (p = 0.045), Ever use of alcohol 53 (15.8%) urban and 31 (19.2%) rural (p = 0.010) Frequent consumption of sugary drinks 53 (17.4%) urban, 35 (10.5%) rural (p = 0.024) were significantly higher among students in urban areas than in rural areas. A family history of hypertension was significantly higher among students in rural 57 (17.0%) than in urban areas 32 (9.5%) (p = 0.017). A family history of hypertension was found to be significantly associated with being hypertensive in both rural and urban schools. The prevalence of microalbuminuria was high among rural 20 (13.8%) and urban 10 (6.9%) respondents. There was no statistically significant association between being positive for microalbuminuria and the location of the schools.

**Conclusion:** The prevalence of hypertension was high among rural and urban adolescents. Knowledge about hypertension among rural and urban adolescents is low and a family history of hypertension was found to be the principal risk factor for adolescent hypertension in this study. Health education, early lifestyle modification, screening for students with a positive family history for hypertension are recommended.
CHAPTER ONE

INTRODUCTION

BACKGROUND

Non-communicable diseases (NCDs), which include cardiovascular diseases, are the leading causes of death in the world and are responsible for a high number of disability adjusted life years (DALYS). Of the 56 million global deaths in 2012, 38 million, or 68%, were due to non-communicable diseases. The four main non-communicable diseases are cardiovascular diseases, cancers, diabetes, and chronic lung diseases. Until recently the burden of NCDs was thought to be a problem afflicting only affluent countries. However evidence has indicated that the problem affects the developing nations more than the developed ones. With the decline in the prevalence of many infectious diseases and a steady increment of NCDs as major causes of death, Nigeria and other sub-Saharan African countries are undergoing epidemiological transition. Globalization, the changing demographic dynamics, affluence, and the pattern of food consumption are responsible for this trend. In Nigeria, non-communicable diseases are currently responsible for at least 20% of all deaths and up to 60% of patients admitted into the medical wards of most tertiary hospitals in Nigeria have non-communicable diseases.

The increasing burden of cardiovascular diseases is largely due to the rising prevalence of many cardiovascular disease risk factors, particularly hypertension. Essential systemic arterial hypertension that used to be rare in traditional African societies, has rapidly become a major public health problem because of increasing urbanisation. This condition has been described as a multifactor disease involving several mechanisms, thus, leading to an increase in cardiac output and peripheral vascular resistance. Adult hypertension, a major public
health problem is a silent threat to the health of people all over the world and is the leading cause of premature death around the world.\textsuperscript{9} Elevated blood pressure or hypertension is an independent, linear and continuous risk factor for cardiovascular disease and has been reported in the young population.\textsuperscript{1}

Normal blood pressure values for children and adolescents are based on age, sex and height, and are available in standardised tables. Prehypertension is defined as a blood pressure in at least the 90\textsuperscript{th} percentile for age, sex and height, or a measurement of 120/80mmhg or greater. Hypertension is defined as blood pressure in the 95\textsuperscript{th} percentile or greater. It can be classified into primary hypertension in which a cause may not be identifiable and accounts for 95\% of all cases of hypertension.\textsuperscript{10} In secondary hypertension a cause is identifiable and accounts for 5-10\% of all cases of hypertension. Hypertension in adolescents commonly leads to hypertension in adulthood, with overweight and obesity being strongly correlated with primary hypertension in adolescents.\textsuperscript{11}

The proportion of the global burden of disease attributable to hypertension has significantly increased from about 4.5 percent (nearly 1 billion adults) in 2000 \textsuperscript{12} to 7 percent in 2010\textsuperscript{13} Hypertension often has no symptoms and has killed many people prematurely. In the medical ward of a hospital in Kano, Nigeria, as much as 25\% of all patients admitted die of complications of hypertension.\textsuperscript{14} A review of hypertension related admissions over 5 years in Enugu reported that hypertension related admissions represented 6.2\% of the total, with a case fatality rate of 42.9\%.\textsuperscript{15} In spite of these increases, the treatment outcomes for hypertension have remained poor even in the best tertiary hospitals in Nigeria.\textsuperscript{15}

The high prevalence of hypertension in developing countries has necessitated a considerable number of studies, one of which is the tracking of childhood/adolescent blood pressure.\textsuperscript{16} It is well established that high blood pressure can be identified in adolescents and it is increasing
in prevalence. It should also be noted that the prevalence of hypertension among adolescents increased in the last decade owing to the increase in the prevalence of obesity in this age group. For these reasons, apart from health education, screening for hypertension, ensuring antihypertensive drug compliance, and regular medical checkup among the adult population, young people must be assessed and managed for hypertension. Early diagnosis of hypertension is an important strategy in its control, and prevention of complications.

**STATEMENT OF THE PROBLEM**

Hypertension is a major contributor to the global disease burden and it poses an important public health challenge to both economically developing and developed countries. Hypertension is the most common non-communicable disease affecting both sexes in all races. It causes one in every eight deaths worldwide, making it the third leading killer disease in the world. Hypertension confers the highest attributable risk to deaths from cardiovascular disease, and epidemiological data provide convincing evidence that the risk of cardiovascular disease related to blood pressure is graded and continuous. It is also associated with high morbidity and mortality. According to the WHO, high blood pressure affects more than one in three adults worldwide and is estimated to cause 7.5 million deaths which, is about 12.8% of the total of all deaths worldwide. This accounts for 57 million DALYS or 3.7% of total DALYS. The proportion of hypertensives among people increases with age, from 1 in 10 people in their twenties and thirties, and 5 in 10 people in their fifties. There is strong evidence to suggest that hypertension and its associated complications are major health challenges of the 21st century. It is estimated that by the year 2025, 1.56 billion of the world’s population will be suffering from hypertension.
The reported prevalence of hypertension in adults ranges from 28% in North America to 44% in Western Europe, however, the reported rates vary worldwide. About 43 million people in the United States have hypertension or are taking antihypertensive medications and about 24% of adult Americans are hypertensive. In Poland, East Europe, males recorded a high prevalence of 68.9% while females recorded a higher prevalence of 72.5%. Similarly, in Brazil, some studies indicated that the prevalence rates were between 22% and 40% among Brazilian adults. A recent publication indicated that the prevalence rate of hypertension was highest in Africa, while the lowest was found in America.

Hypertension, which was almost nonexistent in African societies in the first half of the twentieth century, now has estimates showing that in some settings in Africa more than 40% of adults have hypertension. The prevalence of hypertension has increased significantly over the past two to three decades. There were approximately 80 million adults with hypertension in Sub-Saharan Africa in the year 2000 and projections based on current epidemiological data suggest that this figure will rise to 150 million by the year 2025. According to the Global Burden of Disease (GBD), the ranking of hypertension worsened from the fourth to the third leading risk factor for deaths in West Africa from 1990 – 2015. Further there is evidence that indicates that related complications of hypertension and in particular stroke and heart failure are also becoming increasingly common and more severe in this region.

In Nigeria, hypertension has been reported to the most commonest risk factor for cardiovascular disease with its prevalence rate being reported to range from 8% to 46.4% depending on the study target population, type of measurement and cut off value used for defining hypertension. The documented prevalence in males and females were quite similar (7.9% - 50.2% (females) vs 3.5% - 68.8% (males) respectively). The urban setting recorded
higher rates (8.1% - 42.0%) than the rural setting (13.5% - 46.4%).26 and various prevalence rates have been reported from different parts the country. For example, in Nsukka, southeastern Nigeria, a prevalence rate of 30% was reported.27 However, in another study from Enugu, southeastern Nigeria, the prevalence rate of hypertension was reported to be 44.5%.27 Hypertension is an urgent health problem among children and adolescents and has been reported among young people in Nigeria.27, 28, 29 It is a growing health problem that is often overlooked by physicians.30 Although predominant among adults, hypertension manifestation at an early age must not be ignored.31 Hypertension in the young can progress into adulthood, thus contributing to increase in cardiovascular morbidity and mortality in adults.32 Many studies on hypertension worldwide have been on middle aged and elderly patients, thus giving the impression it is a disease that is peculiar to those age groups.32,33 The astonishment and disbelief with which young individuals react to a diagnosis of hypertension is a pointer to this assertion.33 Even among clinicians who take care of children, the disease is highly underdiagnosed.34 Yet, hypertension could have its origins in childhood, as it is now one of the most common health concerns in childhood and could go undetected unless specially searched for during this period.35 The risk of developing hypertensive cardiovascular complications is greater in younger than in older individuals.36 The younger the age of onset of hypertension the greater the reduction in life expectancy if the blood pressure is left untreated. And the risk is evident even in childhood, 37 as adverse effects of elevated blood pressure in childhood on vascular structure and function, specifically left ventricular hypertrophy, are already apparent in youth.38 Hypertensive children will go on to become hypertensive adults.39 The reduction of blood pressure reduces the risk of complications and it is a desired goal in adolescents and adults.39-40 The highest hypertension frequency is observed among older children with boys being more prone to it than girls.40-41 Epidemiological studies indicate a global prevalence in adolescents ranging between 3% and
The prevalence of high blood pressure in adolescents has increased in the last 20 years globally. The rising global prevalence of hypertension in adolescence is directly related to the increasing prevalence of obesity and overweight among them.

Data available for hypertension prevalence in Africa consistently indicates increased prevalence in the rapidly expanding urban population. A study conducted in 2004 in 12 villages in Ashanti, Ghana showed prevalence of hypertension to be 28.7% overall. The growing prevalence of hypertension in rural settings in Africa is of further concern as detection rates are lower in those areas compared to urban settings. Therefore, even if the rural populations suffer more from hypertension than their urban counterparts, they are often not detected and treated. Another study carried out in the Ashanti region of Ghana revealed that detection, treatment and control rates were higher in semi-urban areas (25.7%, 14.3%, 3.4%) than in rural villages (16.4%, 6.9%, 1.7%).

JUSTIFICATION FOR THE STUDY

Despite effective therapies and lifestyle interventions, as well as prevention of complications, hypertension remains a challenge to health professionals, especially in developing countries such as Nigeria. It is becoming increasingly apparent that essential hypertension may have its origin in early life. In fact, prospective studies have demonstrated increased left ventricular mass and peripheral resistance with elevated blood pressure in childhood. Hypertension in adolescents often goes undiscovered because adolescents are generally healthy and visit a physician only when they are very ill. Even though the burden of hypertension is lower in adolescents than in adults, it is necessary to identify hypertension in adolescents and also to determine its prevalence among them because many lifelong health related behaviours are established during adolescence. Adolescence is an age of transformation known for the
susceptibility to taking up behaviour that induces non-communicable disease development. Increasing evidence also indicates that hypertension begins to develop in the first two decades of life and there is substantial evidence that blood pressure in childhood and adolescence predicts future blood pressure.\textsuperscript{46}

Hypertension in adolescents increases the risk of continuing hypertension and development of complications in adulthood.\textsuperscript{47} Obesity, hypercholesterolemia, hypertension and habits contributing to the risk of cardiovascular diseases that have their roots in childhood tend to continue into adulthood. Consequently any preventive actions against these diseases in adulthood will be far too late. Since even a small decrease in blood pressure can have substantial effects on hypertension related morbidity and mortality, specific cost effective interventions need to be introduced early in that which may ultimately lead to considerable improvement in cardiovascular health in adulthood. Prior to these strategies accurate epidemiological data should be obtained, hence the need for this study.

The inability to adequately prevent and manage hypertension in Nigeria can also be attributed to inadequate knowledge of hypertension among adolescents. Even as most studies describe knowledge of hypertension and its risk factors in older adults and the elderly, there is a paucity of such data among adolescents as they are considered to be at a lower risk of developing the disease. Knowledge of the predisposing risk factors is vital in the adjustment of lifestyle behaviour early in life to one that is conducive to optimal cardiovascular health.\textsuperscript{48} Measuring and appropriately disseminating knowledge of the modifiable risk factors at an early age is an essential preventive educational approach. Although >80\% of the global burden of cardiovascular disease, which includes hypertension, occurs in developing countries, studies on knowledge of hypertension, including knowledge of the risk factors, is largely derived from developed countries.\textsuperscript{48} It is therefore necessary to have more data on the
knowledge of the concept of hypertension and its risk factors from a developing country such as Nigeria.

The identification of gaps in adolescent knowledge of hypertension is capable of aiding the development of adequate information to enhance adolescents' knowledge of hypertension. Over the past 25 years, the prevalence of overweight and obesity doubled in American children aged 6-11 years and tripled in American adolescents aged 12-17 years. This can largely be attributed to the transformation in the lifestyles of young children from being physically active and consuming more of home-cooked food to being more and more home-bound, spending time on the internet, video games and TV, together with having fast foods owing to growing prosperity. A similar kind of change in lifestyle is also taking place quite steadily in children in developing countries, especially in urban areas and more so among the affluent class. It has been shown in various studies that the prevalence of risk factors for non-communicable diseases in childhood and adolescence bears a significant tendency towards development of disease in adulthood. Considering that high blood pressure is a multifactorial problem that affects many different population groups, it is crucial to identify risk factors associated with it in adolescents in order to intervene early and minimise cardiovascular problems at that stage of life and consequently in adulthood. Several studies have shown that primary prevention of these disorders by risk factor education in the community has better benefits compared to secondary prevention of cardiovascular morbidity as well as mortality. Intervention is therefore a necessary step at school level itself for the prevention of non-communicable diseases. Among all settings, school is a priority setting to target adolescents because it offers substantial opportunities for prevention. The growing prevalence of hypertension in rural settings in Africa is of further concern as detection rates are lower in those areas compared to urban settings. Thus, even if the rural populations, which are rapidly becoming semi-urban, suffer from more hypertension than
their urban counterparts, the disease is often not detected and treated among them. Published data on adolescent hypertension among rural and urban settings in Nigeria are scarce.

**SIGNIFICANCE OF THE STUDY**

In adults, hypertension has been perceived as a public health problem. In contrast, its impact in adolescence is far less appreciated. The adolescent period in human growth and development has been defined as the period of a person's life which occurs after childhood and before adulthood. It ranges from 10 years to 19 years of age. The period represents one of the critical transitions in the lifespan and is characterised by a tremendous pace in growth and change that is second only to that of infancy. Adolescents in Nigeria make up a sizable share of the Nigerian population, thus making them integral to the country's social, political and economic development. Adolescence is the period when majority of Nigerian children are in the secondary school and when they can easily be studied as a group. This study will therefore draw more attention to the issue of adolescent hypertension worldwide, in Africa and in Nigeria. It will add to the body of knowledge on the burden of adolescent hypertension.

The findings of this study will provide current information on the level of knowledge as well as the prevalence and associated risk factors of arterial hypertension among secondary school students in rural and urban areas of Lagos state. This study will also provide information on rural and urban differences in the knowledge, prevalence and associated risk factors of adolescent hypertension in Lagos State. The results of this study would be beneficial to all cadres of health workers as it would heighten their awareness of adolescent hypertension and enhance their knowledge of adolescent knowledge of hypertension as well as the prevalence and risk factors of hypertension among them. The results of this study will contribute to the
development of national and international health policies for the prevention and control of adolescent hypertension. To future researchers, this study can provide baseline information on rural – urban comparison of the knowledge, prevalence and associated risk factors of hypertension among secondary school students in Lagos state.

RESEARCH QUESTIONS

1. What is the level of awareness and knowledge of hypertension among students attending secondary schools in a rural area of Lagos state in comparison to students attending secondary schools in an urban area of Lagos State?

2. What is the prevalence of hypertension among students attending secondary schools in a rural area of Lagos State in comparison to students attending secondary schools in an urban area of Lagos State?

3. What are the risk factors of hypertension among students attending secondary schools in a rural area of Lagos State in comparison to students attending secondary schools in an urban area of Lagos State?

AIM AND OBJECTIVES OF STUDY

AIM OF STUDY

To determine and compare the knowledge, prevalence and associated risk factors of arterial hypertension among students in secondary schools in rural and urban areas of Lagos State, Nigeria.

SPECIFIC OBJECTIVES OF THE STUDY

1. To assess and compare the awareness and knowledge of hypertension among secondary school students in rural and urban Local Government Areas of Lagos State.
2. To determine and compare the prevalence of hypertension among secondary school students in rural and urban Local Government Areas of Lagos state

3. To determine and compare the presence of the risk factors of hypertension among Secondary school students in rural and urban Local Government Areas of Lagos State.

**ALTERNATIVE HYPOTHESIS:**

That there is a statistically significant difference in the awareness, knowledge, prevalence and presence of the risk factors of hypertension among secondary school students in rural and urban Local Government Areas of Lagos State.
CHAPTER TWO

LITERATURE REVIEW

HISTORY OF HYPERTENSION

Hypertension once described as the hard pulse disease as far back as 2600 BC, and whose initial treatments were leeching, phlebotomy and acupuncture, has been reported to be the commonest non-communicable disease affecting both sexes in all races. The modern history of hypertension begins with the understanding of the cardiovascular system following the works of physician William Harvey (1578 – 1657) in his book “De Motu Cordis” where he described the blood circulation process. The first published measurement of blood pressure in 1733 was made by English clergyman Stephen Hales. Descriptions of hypertension as a disease came, among others, from Thomas Young in 1808 and especially Richard Bright in 1836. Frederick Akbar Mohamed (1849 – 1884) made the first report of elevated blood pressure in a person without evidence of kidney disease. With the invention of the cuff-based sphygmomanometer by Scipione Riva-Rocci in 1896, hypertension as a clinical entity really came into being. This allowed blood pressure to be measured in the clinic.

In 1905, Nikolai Korotkoff improved the technique by describing the Korotkoff sounds that are heard when the artery is auscultated with a stethoscope while the sphygmomanometer cuff is deflated. Ebernhard Frank coined the term essential hypertension in 1911 to describe elevated blood pressure for which no cause could be found. Physicians from Mayo Clinic coined the term malignant hypertension in 1928 to describe a syndrome of very high blood pressure, severe retinopathy and inadequate kidney function which usually resulted in death within a year from strokes, heart failure or kidney failure. Franklin D Roosevelt was a prominent individual with severe hypertension. However while the menace of severe or
malignant hypertension was well recognised, the risks of more moderate elevations of blood pressure were uncertain and the benefits of treatment doubtful. Consequently hypertension was classified into “malignant” and “benign”. In 1931, John Hay, a Professor of medicine at Liverpool University, wrote that “there is some truth in the saying that the greatest danger to man with a high blood pressure lies in its discovery, because then some fool is certain to try and reduce it.\textsuperscript{58-59} This view was echoed by the eminent US cardiologist Paul Dudley White in 1937 who suggested that “hypertension may be an important compensatory mechanism which should not be tampered with, even if we were certain that we could control it.\textsuperscript{60}

It is stated in Charles Friedberg's 1949 classic textbook Diseases of the Heart that people with mild benign hypertension (defined then as blood pressure up to levels of 210/100mHg) should not be treated.\textsuperscript{61} However the tide of medical opinion was turning as it was recognised in the 1950s that “benign” hypertension was not harmless.\textsuperscript{62-63} Over the next decade increasing evidence accumulated from actuarial reports while longitudinal studies, such as the Framingham Heart Study revealed that “benign” hypertension led to increased deaths and cardiovascular disease, and that these risks increased in a graded manner with increasing blood pressure across the whole spectrum of population blood pressures.\textsuperscript{64} Subsequently, the National Institute of Health also sponsored other population studies that additionally showed that African Americans had a higher burden of hypertension and its complications.\textsuperscript{65} Historically the treatment of what was called the “Hard Pulse Disease” consisted in reducing the quantity of blood in the blood vessels by bloodletting or the application of leeches.\textsuperscript{66} This method was advocated by the Yellow Emperor of China, Cornelius Celsius as well as Glen and Hippocrates.\textsuperscript{66}
DEFINITION OF HYPERTENSION

Hypertension or high blood pressure is a chronic medical condition in which the blood pressure in the arteries is elevated. Blood pressure is summarised by two measurements, systolic and diastolic, which depend on whether the heart muscle is contracting (systole) or relaxed between beats (diastole). The systole and diastole represent the maximum and minimum pressures respectively. Normal blood pressure at rest is within the range of 100-140 mmHg systolic (top reading) and 60-90mmHg diastolic (bottom reading). In people aged 18 years or older hypertension is defined as a systolic and/or a diastolic blood pressure measurement consistently higher than an accepted normal value (currently 139 mmHg systolic, 89 mmHg diastolic. Lower thresholds are used (135 mmHg systolic or 85 mmHg diastolic) if measurements are derived from 24-hour ambulatory or home monitoring.

As per the currently accepted criteria -The Fourth Report on the Diagnosis, Evaluation and Treatment of High Blood Pressure in Children and Adolescents, hypertension in adolescents is defined as average SBP/DBP that is greater than or equal to the 95th percentile for sex, age and height on three or more occasions. Prehypertension in adolescents is defined as average SBP or DBP levels that are greater than or equal to the 90th percentile, but less than the 95th percentile. As with adults, adolescents with BP levels greater than or equal to 120/80mmHg should be considered pre-hypertensive.

CLASSIFICATION OF HYPERTENSION

Recent international hypertension guidelines have also created categories below the hypertensive range to indicate a continuum of risk with higher blood pressures in the normal range. The Seventh Joint National Committee on Prevention, Detection, Evaluation and treatment of High Blood pressure (JNC-7) uses the term pre-hypertension for blood pressure
in the range 120 - 139 mmHg systolic and/or 80 - 89 mmHg diastolic, while the European Society of Cardiology (ESC) and British Heart Society (BHS) used optimal, normal and high normal categories to subdivide pressures below 140 mmHg systolic and 90 mmHg diastolic. Hypertension is classified by the JNC-7 as hypertension stage I, hypertension stage II, and isolated systolic hypertension. The ESC Guidelines and BHS additionally defined a third stage (stage III hypertension) for people with systolic blood pressure exceeding 179 mmHg or a diastolic pressure over 109 mmHg. Hypertension is classified as "resistant" if medications do not reduce blood pressure to normal. Hypertension can also be classified into primary and secondary hypertension. Primary hypertension has an unknown cause and accounts for 95% of all cases of hypertension. This type of hypertension is strongly associated with an individual's lifestyle. Usually those affected have no signs or symptoms but may experience frequent headaches, tiredness, dizziness or nose bleeding. Documented evidence also suggests that obesity, smoking, alcohol, diet and heredity play a role in essential or primary hypertension. Secondary hypertension has a known cause and accounts for five to ten percent of all cases of hypertension. Primary or essential hypertension has been described as the most common form of hypertension. In almost all contemporary societies, blood pressure rises with aging and the risk of becoming hypertensive in later life is considerable. Hypertension has been reported to occur from a complex interaction of genes and environmental factors. Numerous common genetic variants with small effects on blood pressure have been identified as well as some rare genetic variants with large effects on blood pressure. However, the genetic basis of hypertension is still poorly understood. Secondary hypertension has been reported to result from an identifiable cause and renal disease has been found to be the most common cause of secondary hypertension. Secondary hypertension can also be caused by endocrine conditions, such as Cushing's syndrome, hyperthyroidism, hypothyroidism, acromegaly, Conn's Syndrome or hyperparathyroidism and
pheochromocytoma. Other causes of secondary hypertension include obesity, sleep apnea, pregnancy, coarctation of the aorta, excessive liquor consumption and certain prescription medicines, herbal remedies and illicit drugs.

**DIAGNOSIS OF HYPERTENSION**

Hypertension is diagnosed on the basis of a persistently high blood pressure. The National Institute of Clinical Excellence recommends three separate sphygmomanometer measurements at one monthly interval.\(^7^2\) The American Heart Association recommends at least three measurements on at least two separate health care visits. However, ambulatory blood pressure monitoring over 12 s– 24 hours is the most accurate method to confirm the diagnosis. An exception to this is those with very high blood pressure readings especially when there is poor organ function. While high blood pressure is commonly thought of as an adult problem, adolescents and even younger children can develop high blood pressure. Adolescents in the US now weigh more and exercise less than adolescents of past generations; as a result, high blood pressure among adolescents has increased. A large authoritative study showed that high blood pressure in adolescents increased from one per cent to five per cent between 1989 and 2002.\(^7^2\) It was once believed that most cases of high blood pressure in adolescents were caused by underlying problems with the heart and kidney. Further research has shown that this is not true and it now appears that adolescents develop high blood pressure in approximately the same proportion as adults. In other words, most cases of high blood pressure in adolescents are classified as primary hypertension. As with adults, the underlying causes of primary hypertension are not entirely understood; some adolescents appear to inherit the tendency to develop high blood pressure from their parents, while others fall victim of poor lifestyle choices that result in obesity. It is important to realise that adolescents are not just smaller versions of adults. The hormonal changes of adolescence change some of the dynamics that affect high blood pressure risk, for example,
eating junk food and not getting enough exercise is not always directly reflected by increasing body weight, yet these things can still affect blood pressure in adolescents. Surges in the sex hormones testosterone and estrogen also play a role in the development of high blood pressure among teenagers. While the precise roles these hormones play are complex and not fully understood, it has been shown that adolescents who begin puberty at a younger age tend to have an increased overall risk of developing high blood pressure.

**RISK FACTORS OF HYPERTENSION**

The risk factors of hypertension are of two types: non-modifiable risk factors and modifiable risk factors. The non-modifiable risk factors of hypertension among adolescents are the following, age, gender, race, ethnicity, and family history while modifiable risk factors include obstructive sleep apnea, cigarette smoking, alcohol use, steroid abuse, low birth weight, physical inactivity, stress, being overweight or obese with a body mass index of over 25, type II diabetes mellitus or a high fasting blood sugar level and high cholesterol and triglycerides. Some of the modifiable risk factors such as cigarette smoking, alcohol intake, physical inactivity, obesity and steroid abuse have been found to be prevalent among the adolescent age group and present serious challenge in intervention since they are usually difficult to change.

**LIFESTYLE FACTORS**

Cigarette smoking was found to be a major risk factor for high blood pressure. The consumption of excessive salt and sodium can also increase the risk of developing high blood pressure in some people. Similarly, a diet that is low in potassium can make the body accumulate too much sodium. Sodium and potassium are important regulators of fluid balance in cells. Chronic and heavy alcohol use can also increase blood pressure; women may be more sensitive than men to the blood pressure effects of alcohol. Physical inactivity
such as sedentary lifestyle and lack of physical activity can increase the risk of becoming overweight and this can predispose a person to developing hypertension. In the same vein, mental and emotional stress can cause a temporary increase in blood pressure while chronic stress can lead to engaging in unhealthy behaviour that can increase the risk of developing hypertension.

In recent years, studies have focused on intrauterine malnutrition and its association with degenerative pathologies such as hypertension, coronary disease and others. Familial aggregation and hypertension have also been investigated. A combination of family lifestyle, such as incorrect dietary habits, inactivity, being overweight and obese may be present in individuals who are genetically predisposed. It is accepted that hypertension is determined by changes to biological systems, originating from combinations of genes, each one contributing an effect in the direction of increased blood pressure levels. The fundamental importance of identifying these genes lies in the fact that, if children and adolescents who are predisposed can be diagnosed while still in the pre hypertensive state, more effective preventive measures can be taken.

1. **AGE AND GENDER**

Age has been found to be a major risk factor for hypertension. Blood pressure increases with age in both men and women. The risk for high blood pressure increases in men over 45 years and in women over 55 years. Studies have shown that over half of Americans above the age of 60 years have hypertension.

2. **RACE AND ETHNICITY**

Compared to Caucasians and other races, African-Americans are more likely to have high blood pressure and it has been reported to account for more than 40% of all deaths in this
group. High blood pressure tends to start at a younger age among African-Americans. It is often more severe and causes greater risks of premature death from heart attack, stroke as well as heart and kidney failure.\textsuperscript{73}

3. FAMILY HISTORY

People with parents or other close relatives who have high blood pressure have an increased risk of developing it themselves.\textsuperscript{73}

4. OBESITY

About a third of patients with high blood pressure were found to be overweight. Even moderately obese adults have double the risk of hypertension than people with normal weights. Children and adolescents who are obese are at greater risk for high blood pressure when they reach adulthood. The growing prevalence of hypertension in young people arises mainly from the increase in obesity observed in most countries, obesity being the principal risk factor for hypertension. However, reducing Body Mass Index (BMI) results in significant reductions in blood pressure levels and this is one of the pillars of non-pharmacological management of the disease.\textsuperscript{73}

CLINICAL FEATURES OF HYPERTENSION

Hypertension is rarely accompanied by any symptoms, and its identification is usually through screening or when seeking health care for an unrelated problem. Some people with high blood pressure report headaches (particularly at the back of the head and in the mornings,) as well as light headedness, vertigo, tinnitus (buzzing or hissing in the ears), altered vision or fainting episodes. These symptoms might be related to associated anxiety rather than the high blood pressure itself. On physical examination, hypertension may be associated with the presence of changes in the optic fundus seen by
ophthalmoscopy. The severity of the changes typical of hypertensive retinopathy is graded from I-IV. Grades I and II may be difficult to differentiate but the severity of the retinopathy correlates roughly with the duration and/or the severity of the hypertension.

**PREVENTION OF HYPERTENSION**

Much of the disease burden of high blood pressure is experienced by people who are not labeled as hypertensive. Consequently, population strategies are required to reduce the consequences of high blood pressure and reduce the need for antihypertensive drug therapy. Published evidence indicate that lifestyle changes are recommended to lower blood pressure before starting drug therapy. The British Hypertension Society Guidelines propose the following lifestyle changes, which are also consistent with those by the US National High BP Education Programme for the Primary Prevention of hypertension. Maintaining normal body weight for adults (Body Mass Index of 20-26), reducing dietary sodium intake to (<6g of sodium chloride or <2.4g of sodium per day) engaging in regular aerobic activity such as brisk walking (> 30min per day, most days of the week), limiting alcohol consumption to not more than 3 units per day in men and not more than 2 units per day in women, consuming a diet rich in fruits and vegetables (five portions per day). These prescribed lifestyle modifications have been reported to lower blood pressure as much as antihypertensive drugs. Combinations of two or more of these lifestyle modifications were observed to produce even better results.

**TREATMENT OF HYPERTENSION**

The first line of treatment for hypertension is lifestyle changes, including dietary changes, physical exercise and weight loss. Dietary changes shown to reduce blood pressure include diets with low sodium, the DASH diet, vegetarian diets and high potassium diets. Physical exercises that are shown to reduce blood pressure include isometric resistance
exercise, aerobic exercise and device guided breathing. Stress reduction techniques such as biofeedback or transcendental meditation may be considered as an addition to other treatments to reduce hypertension. However, there is no evidence that they prevent cardiovascular disease on their own. Several classes of medications, collectively known to as antihypertensive medications, are available for treating hypertension. First-line medications for hypertension include Thiazide diuretics, Calcium channel blockers, Angiotensin converting enzyme inhibitors and Angiotensin receptor blockers. These drugs may be used alone or in combination; the latter option may serve to minimise counter-regulatory mechanisms that act to revert blood pressure values to pre-treatment levels. 

The majority of people require more than one medication to control their hypertension. Treatment options for adolescents with hypertension vary; as with adults, more severe forms of HBP require more aggressive treatment. Unlike adults, however, lifestyle adjustments tend to be the first treatment options, though medications are still used when needed. 

**ADOLESCENT KNOWLEDGE OF HYPERTENSION**

A study conducted on adolescent knowledge of hypertension showed that adolescents’ knowledge about hypertension is both unsatisfactory and random, thus indicating the necessity of its promotion across this age group especially with regards to its symptoms. 

The study did not reveal any significant relationship between adolescent knowledge about hypertension and their age. However the higher the level of education, the higher the percentage of adolescents presenting with good knowledge about this disease and the lower the percentage of young people with poor knowledge about the disease. Such tendency is in accordance with a commonly known concept claiming that children’s’ knowledge expands along with increasing years of education. The results of this study
did not show any differences in global knowledge about hypertension when taking sex into consideration. Research has also shown that urban adolescents have better knowledge of hypertension in comparison to their peers from rural areas. The explanation for these results lies in the diversification of the learning process which is varied for children of different regions and different social backgrounds.\textsuperscript{77}

Adolescents from rural areas tend to obtain lower rates in an intellectual learning process, therefore during educational activities it is worth paying attention to the fact that the acquisition of knowledge about health and disease might become more difficult for such groups of students. This study also reveals that students who previously had blood pressure measurements possess twice the degree of knowledge of hypertension than their peers who have not had such tests so far. In fact none of this group is reported to have a good level of knowledge about hypertension. In a study conducted in Poland on adolescents' knowledge of hypertension, almost half of the adolescents questioned in the survey (49.2\%) revealed a low level of global knowledge of hypertension. Nearly 38\% of them had medium knowledge about it and only 13\% of them had a good knowledge. Knowledge of its epidemiology as well as of treatment and prevention were not satisfactory either. Most of the adolescents had good knowledge only about the causes of hypertension.\textsuperscript{77}

A study done in the United States of America also demonstrated that adolescents lack knowledge regarding the risk factors of cardiovascular disease.\textsuperscript{78} A study carried out in Brazil in 2009 showed that higher socioeconomic status, level of schooling and age group are important factors affecting the knowledge of risk factors for hypertension.\textsuperscript{79} Another
study carried out in Ghana on adolescents’ knowledge of diet related chronic diseases and dietary practices revealed that knowledge of hypertension was low among the respondents, with most of them (89.2%) having fair to poor knowledge of the diseases. There was a significant relationship between the knowledge of diet related chronic diseases such as hypertension and the dietary practices of the adolescents. As knowledge of the disease increased, diet also improved.80 A study carried out among medical students in the United Arab Emirates indicated that more than 70% of the participants were aware that stress, high cholesterol and obesity were the risk factors of hypertension. More than 60% were aware that a high salt intake and a high-calorie diet were risk factors of hypertension. However, a gap in knowledge was seen in two modifiable risk factors: physical activity (52.7%) and oral contraceptives. A total of 86.4% of the participants were not aware that these were risk factors for hypertension.

More than 50% were not aware of the non-modifiable risk factors such as male gender (88.2%), increasing age (60.0%) and positive family history of CVD (58.9%). These findings were similar to that of a study done in Germany where the overall knowledge of risk factors was good, but less people could tell the association between physical activity (58%) and hereditary factors (48%) in relation to hypertension.81

**PREVALENCE OF HYPERTENSION IN ADOLESCENTS**

The African adult population is facing a growing epidemic of hypertension, which has become a major public health problem because of high prevalence rates contrasting with low awareness, treatment and control rates.82 The high prevalence of hypertension in Africa is due both to urbanisation and a shift towards western habits such as smoking, unhealthy diets with excess salt and fat intake, physical inactivity and consequently
increased adiposity as well as increasingly recognised non-traditional risk factors such as air pollution. It has been shown that hypertension in children and adolescents can progress into adulthood, thus contributing to the increase in cardiovascular morbidity and mortality in adults.

In a cross sectional study done on 6790 adolescents (11 – 17 years) in Houston schools in the USA from 2003-2005, the prevalence of hypertension was found to be 3.2% after three screenings. In another study done in India on the prevalence of adolescent hypertension, the prevalence of hypertension was found to be 4.7%, which is consistent with other studies in which the reported prevalence ranges from 1-5% and 2-5%. A study done in Peru on school going adolescents revealed a BP prevalence that was relatively high. Observations of adolescents in Rio Grande do Sul revealed that 6.6% had diastolic blood pressure and 12.9% systolic pressure above the 95th percentile. In Sao Paulo, a prevalence of 2.9% was observed.

Many epidemiological studies summarised in a systematic review in Africa have reported an increasing burden of hypertension in adolescents, with prevalence rates of 1-5%. The prevalence of adolescent hypertension was found to be 5.4% in a study done in Enugu, Nigeria with male and female prevalence rates of 3.8% and 6.9% respectively. This was higher than the rate of 3.3% obtained in the southwest of Nigeria, Kogi State 4.6% (North central Nigeria) but lower than the 7.2% obtained in Kano state (North west Nigeria). The prevalence of adolescent hypertension was found to be 10.7% in another study done in Enugu and 6% in another study done in Lagos, southwest, Nigeria.
A study done in Port Harcourt, Nigeria revealed a prevalence of adolescent hypertension of 3.2%, the proportional prevalence was higher in the age group 15 – 17 years (39%). A study done in Maiduguri Nigeria revealed a prevalence of 13.2% among adolescents. This prevalence rate is higher than the rates of 5.6%, 6.3%, 9.4% and 9.6% reported in similar studies carried out in Iran, China, Brazil and Tunisia respectively. The prevalence rates in Nigeria are however lower than the rates reported in affluent societies such as Italy (37.7%), Sweden (38.4%), England (41.7%), Finland (48.7%) and Germany (55.3%). The difference in prevalence rates may also be due to varying methodology, different criteria for diagnosis of hypertension and regional variations. Nevertheless, the observed rate falls within the documented prevalence rate of adolescent hypertension of 1-13% in Nigerian adolescents. A recent systematic review of studies done in the last two decades on the prevalence of hypertension in Nigeria reported a crude prevalence of 0.1-17.5% for adolescents.

The implication of this is that hypertension can be detected in the adolescent age group. Given that adolescents presenting with high blood pressure have a major risk of becoming hypertensive adults, specific cost effective interventions need to be introduced early in life to prevent CVD in adulthood. Prior to these strategies, accurate epidemiological data should be obtained. In a systematic review and meta-analysis done to estimate the prevalence of hypertension in Nigeria, pooled results also showed a higher urban prevalence of hypertension compared to the rural prevalence (31% versus 26%). Another systematic review revealed that the prevalence of hypertension in Nigeria across urban and rural populations ranged from 9.5% to 51.6% and 4.8% to 43% respectively except for one study which reported the prevalence of hypertension to be higher in a rural
area compared to an urban area. This is contextually similar to other studies done in African countries where higher prevalence rates of hypertension have been reported among urban dwellers.

The higher prevalence among urban populations may portray a different lifestyle pattern from that of the rural population. Urban dwellers are more likely to consume foods that are processed and foods that have a high salt and fat content. Furthermore the lower rural prevalence may indicate higher physical activity levels. However, in a few studies especially in the eastern part of Nigeria, it was noted that the prevalence rate of hypertension was higher in the rural areas in comparison to the urban areas. The prevalence of hypertension in the semi-urban area compares with figures from other (mostly developed) parts of the world. However when separated based on place of domicile, it becomes clear that the increases have taken place mainly in the urban areas, as the prevalence of hypertension there was as high as 17.5% as against 4.6% in the semi-urban areas. This is worrisome and calls for urgent attention. Nevertheless, what is more worrisome is that the prevalence of hypertension in the urban population is almost a fourfold increase from the semi-urban group and is one of the highest in the recorded literature.

**RISK FACTORS OF HYPERTENSION IN ADOLESCENTS**

**SEX/GENDER**

In a study carried out in the Canary Islands, the prevalence of hypertension was higher in men. A total of 151 young persons with hypertension were also studied in Uyo Nigeria, this study revealed that hypertension was more common among young females than
males in contrast to the previously held view that hypertension was more common in males till the age of 65 years, when it becomes more common among females. In another study that was done in Maiduguri Nigeria, findings showed that hypertension occurred more frequently in female adolescent students (58.6%) than in male adolescent students (41.4%). This finding is comparable to the findings from the study done in Uyo and another on Tunisian adolescents which showed a higher prevalence of hypertension in adolescent girls compared to boys (51% vs. 49%).

A study done on a market population in Enugu found that hypertension was more common among young women aged 20-30 years than among young males. This finding is not in consonance with several studies on Nigerian populations of age 15 years and above which shows a higher prevalence in males or no difference in prevalence by gender. In many studies, the prevalence of hypertension was higher in men than in women at least up to the age of forty years when the prevalence equalised (7.9% - 50.2% (females) vs. 3.5% - 68.8% (males) respectively).

**OBESITY**

Hypertension is the most common comorbidity identified in overweight adolescents. It is also the leading risk factor for mortality in adulthood, attributable to approximately 12.8% of deaths worldwide. A number of studies have investigated the association between BMI and blood pressure in adolescent populations, with the majority finding moderate to strong associations and with the majority of correlation coefficients > 0.3. The most recently published investigation was a cross sectional study of 714,922 subjects aged 16-19 years which demonstrated that each one unit increase in BMI was
associated with a higher risk of systolic blood pressure (SBP) greater than 130mmHg. In view of these data, it is not surprising that secular trends show an increase in adolescent hypertension that parallels the rise in overweight and obesity.

These trends challenge the previously held assertion that hypertension in adolescence was only a result of secondary causes such as renal disease. In fact essential (Primary) hypertension now accounts for the vast majority of hypertension identified in adolescence. A study carried out among adults in Ibadan, Nigeria revealed that hypertension was significantly associated with being overweight or obese. Hypertension was inversely associated with being underweight. In another study done on the risk factors of hypertension among adults aged 35 – 64 years living in an urban slum in Nairobi, Kenya, the prevalence of being overweight and obese was 26.2% and 17.3% respectively. Females had higher mean BMI than males. The prevalence of obesity (BMI \( \geq 30.0 \text{ kg/m}^2 \)) among females was four folds higher than males (25.9% vs 6.0%). Overall, 19.3% and 80.3% of the males and females respectively had abdominal obesity. The overall prevalence of abdominal obesity was 54.6%. Prevalence of hypertension differed significantly between obese and non-obese individuals (36.0% vs 25.8%). Obesity affects 20% of adolescents in the United States and the prevalence of hypertension is much higher among obese adolescents compared with non-obese adolescents. In a study done on hypertensive adolescents in Brazil, the prevalence rates of obesity for males and females were 4.7% and 15.2% respectively. A study done on apparently healthy adolescents in Pradesh, Central India revealed a significant association between BMI and both systolic and diastolic blood pressure. The report of a study on the casual blood pressure of elementary school students in south west Nigeria over two decades ago, also showed that body weight was a strong determinant of blood pressure.
SOCIO-ECONOMIC STATUS

In a study done on the influence of parental socioeconomic status on blood pressure, it was discovered that parental socioeconomic status had no influence on the blood pressure of male elementary and secondary school students. Female adolescents with parents in the lower socio-economic classes had significantly higher systolic and diastolic blood pressures. In contrast, parental socio-economic status showed no significant relationship with systolic blood pressure and diastolic blood pressure in males. The prevalence of elevated BP was higher in adolescent females than males.

INADEQUATE PHYSICAL ACTIVITY

Adequate physical activity has been shown to have many health promoting effects and has a direct independent role in reducing hypertension. Traditionally it has been thought that a high level of physical activity could in part explain the low levels of chronic diseases found in most of Africa. However, the amounts of physical activity have been decreasing as a result of the high rate of urbanization that has been occurring across the continent. Few studies on physical activity patterns of African populations have been published.

HIGH SALT INTAKE

A high intake of sodium is common, in Africa mostly from salt used to preserve food or to make it tastier. Also, salt is added to already prepared food by the consumer, as processed food is rare. Decreased salt intake not only reduces blood pressure and related CVD risk but has other beneficial cardiovascular effects that are independent of and additive to its effect on blood pressure. It has been reported to have a direct effect on
reducing stroke, left ventricular hypertrophy, aortic stiffness, and chronic kidney disease and proteinuria. For that reason, it is reasonable to infer that the total impact of reducing salt intake on cardiovascular outcomes could be greater than those expected from blood pressure reduction only. Few intervention studies have been conducted to show that a reduction in salt intake and an increase in potassium intake improve the blood pressure in African populations. A study done in Tanzania indicated that a low sodium diet leading to a low urinary excretion level of 52 mmols per day, reduced blood pressure in normotensive people significantly within four to five days. A study in Kenya reported that supplementation with potassium in newly diagnosed patients with hypertension reduced the blood pressure to a level similar to that found in patients treated with a diuretic. These studies provide evidence of the impact of community based and context specific salt reduction programs in Africa where most salt is still discretionary rather than from processed foods as is the case in developed countries.

FAMILY HISTORY OF HYPERTENSION

Family history is an important non-modifiable risk factor for hypertension; familial aggregation and hypertension have been investigated. A combination of family lifestyle, incorrect dietary habits and inactivity results in hypertension in individuals who are genetically predisposed. It is accepted that hypertension is determined by changes to biological systems originating from a combination of genes, each one contributing an effect in the direction of blood pressure levels. A study done in India showed that young normotensives with a positive family history of hypertension had significantly higher blood pressure and also increased resting heart rates than normotensives with a negative family history of hypertension.
A similar study done in Kano, Nigeria reported that adolescent hypertensives in Kano, Nigeria were twice more likely to have a family history of hypertension than their normotensive counterparts. Another study done on adolescent hypertension in India showed that hypertension has a significant relationship with a family history of the disease. A similar study done on adolescents in randomly selected schools in Poland revealed that a positive family history in pupils of both gender increased the probability of elevated systolic and diastolic blood pressure occurrence.

**AGE**

In a study carried out among Canadian adults, older age, lowest income and less than high school education was associated with the presence of hypertension. A study done in the West Indies revealed that among children and adolescents, blood pressure levels are strongly influenced by age, growth patterns and gender. In many other studies, the most likely determinant of blood pressure and presence of high blood pressure was age. Blood pressure was shown to increase steadily with age from the youngest to the oldest age brackets, irrespective of gender. Similarly, two studies - one done on 820 adolescents from 12 secondary schools in Port Harcourt, Nigeria and another done on Indian adolescents to determine the prevalence of adolescent hypertension - revealed that systolic and diastolic blood pressure increased with age in all subjects. In a study done in Calabar, Nigeria, blood pressure levels were also found to increase with age, with males having higher values than females. The other major determinants of blood pressure were weight, height, body mass index, level of physical activity and parental socioeconomic status.
CIGARETTE SMOKING

Cigarette smoking is a powerful cardiovascular risk factor and smoking cessation is the single most effective lifestyle measure for the prevention of a large number of Cardiovascular diseases.\textsuperscript{120} Impairment of endothelial function, arterial stiffness, inflammation, lipid modification as well as alteration of antithrombotic and prothrombotic factors are smoking related major determinants of initiation and acceleration of the atherothrombotic process leading to cardiovascular events.\textsuperscript{120} Cigarette smoking acutely exerts an hypertensive effect mainly through the stimulation of the sympathetic nervous system.

As concerns the impact of chronic smoking on blood pressure, available data do not show clearly evidence of a direct causal relationship between these two cardiovascular risk factors, a concept supported by the evidence that no lower blood pressure values have been observed after chronic smoking cessation. Nevertheless, smoking affecting arterial stiffness and wave reflection might have greater detrimental effect on central blood pressure which is more closely related to target organ damage than brachial blood pressure.

Hypertensive smokers are more likely to develop severe forms of hypertension including malignant and renovascular hypertension, an effect likely due to an accelerated atherosclerosis.\textsuperscript{120} In order to reduce smoking at the population level, it is important to implement multi sectoral interventions like increasing taxes on tobacco products, banning of tobacco advertisements and banning smoking in public spaces.\textsuperscript{121}
ALCOHOL CONSUMPTION

A study was done on Spanish men and women from the Seguimien to Universidad de Navarra that were free of hypertension at baseline, after an average follow up of 4 years, they found evidence for a positive and linear association between total alcohol consumption and incident hypertension. These data were consistent with much of the existing literature and suggests that there may be a threshold below which smaller amounts of alcohol do not raise blood pressure.\textsuperscript{122}

INSUFFICIENT FRUIT AND VEGETABLE CONSUMPTION

Fruit and vegetable consumption is one element of a healthy diet and varies considerably among countries, reflecting economic, cultural and agricultural production environments.\textsuperscript{123} Most of the benefits of fruits and vegetables come from reduction in CVD risk factors, particularly hypertension. In addition to a high salt intake, many people in Africa often eat insufficient fruits and vegetables, resulting in low potassium intake. This in turn is associated with higher blood pressures in some patients; a potassium intake of 90mmol/day is recommended.\textsuperscript{124}

MICROALBUMINURIA is a subclinical condition that is associated with high morbidity and mortality. It is a term used to describe a moderate increase in the level of urine albumin. It occurs when small amounts of albumin are found in the urine - in other words, when there is an abnormally high permeability for albumin in the glomerulus of the kidney.
Microalbuminuria is an early sign of kidney and cardiovascular damage. The kidneys do not, however, filter albumin, therefore, if albumin is found in the urine, this is a marker of kidney disease. However, the term ‘microalbuminuria’ is discouraged by KDIGO (Kidney Disease Improving Global Outcomes) and has been replaced by ‘moderately increased albuminuria. Microalbuminuria is an acknowledged predictor of increased renal and cardiovascular risks associated with hypertension and diabetes mellitus. Its early detection coupled with relevant intervention, have been known to retard the rate of progression of the morbidity process in adult hypertensives. In non-hypertensive and non-diabetic populations, the presence of microalbuminuria is also known to be associated with increased levels of atherogenic factors and an increase in cardiovascular morbidity and mortality.

The major identified causes of microalbuminuria include diabetes mellitus (DM), hypertension, sickle cell anemia (SCA), Human Immunodeficiency Virus (HIV) infection, and obesity. Higher dietary intake of animal protein, animal fat and cholesterol may increase the risk for micro-albuminuria and, generally, diets higher in fruits, vegetables and whole grains but lower in meat and sweets may be protective against kidney function decline.

The level of albumin produced by microalbuminuria can be detected by special albumin specific urine dipsticks. A microalbumin urine test determines the presence of the albumin in the urine. In a properly functioning body, albumin is not normally present in the urine. Microalbuminuria is a marker of vascular endothelial dysfunction. It is an important prognostic marker for kidney disease in diabetes mellitus, hypertension and
post-streptococcal glomerulonephritis. Increasing micro albuminuria during the first 48 hours after admission into an intensive care unit predicts an elevated risk for acute respiratory failure, multiple organ failure and overall mortality. It is also a risk factor for venous thromboembolism. The prevalence of microalbuminuria is enhanced in patients with hypertension. Besides, its prevalence is known to be commoner in normotensive children of one or two hypertensive parents, implying that possible microalbuminuria could identify an early stage hypertensive patient. The prevalence of microalbuminuria in the general population is reported to be 10 – 15%. In the Netherlands, microalbuminuria was found in 12% of apparently healthy adults in the general population. In the United States of America (USA), a lower prevalence of 7.8% was reported in the general population of children, adolescents and adults. In Africa there is paucity of data on the prevalence of microalbuminuria among adolescents. In Nigeria, a study done in Benin City reported a prevalence of 19% among healthy adolescents and young adult offspring (aged 10-24 years) of hypertensive parents. Individuals with microalbuminuria may have a rapid progression to overt proteinuria, and progressive deterioration in renal function, and development of end stage renal disease (ESRD) later in life.
CHAPTER THREE

MATERIALS AND METHODS

BACKGROUND TO STUDY AREA

Lagos State, one of the 36 states in Nigeria, is the smallest state in Nigeria. It is located on latitudes 6 35 N and Longitude 3 45 E with a terminal land area of 3,577 km$^2$. Lagos State was created on May 27, 1967 and took off as an administrative entity on April 11th 1968. It is divided into three senatorial districts; Lagos West, Lagos East, and Lagos Central. It is made up of five administrative divisions: Lagos, Ikeja, Badagry, Ikorodu and Epe. In line with the nation’s three-tier federal structure, the divisions were further divided into 20 Local Government Areas (LGA), four of which are rural and 16 urban. The Rural Local Government Areas in Lagos State are Badagry, Epe, Ibeju, Lekki and Ikorodu. The Urban Local Government Areas in Lagos State are Alimosho, Ajeromi-Ifelodun, Kosofe, Mushin, Oshodi-Isolo, Ojo, Surulere, Ifako-Ijaiye, Agege, Shomolu, Amuwo-Odofin, Lagos Mainland, Ikeja, Eti-Osa, Apapa and Lagos Island.

This classification is based on the availability of social amenities and infrastructure such as pipe borne water, electricity and good road networks. Lagos State has an estimated population of 17 million, out of a national estimate of 150 million. The state is predominantly dominated by the Yoruba and the Egun. The Aworis, Ijebus and the Egbas are subgroups of the Yoruba. It is also a socio-cultural melting point attracting other Nigerian tribes and foreigners from various parts of the world.
STUDY SITES

The study was conducted in registered co-educational public and private secondary schools in selected Local Government Areas in rural and urban areas of Lagos State. These Local Government Areas are Badagry Local Government Area (Rural LGA), Ikorodu Local Government Area (Rural LGA), Mainland Local Government Area (Urban LGA) and Surulere Local Government Area (Urban LGA).

In Badagry LGA, there is a total of 28 co-educational public secondary schools; 14 of these are senior secondary schools and 14 of them are junior secondary schools. The private co-educational secondary schools are 15 in all. In Ikorodu LGA there is a total of 56 co-educational public secondary schools made up of senior and junior schools. The co-educational private secondary schools in Ikorodu LGA are 27 in all. In the Mainland LGA, there is a total of 23 co-educational public secondary schools; 14 of them are junior secondary schools while 9 of them are senior secondary schools. The co-educational private secondary schools are 25 in all. In Surulere LGA, there are a total of 57 co-educational public secondary schools and 27 co-educational private secondary schools; 28 of the co-educational public secondary schools are co-educational junior secondary schools while 29 of them are co-educational senior secondary schools.

The selected two co-educational public junior and senior secondary schools chosen in each of the four LGAs were 1) Government Senior College, Badagry and Ajara Junior Comprehensive High School, Isalu Road, Ajara-Topo, Badagry, Badagry LGA; 2) State Junior High School and State Senior High School, Badagry, Badagry LGA 3) Ayangburen Junior High School and Ayangburen Senior High School, Ikorodu, Ikorodu LGA 4) United

The co-educational private secondary schools chosen in each of the four LGAS were 1) Jumes Infant Jesus College Badagry, Badagry LGA 2) Frontline Comprehensive College Badagry, Badagry LGA 3) Tindip College, Ikorodu, Ikorodu LGA 4) Uncle Bayus College, Ikorodu, Ikorodu LGA 5) Federal College of Education (Technical) Secondary School, FCE (Technical) Akoka, Yaba, Mainland LGA 6) Bellina College, Akoka, Yaba, Mainland LGA 7) Agape Baptist College Surulere, Surulere LGA, 8) New Estate Baptist Church Secondary School, Surulere, Surulere LGA

DESCRIPTION OF PUBLIC SECONDARY SCHOOLS IN BADAGRY LOCAL GOVERNMENT AREA (RURAL LGA)

Government Senior College, Badagry, Badagry LGA

The Government Senior College Badagry is situated along the Badagry Expressway, Lagos State; it is directly opposite the Nigeria-French Language village. It shares the same premises with the Government Junior College Badagry. It is a co-educational senior public secondary school. The college is made up of two main buildings. The school has a big borehole and a solar energy generating plant. The total number of students in Government Senior College Badagry is 1404.
Ajara Comprehensive Junior High School, Ajara Isalu Road, Badagry LGA, Lagos State

This is a co-educational public junior secondary school. The school is situated on the same premises with Ajara Comprehensive Senior High School Badagry. The total number of students in the school is 973.

State Senior High School, Badagry, Badagry LGA

This is a co-educational public senior secondary school. It occupies the same premises as the State Junior High School. The total number of students in the school is 906.

State Junior High School, Badagry, Badagry LGA

This is a co-educational public junior secondary school that shares the same premises with State Senior High School Badagry. There are a total of 1763 students in the school.

DESCRIPTION OF PRIVATE SECONDARY SCHOOLS IN BADAGRY LOCAL GOVERNMENT AREA (RURAL LGA)

Jumes Infant Jesus College, Badagry, Badagry LGA

This is a co-educational private secondary school located in Badagry, Badagry LGA. The school building is a u-shaped bungalow. This building contains the classrooms, the teachers' staff room, the laboratories, the library as well as the school assembly hall. There is a large field in the middle of the school where recreational activities are held.

Frontline College, Badagry, Badagry LGA

This is a co-educational private secondary school located in Badagry. It is made up of both junior and senior schools. The school has a big compound with two big storey buildings.
United Junior High School, Ikorodu, Ikorodu LGA

This is a co-educational public junior secondary school located in Ikorodu, Ikorodu LGA. The address of this school is 22 Allison Street, Ikorodu. It is located close to the compounds of the United Senior High School as well as Ayangburen Junior and Senior High School, Ikorodu. There area total of 763 students in the school.

United Senior High School, Ikorodu, Ikorodu LGA

This is a co-educational public senior secondary school. This school shares the same building with Ayangburen Senior High School and occupies the same premises with Ayangburen Junior High School. There area total of 873 students in the school.

Ayangburen Senior High School, Ikorodu, Ikorodu LGA

This is a co-educational public senior secondary school. It is located on 22 Allison street Ikorodu. It shares the same compound with United Senior High School and Ayangburen Junior Secondary School. There area total of 800 students in the school

Ayangburen Junior High School, Ikorodu, Ikorodu LGA

This is co-educational public junior secondary school located in Ikorodu. It is situated on the same premises with Ayangburen Senior High School as well as United Senior High School. There are a total of twelve classrooms in the school, there are a total of 763 students in the school.
DESCRIPTION OF PRIVATE SECONDARY SCHOOLS IN IKORODU LOCAL GOVERNMENT AREA (RURAL LGA)

Uncle Bayus International School, Ewu-elepe, Ikorodu, Ikorodu LGA
This is a co-educational private secondary school located in Ewu-elepe, Ikorodu. The school is made up of four buildings which form a semi-circle. There are a total of twelve classrooms and each class has two arms. The total number of students in the school is 150.

Tindip College, 1-5 Olori M.O.Oyefusi Street, Solomade, Ikorodu, Ikorodu LGA
This is a co-educational private secondary school established on June 19th 2004 by Tindip Educational Services. The school is made up of four big two-storey buildings on a large expanse of land. The total number of students in the school is 130, made up of 60 boys and 70 girls. Each class has two arms.

DESCRIPTION OF PUBLIC SECONDARY SCHOOLS IN MAINLAND LOCAL GOVERNMENT AREA (URBAN LGA)

Eletu-Odibo Junior High School. Abule-Oja, Yaba, Mainland LGA, 1 Ameen Street
Abule-Oja, Yaba, Mainland LGA
This is a co-educational junior public secondary school. The school consists of a big storey building. The total number of students in the school is 830.

Eletu-Odibo Senior High School1 Eletu-Odibo Street, Abule-Oja, Yaba, Mainland LGA.
This is a co-educational senior public secondary school. Founded 29, September 1981, the school is made up of a storey building and two bungalows. The Total student population of the school is 831.
Aje Comprehensive Junior High School, Sabo, Yaba, Mainland LGA, 42 Aje Street, Sabo Yaba, Lagos. Education District 4.

The school was founded in September 1980 as the first "Jakande" school in Lagos State. The school's structures are two-one storey buildings at an angle to each other. On the ground floor are JSS1 classrooms and toilets. On the first floor are the JSS2 and JSS3 classrooms. Facing the main structure is a bungalow housing the reading room, the library and the sick bay. The total student population is 834.

Lagos City College (Senior school) 34, Commercial Avenue, Sabo, Yaba, Lagos, Mainland LGA

The school was founded in 1963. It is made up of a big three storey building with a big playing field and a car park. On the ground floor is the principal's office and the administrative office, the Library is on the first floor. Classrooms also occupy the first, second and third floors. The total number of students in the school is 998.

DESCRIPTION OF PRIVATE SECONDARY SCHOOLS IN MAINLAND LOCAL GOVERNMENT AREA (URBAN LGA)

Bellina Secondary School, Akoka, Yaba, Mainland LGA

This is a co-educational private secondary school located in Akoka, Yaba. The school is made up of four buildingssurrounded by a big basketball court. The total number of students in this school is 168. There are two arms of each class from JSS1 to SSS3 and each arm has a total number of fourteen students.

The Federal College of Education (Technical) Secondary School is situated within the premises of the Federal College of Education (Technical) Akoka. This institution is situated along St Finbarr's College Road Akoka, Mainland LGA. The school has four main buildings; two which are attached to each other. The total number of students in the school is 250.

DESCRIPTION OF PUBLIC SECONDARY SCHOOLS IN SURULERE LGA (URBAN LGA)

Eric Moore Junior High School, Itolo Street, Surulere, Surulere LGA

Eric Moore Junior High School is made up of three main bungalows buildings that are very close to each other. The total number of students in Eric Moore Junior High School is 564.

Eric Moore Senior High School, Itolo Road, Surulere, Surulere LGA

Eric Moore Senior High School is made up of two storey buildings running parallel to each other and a third at a right angle to them. The first building which is closer to the gate contains the SSS3 classrooms. The students’ classrooms for SSS1 to SSS3 are in the second building located in front of this building. The total number of students in Eric Moore Senior High School is 484.

Obele Community Junior High School, Randle Avenue, Surulere, Surulere LGA

The buildings of Obele Community Junior High School are opposite Obele Community Senior High School. This school is made up of two bungalow buildings, one at each end of the compound, together with an L-shaped storey building. A big sandy space exists between
these buildings where the students can play games and do sporting activities. The total number of students in the school is 484.

**Obele Community Senior High School, Randle Avenue, Surulere, Surulere LGA**

This is a co-educational public senior secondary school which is located off Randle Avenue in Surulere. The school is made up of an L-shaped storey building and two bungalows facing each other at the main entrance to the school. The bungalows contain the SSS3classrooms. The total number of students in the school is 460.

**DESCRIPTION OF PRIVATE SECONDARY SCHOOLS IN SURULERE LOCAL GOVERNMENT AREA (URBAN LGA)**

**Agape Baptist College, Surulere, Surulere LGA**

This is a co-educational private secondary school located in Surulere, off Ogunlana Drive in Surulere LGA. The school is made up of one big extensive storey building. The big space surrounding this building is used for recreational activities. On the first floor are all the classrooms for JSS1 to SSS3, the principal's office, staff rooms and students toilets. There is a total of 208 students in the school.

**New Estate Baptist Church Secondary School, Surulere, Surulere LGA**

New Estate Baptist Church Secondary School is situated along AdisaBashua Street, off Adelabu Street, Surulere. This school is a co-educational private secondary school which occupies the same compound as the New Estate Baptist Church. The total number of students in the school is 300.
STUDY DESIGN

The study was a cross-sectional analytic study of the knowledge, prevalence and risk factors of hypertension among secondary school students in rural and urban areas of Lagos State.

STUDY POPULATION

The study population consists of students in secondary schools in rural and urban areas of Lagos State.

STUDENTS' INCLUSION CRITERIA

Registered students within the age range 10-19 years and enrolled in secondary schools in Lagos state.

SCHOOLS' INCLUSION CRITERIA

The secondary schools were co-educational secondary schools comprising senior and junior schools.

STUDENTS’ EXCLUSION CRITERIA

Acutely ill adolescents

Students from non-co-educational schools

Students from special schools for the physically or mentally challenged

SCHOOLS’ EXCLUSION CRITERIA

Co-educational school dedicated for the training of physically and mentally challenged children.
SAMPLE SIZE DETERMINATION

Sample size was determined using the formula for calculation of minimum sample size for a comparative study.  

\[ n = \frac{(u + v)^2 \times P1(100 - P1) + P2(100 - P2)}{(P1 - P2)^2} \]

\[ n = \text{Minimum required sample size per group} \]

\[ P1 = \text{Prevalence of adolescent hypertension amongst students residing an urban area} = 10.7\% \]

\[ P2 = \text{Prevalence of adolescent hypertension amongst students residing in a rural area} = 4.6\% \]

\[ u = \text{the critical value corresponding to the power of the study at 80\%} = 0.84 \]

\[ v = \text{the critical value of the normal distribution corresponding to the significance level (5\%)} = 1.96 \]

\[ n = \frac{(0.84 + 1.96)^2 \times 10.7(100 - 10.7) + 4.6 (100 - 4.6)}{(10.7 - 4.6)^2} \]

\[ n = 293.58 \]

The minimum sample size for each group was calculated to be 293.6. It was rounded up to 300. For the urban LGA, sample size was 300 and for the rural LGA, sample size was 300.

Total minimum sample size was 600.

Total number of schools used for the study was 16 (8 rural and 8 urban). To obtain the number of students per school, 600 (minimum sample size) was divided by 16 (Total number of schools used for the study). It was calculated to be 37.5.

To obtain the number of students per class, the number of students per school 37.5 was divided by the number of classes per school 6 (JSS1-SSS3). It was calculated to be 6.25. This was rounded up to 7. Number of students selected per class from each school was 7.
Forty two students each were selected from each secondary school selected. There were a total of 16 secondary schools selected for this study. Forty two students each from 16 secondary schools gave a total of 672 students who participated in this study.

**SAMPLING METHODOLOGY**

A multistage sampling technique was used to select the respondents for the study.

**Stage 1: Selection of Local Government Areas**

There are 16 urban LGAs and 4 rural LGAs in Lagos State. Four LGAs, two urban (Mainland and Surulere LGAs) and two rural (Badagry and Ikorodu LGAs) were selected by simple random sampling using a table of random numbers.

**Stage 2: Selection of schools in rural and urban Local Government Areas**

A list of all co-educational secondary schools in each of the four Local Government Areas selected (Badagry, Ikorodu, Mainland and Surulere Local Government Areas) was obtained from Lagos State Education District 4, Yaba, Lagos State Education District 5, Agboju, Badagry LGA headquarters Badagry, Ikorodu LGA headquarters Ikorodu respectively. This was stratified by type of school i.e. Private and Public schools.

Sixteen secondary schools were used for this study. The public co-educational secondary schools selected were (1) Government Senior College, Badagry and Ajara Comprehensive Junior High School, Badagry, Badagry LGA (2) State Junior High School and State Senior High School, Badagry, Badagry LGA (3) Ayangburen Junior High School and Ayangburen Senior High School, Ikorodu, Ikorodu Local Government Area (4) United Junior High School and United Senior High School, Ikorodu, Ikorodu Local Government Area (5) Aje


**Stage Three: Selection of the arms of the classes**

One arm of each class (JSS1- SSS3) was selected by simple random sampling using a table of random numbers from the list of the arms of each class in each school (6 classes per school).

**Stage Four: Selection of students from one arm of each class**

A class list of each selected class was obtained from the school authorities. Seven students each were selected by simple random sampling using a table of random numbers from the class list. This resulted in a total of forty two students from each school.

A subset of the respondents were selected using multiphase sampling for a biochemical test (urinalysis) done to detect microalbuminuria, an indicator of early onset of kidney disease.
Three students were selected by simple random sampling using a table of random numbers from the seven students originally selected from each class. This resulted in eighteen students from each school and a total of 288 students altogether - 144 rural and 144 urban selected for this study.

DATA COLLECTION
Quantitative data were collected using questionnaires, blood pressure measurements and anthropometric measurements.

DATA COLLECTION TOOLS AND TECHNIQUES.
The tools that were used in this study include the following: questionnaires, calibrated scales: 2 portable digital weighing scales, 2 stadiometers, 2 Non-elastic plastic measuring tapes, 4 standard mercury sphygmomanometers.

Questionnaire: The questionnaire, parts of which were modified from the WHO STEPS Instrument for Non-Communicable Disease risk factors (Core and expanded version 1.4), the Global Youth Tobacco Survey (GYTS) and the Hypertension Knowledge Level Scale by Erkoc et al has four parts. The first section (section A) contained questions on the socio demographic characteristics of the adolescent students, the second section (section B) contained questions to determine the level of knowledge of hypertension among the adolescents and this included questions on the awareness and sources of information about hypertension, questions on the correct knowledge of hypertension, the knowledge of the symptoms of hypertension, knowledge of the organs of the body that can be damaged by hypertension and questions on knowledge of how hypertension can be prevented and managed. The third section (section C) contained questions on the presence of the various
associated risk factors of hypertension among the adolescents which include the following: Family history of hypertension, smoking of cigarettes, consumption of alcohol, fastfood and sugary drinks, addition of extra salt to food, inadequate physical activity. The last part of the questionnaire is a space for the record of the blood pressures and anthropometric measurements which are the height, weight, BMI, waist circumference and hip circumference. The result of the urinalysis for microalbuminuria is also included.

**The digital weighing scale:** The digital weighing scale is a Camry digital weighing scale. It is manufactured by the Camry electronic Ltd, Zhaoqing 4 Kangle Road, Zhaqing, Guangdong China. The model is E D 301. It is an electronic weighing machine. It has a spring mechanism that compresses in proportion to the weight. The upper part of the apparatus consists of a hard platform, called the weighing platform on which the subject stands to have his or her weight measured; the platform is dark in colour. Just ahead of the platform is a transparent digital display, this is a liquid crystal display that indicates the weight in numbers in kilogrammes.

**The stadiometer:** The stadiometer is a piece of medical equipment which is used for measuring human height. It is a Secca 213 height measure (Leicester). Secca, a company located on 40 Barn Street Birmingham B5 5QB, is the manufacturer and authorised dealer. Warranty is for 2 years. It typically consists of a base, 3 vertical measure pieces (the measures are on both sides, in inches and in centimetres) a horizontal gliding piece and a stabilizer. The first vertical measure piece, that is one foot in length, is inserted into the base (must snap down tightly). The base is then placed on the floor. The next piece is a two feet measure piece which is snapped down tightly, the third one is a three feet measure which is also snapped down tightly. The horizontal gliding piece is then made to slide down the
connected measures. It is adjusted to rest on top of the head while measuring the height with the stabiliser attached to stabilise it.

**Non-elastic measuring tape:** The non-elastic measuring tape is a tape with two sides and it has measures on both sides. On one side the measure is in inches (up to 60 inches), while on the other side the measure is in centimeters (up to 150 centimetres). For the purpose of this study measurements were done in centimetres.

**The Mercury Sphygmomanometer:** The Mercury Sphygmomanometer is an Accoson sphygmomanometer (Dekamet model). It is made in the UK and guaranteed accurate to BS EN 1060–1. It has a lightweight die cast case, a shatterproof plastic manometer tube, a mercury reservoir isolation valve as well as steel hinge pivots. It has a range of 0-300mmhg, and it is supplied with a Velcro cuff and latex free bulb.

**The Micral test strip for microalbuminuria:** The urine test strip is a basic diagnostic tool used to determine biochemical changes which could be pathological in a patient's urine. The pack contains simple, easy to use reagent strips for the detection of key diagnostic chemical markers in human urine. They are plastic strips to which a chemically specific reagent pads are affixed. These urine testing strips are ready to use upon removal from the vial and the entire reagent strip is disposable. The Micral test strips are manufactured by Roche USA (Lot no: 22265903) and they are used specifically for detecting micro albuminuria. A reading of 20mg/dl and above is considered positive for microalbuminuria.
QUALITY CONTROL

TRAINING OF RESEARCH ASSISTANTS

Four research assistants were trained to assist in interviewing the students with the questionnaires and collecting anthropometric and biochemical data. The research assistants were medical doctors and nurses who had just graduated from the Medical School and the School of Nursing. They had five days of training for two hours each day in order to ensure that they had an overview of the study, understood the study objectives, the consenting process, contents of the questionnaire, procedure for data collection as well as data accuracy and completeness. Training was done on proper procedures for the blood pressure measurements as well as for height, weight, hip and waist circumference and urinalysis.

PRETESTING OF THE QUESTIONNAIRE

The questionnaire was pretested before the main study among 10% (80) of the total number of secondary school students in 2 co-educational schools located in one LGA not among those to be studied (Dowen College Ikoyi, WahabFolawiyo Secondary School Ikoyi (Ibeju-Lekki LGA). After the pretesting, necessary corrections and adjustments were be made to the questionnaire before copies of its final draft were produced and made ready for data collection.

DATA COLLECTION PROCEDURE

Data was collected from the participants in the two groups using an interviewer administered pretested, structured questionnaire. This was carried out from February 2017 to June 2017 in the 16 schools by the four research assistants and the principal investigator. The calibrated scales, measuring tapes and the mercury sphygmomanometers were checked properly to make sure they were in good working condition. This was done by using them to take
measurements on the four research assistants. Blood pressure and anthropometric assessment weight, height, waist circumference and hip circumference were taken. BMIs were calculated and urinalyses were done on the participants after interviewing them with the questionnaire. All investigations were carried out during the students’ lunch break, free periods during school hours and after school hours.

Blood pressures were measured in accordance with the recommendations of The Fourth Report on the Diagnosis, Evaluation and Treatment of High Blood Pressure in Children and Adolescents68 using a mercury sphygmomanometer with a cuff of appropriate size (width measuring 10cm and 13cm). Before taking the measurements the students were advised to sit quietly and rest for five minutes with legs uncrossed, feet resting on a firm surface and the right arm free of clothing. The cuff was placed on the right arm at the heart level. BP cuffs with bladder width at least 40% of the upper arm length at a point midway between the olecranon and the acromion and length covering 100% of the arm circumference were used.

Blood pressures were taken three times from each student included in the sample, the final BP used was the mean of three readings taken on a single occasion at approximately 30minute intervals during which the subject remained seated and rested. The systolic blood pressure (SBP) was taken at the point of first appearance of the Korotkoff sound (phase 1), while the diastolic blood (DBP) pressure was taken at the level of muffling (phase 4), for uniformity. Blood pressure assessments were performed in a pleasant and restful environment provided by the school authorities away from the classrooms.

The Fourth Report on the Diagnosis, Evaluation and Treatment of High Blood Pressure in Children and Adolescents table was used to allocate the resulting blood pressure values to percentiles for gender, age and height and the adolescents were classified as hypertensive
(SBP and/ DBP > P95), pre-hypertensive (SBP and DBP between P90 and P95 or > 120/80 but < P95), or normotensive (SBP and DBP < P90).\textsuperscript{68}

The portable digital weighing scales were calibrated using the weight of an adult registered as the maximum capacity. They have calibration buttons that can be pushed to trigger the scales to register the weight. The process of calibration is complete when the display shows all zeros. Weights were assessed using the portable digital weighing scales after checking for zero error at each measurement and the reading was taken to the nearest 0.1kg. Subjects were barefoot and without heavy clothing such as cardigans. They stood erect with the weight distributed equally between both feet at the centre of the platform and their heels together and looking straight ahead while the numbers flashed and scrolled through. When the numbers stopped the weight of the subject was read as the number from the face of the scale.

Heights were measured in centimetres using stadiometers with a range from 20cm to 220cm. Heights were measured to the nearest 0.5cm. Subjects were barefoot, lightly clothed and climbed onto the stadiometer with their heels and back against the height ruler. The lower edge of the socket was on the same horizontal plane as the external auditory meatus. The horizontal gliding piece was moved until it touched the head gently without crushing. For those with thick hair a little compression was applied.

Waist circumference is defined as the smallest circumference measured between the costal margin and the iliac crest. Waist circumferences were measured with non-elastic measuring tapes. The measuring tapes were applied to the waist lines of the students. The waistline is the equidistant abdominal circumference between the costal margin and the iliac crest and from here the waist circumference was taken, this was done on an empty stomach. Measurements
were done on participants who had not had lunch, others were told to come without eating the next day. The average of three consecutive measurements was considered and measurements were rounded up to the nearest 0.5cm. Hip circumferences were measured by first identifying the widest part of the buttocks, the tape measure is then placed at this location and measured around the circumference of the hips and buttocks. Using the waist circumference measurement, the waist hip ratio is calculated by dividing the waist circumference by the hip circumference. High WHR > 1 in male and > 0.8 in female.\textsuperscript{145, 146}

Height and weight were used to calculate the BMI by dividing the weight (kg) by the square of the height (metres). The students were categorised by age and sex using the US Center for Disease Control and Prevention (CDC) BMI growth charts as follows: Obese > 95\textsuperscript{th} percentile, Overweight: >85\textsuperscript{th} and <95\textsuperscript{th} percentile, Normal: 5\textsuperscript{th} to 85\textsuperscript{th} percentile, Underweight: < 5\textsuperscript{th} percentile.\textsuperscript{24}

The test for microalbuminuria was done on the field. The test was done as soon as the urine samples were available and the results read immediately. The students voided urine into a 20mls universal container which was labeled with their names (The students were told to ensure that all samples were midstream). The Micral test strips manufactured by Roche USA was used to test the students urine samples for microalbuminuria. Biochemical testing of urine was performed using dry reagent strips (dipsticks). The test was performed by dipping one reagent strip into each fresh urine sample and letting it sit for 5 seconds before withdrawal. The reagent pads reacted with the sample urine to provide a standardised visible colour reaction within 30 seconds to one minute.
The strip was left to stand for the time necessary for the reactions to occur (usually 1 to 2 minutes). The colour was then visually compared to the included colour chart to determine the level of the chemical factor. There are four colour blocks on the Micral test strip vial (0, 20, 50,100 milligram per liter (mg/l) reflecting the categories of albumin concentrations. A reading of 20mg/l and above was considered positive for micro albuminuria. All adolescents with abnormal urine findings were referred to the Nephrology Unit of the Lagos University Teaching Hospital, Lagos.

DATA MANAGEMENT

DATA CLEANING

Data cleaning was done immediately after data collection. This involved checking to make sure the questions were completely answered immediately and at the end of each working day. This also involved ensuring the questionnaires were numbered as well as crosschecking all the completed questionnaires and making sure all the questions were answered properly and clearly recorded. Data entry and analysis was carried out using IBM Statistical Package for Social Science Statistics version 20.0 (copyright IBM Corporation 2011). 33 questions assessed knowledge about hypertension. The responses ‘Yes’ ‘No’ and ‘Don’t know’ were dichotomized by collapsing ‘No and ‘Don’t know’ into No. In scoring the knowledge questions with responses ‘Yes’, ‘No’ and Don’t know’ the response ‘Yes’ which was the correct response was allotted a score of 1 while ‘No’ or ‘Don’t know’ responses were allotted a score of zero. Frequency tables were generated for presentation of the data. The respondents’ aggregate score was expressed as a percentage of the highest possible aggregate score. Out of a total score, a score of fifty percent and above was considered as good knowledge and a score of less than fifty percent considered poor knowledge. Univariate analysis was conducted and continuous variables were presented as means and standard
deviations while categorical variables were presented as proportions. Bivariate rural-urban comparisons were done using chi square and Fishers exact tests for categorical variables and t tests for continuous variables. P values less than 0.05 were considered to be statistically significant.

OUTCOME INDICATORS

1. PROPORTION OF ADOLESCENTS WITH HYPERTENSION

These are students with (1) Systolic blood pressure > 95th percentile for age, sex and height (2) Diastolic blood pressure > 95th percentile for age, sex and height (3) Systolic and Diastolic blood pressure > 95th percentile for age, sex and height

2. LEVEL OF KNOWLEDGE ABOUT HYPERTENSION IN ADOLESCENTS: To determine the level of knowledge about hypertension, knowledge was scored. Thirty three questions assessed knowledge about hypertension. To check if the information about hypertension among the students is accurate, a point scale was employed: one mark for each correct answer and zero for each incorrect answer. Out of a total score, a score of fifty percent and above was considered as good knowledge and a score of less than fifty percent considered poor knowledge.

3. RISK FACTORS FOR HYPERTENSION IN ADOLESCENTS

To assess the risk factors of hypertension, the following questions were asked from the respondents

1. Family history of hypertension: Is any member of your family hypertensive. If yes, to above whom?
2. **Inadequate intake of fruits and vegetables.** This was assessed using the questions: Do you take fruits and vegetables? If Yes to above, How often do you take fruits and vegetables? Is it 1.) Everyday 2.) 1-3 times per week 3.) 4-6 times per week. How many portions of fruits and vegetables do you eat in a day 1.) 1-3 portions 2.) 4-6 portions. Respondents who answered in the affirmative 1-3 times per week and 1-3 portions per day were classified as having inadequate intake of fruits and vegetables.

3. **Consumption of fast food:** This was assessed using the question: Do you eat foods such as meat pie, cakes, scotch eggs, fried chicken? Respondents who answered in the affirmative were classified as consumers of fast food.

4. **Consumption of sugary drinks:** This was assessed using the question: Do you take sugary drinks such as Coca-Cola, Fanta, Sprite? Respondents who answered in the affirmative were classified as consumers of sugary soft drinks.

5. **Low physical activity:** This was assessed using the question: Do you engage in physical activity? If Yes, is it 1.) everyday 2.) 1-3 times per week 3.) 4-6 times per week. How many minutes do you engage in physical activity per day 1.) < 30 minutes 2.) 30 minutes 3.) 1 hour 4) 2 hours. Respondents who answered in the affirmative 1-3 times per week and < 30 minutes per day were classified as respondents having low physical activity.

6. **Cigarette smoking:** This was assessed using the questions: Have you ever tried or experimented with cigarette smoking? Even if it is one or two puffs. Respondents who answered in the affirmative were classified as respondents who had ever smoked.

7. **Alcohol intake:** This was assessed using the question: Do you drink alcohol? Respondents who answered in the affirmative were classified as respondents who had ever used alcohol.
8. **Addition of extra salt to meals:** This was assessed using the question Do you add extra salt to your meals? Respondents who answered in the affirmative were classified as respondents who added extra salt to food.

9. **The BMI was calculated.** The height and weight were used to calculate the BMI

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

**ETHICAL CONSIDERATION**

Ethical approval for this study was obtained from the Health Research and Ethics Committee (HREC) of the Lagos University Teaching Hospital, Lagos (Appendix 2). Permission was also sought from the principals of the secondary schools involved in the study. Assent was obtained from all the respondents in both groups after explaining the nature of the study, its goals, their obligations and assurance that participation is purely voluntary and without consequences for non-participation. Informed consent was obtained from subjects’ parents and guardians. All study participants with old and newly discovered health conditions in the course of the study were referred to the appropriate point of care for management.

**LIMITATION OF THE STUDY**

Out of school adolescents in Lagos State were not included in the study.
CHAPTER FOUR

RESULTS

Table 1: Comparison of the socio-demographic characteristics of rural and urban

<table>
<thead>
<tr>
<th>Respondents Variable</th>
<th>Frequency (%)</th>
<th>Urban (n=336)</th>
<th>Rural (n=336)</th>
<th>$\chi^2$</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year) ≤15</td>
<td>230 (68.4)</td>
<td>270 (80.4)</td>
<td>12.50</td>
<td>1</td>
<td>0.0004</td>
<td></td>
</tr>
<tr>
<td>Age (year) ≥16</td>
<td>106 (30.6)</td>
<td>66 (19.6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean age</td>
<td>14.4 ± 2.2</td>
<td>13.8 ± 2.0</td>
<td>t = 3.131, p = 0.002*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>164 (48.8)</td>
<td>158 (47.0)</td>
<td>0.215</td>
<td>1</td>
<td>0.643</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>172 (51.2)</td>
<td>178 (53.0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yoruba</td>
<td>226 (67.3)</td>
<td>205 (61.0)</td>
<td>2.85</td>
<td>1</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>110 (32.7)</td>
<td>131 (38.9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Religion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Christianity</td>
<td>224 (66.7)</td>
<td>240 (71.4)</td>
<td>1.783</td>
<td>1</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>112 (33.3)</td>
<td>96 (28.6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of school</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>168 (50.0)</td>
<td>168 (50.0)</td>
<td>0.000</td>
<td>1</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>168 (50.0)</td>
<td>168 (50.0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JSS</td>
<td>167 (49.7)</td>
<td>173 (51.5)</td>
<td>0.214</td>
<td>1</td>
<td>0.643</td>
<td></td>
</tr>
<tr>
<td>SSS</td>
<td>169 (50.3)</td>
<td>163 (48.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Father’s highest level of education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ Primary</td>
<td>111 (33.1)</td>
<td>81 (24)</td>
<td>41.39</td>
<td>1</td>
<td>&lt;0.0001*</td>
<td></td>
</tr>
<tr>
<td>≥Secondary</td>
<td>225 (66.9)</td>
<td>255 (76)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mother’s highest level of education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ Primary</td>
<td>124 (36.9)</td>
<td>73 (21.7)</td>
<td>18.68</td>
<td>1</td>
<td>&lt;0.001*</td>
<td></td>
</tr>
<tr>
<td>≥Secondary</td>
<td>212 (63.1)</td>
<td>263 (78.3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
* Statistically significant

JSS – Junior Secondary School

SSS – Senior Secondary School
A total of 672 adolescents participated in the study - 336 in rural schools and 336 in urban schools. Majority of the students were 15 years old and less, rural 230 (68.4%) and urban 270 (80.4%). A higher proportion of students in the age brackets 16 years old and older were in the rural schools 106 (30.6%), in comparison to those in the urban schools 66 (19.6%). There was no statistically significant association between the age of a student and being in a rural or urban school. The mean ages of the students were 14.4±2.2 for the rural schools and 13.8±2.0 for the urban schools. The mean age of the students in the rural schools was higher than that of those in the urban schools and the difference was statistically significant. There was a statistically significant relationship between ethnicity and school location (rural or urban) with a higher proportion of the students from the Yoruba ethnic group being more in the rural schools 226 (67.3%) in comparison to the urban schools 205 (61.0%). A higher proportion of the fathers of students in urban schools had secondary and higher education 255 (76%), in comparison to the fathers of students in the rural schools 225 (66.9%), likewise a higher proportion of the mothers of students in urban schools had secondary and higher education 263 (78.3%) in comparison to the mothers of students in the rural schools 212 (63.1%). A statistically significant association was observed between fathers’ and mothers’ level of education and location of schools (rural or urban).
Table 2: Comparison of the awareness and sources of information about hypertension between rural and urban respondents

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (%)</th>
<th>$\chi^2$</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rural (n=336)</td>
<td>Urban (n=336)</td>
<td></td>
</tr>
<tr>
<td>Respondent has heard of hypertension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>305 (90.8)</td>
<td>293 (87.2)</td>
<td>2.187</td>
</tr>
<tr>
<td>No</td>
<td>31 (9.2)</td>
<td>43 (12.8)</td>
<td></td>
</tr>
<tr>
<td>Source of information</td>
<td>n=305</td>
<td>n=293</td>
<td></td>
</tr>
<tr>
<td>Family members</td>
<td>152 (49.8)</td>
<td>164 (56.0)</td>
<td>2.258</td>
</tr>
<tr>
<td>School</td>
<td>136 (44.6)</td>
<td>134 (45.7)</td>
<td>0.079</td>
</tr>
<tr>
<td>Television/radio</td>
<td>130 (42.6)</td>
<td>131 (44.7)</td>
<td>0.265</td>
</tr>
<tr>
<td>Internet</td>
<td>62 (20.3)</td>
<td>78 (26.6)</td>
<td>3.301</td>
</tr>
<tr>
<td>Newspapers/books/magazines</td>
<td>66 (21.6)</td>
<td>82 (28.0)</td>
<td>3.232</td>
</tr>
<tr>
<td>Health professional</td>
<td>100 (32.8)</td>
<td>92 (31.4)</td>
<td>0.132</td>
</tr>
<tr>
<td>Relatives</td>
<td>74 (24.3)</td>
<td>80 (27.3)</td>
<td>0.723</td>
</tr>
<tr>
<td>Friends</td>
<td>56 (18.4)</td>
<td>67 (22.9)</td>
<td>1.857</td>
</tr>
</tbody>
</table>

Multiple responses

The table above shows a comparison of the level of awareness and sources of information about hypertension among rural and urban respondents. It shows that majority of the students had heard about hypertension. However, a higher proportion of students from the rural schools 305 (90.8%) than those in the urban schools 293 (87.2%) were aware of hypertension. The difference was however not statistically significant. A higher proportion of the students in the urban 164 (56.0%) than those in the rural schools 152 (49.8%) claimed that family members were their source of information about hypertension. This was also not statistically significant. Other sources of information are as shown in Table 2, and comparison between urban and rural schools showed no statistical significance in any.
Table 3: Comparison of the correct knowledge of hypertension among rural and urban respondents

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rural (n=336)</th>
<th>Frequency (%)</th>
<th>Urban (n=336)</th>
<th>Frequency (%)</th>
<th>( \chi^2 )</th>
<th>Df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Knew the meaning of hypertension</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>221 (65.8)</td>
<td>162 (48.2)</td>
<td>21.10</td>
<td>2</td>
<td>&lt;</td>
<td></td>
<td>0.001*</td>
</tr>
<tr>
<td>No</td>
<td>115 (34.2)</td>
<td>174 (51.8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hypertension is dangerous</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>286 (85.1)</td>
<td>279 (83.1)</td>
<td>0.545</td>
<td>1</td>
<td>0.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>50 (14.9)</td>
<td>57 (16.9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hypertension is part of aging</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>115 (34.2)</td>
<td>124 (36.9)</td>
<td>0.53</td>
<td>1</td>
<td>0.47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>221 (65.8)</td>
<td>212 (63.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hypertension is a lifelong disease</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>116 (34.5)</td>
<td>111 (33.0)</td>
<td>0.17</td>
<td>1</td>
<td>0.68*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>220 (65.5)</td>
<td>225 (66.9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hypertension has symptoms</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>231 (68.8)</td>
<td>190 (56.5)</td>
<td>10.69</td>
<td>1</td>
<td>0.001*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>105 (31.2)</td>
<td>146 (43.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>If untreated, leads to organ damage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>262 (78.0)</td>
<td>245 (72.9)</td>
<td>2.32</td>
<td>1</td>
<td>0.127</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>74 (22.0)</td>
<td>91 (27.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hypertension can be prevented</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>267 (79.5)</td>
<td>277 (82.4)</td>
<td>0.97</td>
<td>1</td>
<td>0.33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>69 (20.5)</td>
<td>59 (17.6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hypertension is manageable</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>239 (71.1)</td>
<td>242 (72.0)</td>
<td>0.07</td>
<td>1</td>
<td>0.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>97 (28.9)</td>
<td>94 (28.0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Statistically significant
The table above shows a comparison of the correct knowledge of hypertension among rural and urban respondents. In the rural schools a higher proportion of students 221(65.8%) knew the meaning of hypertension in comparison to those in the urban schools162 (48.2%) There was a statistically significant association between knowledge of the meaning of hypertension and being in a rural or urban school. A higher proportion of students in the rural schools 116 (34.5%) knew that hypertension was a lifelong disease in comparison to those in the urban schools 111 (33.0%) There was a statistically significant association between the knowledge that hypertension is a lifelong disease and being in a rural or urban school.A higher proportion of students in the rural schools 231(68.8%) knew that hypertension has symptoms in comparison to students in the urban schools 190 (56.5%). There was a statistically significant association between the knowledge that hypertension has symptoms and being in a rural or urban school.
Table 4: Comparison of the correct knowledge of the symptoms of hypertension among rural and urban respondents

<table>
<thead>
<tr>
<th>Symptoms of hypertension</th>
<th>Frequency (%) Rural (n=336)</th>
<th>Frequency (%) Urban (n=336)</th>
<th>( \chi^2 )</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>145 (43.2)</td>
<td>135 (40.2)</td>
<td>0.612</td>
<td>0.434</td>
</tr>
<tr>
<td>Dizziness</td>
<td>119 (35.4)</td>
<td>115 (34.2)</td>
<td>0.105</td>
<td>0.746</td>
</tr>
<tr>
<td>Sweating</td>
<td>88 (26.2)</td>
<td>70 (20.8)</td>
<td>2.681</td>
<td>0.102</td>
</tr>
<tr>
<td>Irritability</td>
<td>72 (21.4)</td>
<td>65 (19.3)</td>
<td>0.449</td>
<td>0.503</td>
</tr>
<tr>
<td>Chest pain</td>
<td>190 (56.5)</td>
<td>164 (48.8)</td>
<td>4.035</td>
<td>0.045*</td>
</tr>
<tr>
<td>Blurred vision</td>
<td>87 (25.9)</td>
<td>42 (12.5)</td>
<td>19.427</td>
<td>&lt; 0.001*</td>
</tr>
</tbody>
</table>

*Statistically significant

\( df = 1 \) (For each level of analysis)

The table above shows a comparison of the correct knowledge of the symptoms of hypertension among rural and urban respondents. A higher proportion of students in the rural schools generally displayed better correct knowledge of the symptoms of hypertension in comparison to those in the urban schools. The associations between correct knowledge of the symptoms of hypertension and the location of schools (rural or urban) were statistically significant for the following symptoms of hypertension: Chest pain 190 (56.5%), 164 (48.8%) and Blurred vision 87 (25.9%), 42 (12.5%).
Table 5: Comparison of the knowledge of the organs of the body that can be damaged by hypertension among rural and urban respondents.

<table>
<thead>
<tr>
<th>Organs damaged by hypertension</th>
<th>Frequency (%)</th>
<th>Rural (n=336)</th>
<th>Urban (n=336)</th>
<th>$\chi^2$</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart</td>
<td></td>
<td>248 (73.8)</td>
<td>214 (63.7)</td>
<td>8.007</td>
<td>0.005*</td>
</tr>
<tr>
<td>Eyes</td>
<td></td>
<td>46 (13.7)</td>
<td>54 (16.1)</td>
<td>0.752</td>
<td>0.386</td>
</tr>
<tr>
<td>Brain</td>
<td></td>
<td>101 (30.1)</td>
<td>115 (34.2)</td>
<td>1.337</td>
<td>0.248</td>
</tr>
<tr>
<td>Kidneys</td>
<td></td>
<td>113 (33.6)</td>
<td>116 (34.5)</td>
<td>0.060</td>
<td>0.807</td>
</tr>
</tbody>
</table>

* Statistically significant

The table above shows a comparison of the knowledge of the organs of the body that can be damaged by hypertension among rural and urban respondents. A higher proportion of students in the rural schools knew that the Heart is an organ that can be damaged by hypertension 248(73.8%) in comparison to those in the urban schools 214(63.7%). There was a statistically significant association between knowledge that the heart can be damaged by hypertension and being in a rural or an urban school. A higher proportion of students in the urban schools displayed better knowledge indicating that the (Eyes, Brain and Kidneys) 54(16.1%), 115(34.2%), 116(34.5%) are organs that can be damaged by hypertension in comparison to those in the rural school 46 (13.7%), 101 (30.1%), 113(33.6%). There was no statistically significant association between knowledge that the Eyes, Brain and Kidney can be damaged by hypertension and being in a rural or an urban school.
Table 6: Comparison of the knowledge of ways by which hypertension can be prevented among rural and urban respondents

<table>
<thead>
<tr>
<th>How Hypertension is prevented</th>
<th>Frequency (%)</th>
<th>Rural (n=336)</th>
<th>Urban (n=336)</th>
<th>$\chi^2$</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid alcohol abuse</td>
<td>179 (53.3)</td>
<td>159 (47.3)</td>
<td>2.381</td>
<td>0.123</td>
<td></td>
</tr>
<tr>
<td>Avoid cigarette smoking</td>
<td>171 (50.9)</td>
<td>153 (45.5)</td>
<td>1.931</td>
<td>0.165</td>
<td></td>
</tr>
<tr>
<td>Avoid high sugar soft drinks</td>
<td>145 (43.2)</td>
<td>142 (42.3)</td>
<td>0.055</td>
<td>0.815</td>
<td></td>
</tr>
<tr>
<td>Avoid high fat foods</td>
<td>119 (35.4)</td>
<td>126 (37.5)</td>
<td>0.315</td>
<td>0.575</td>
<td></td>
</tr>
<tr>
<td>Avoid stress</td>
<td>208 (61.9)</td>
<td>215 (64.0)</td>
<td>0.313</td>
<td>0.576</td>
<td></td>
</tr>
<tr>
<td>Regularly eat fruits/vegetables</td>
<td>157 (46.7)</td>
<td>157 (46.7)</td>
<td>0.000</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Reduce portion sizes</td>
<td>75 (22.3)</td>
<td>84 (25.0)</td>
<td>0.667</td>
<td>0.414</td>
<td></td>
</tr>
<tr>
<td>Have regular medical check-up</td>
<td>189 (56.3)</td>
<td>194 (57.7)</td>
<td>0.152</td>
<td>0.697</td>
<td></td>
</tr>
<tr>
<td>Do regular exercises</td>
<td>152 (45.2)</td>
<td>177 (52.7)</td>
<td>3.722</td>
<td>0.054</td>
<td></td>
</tr>
<tr>
<td>Avoid excess salt intake</td>
<td>134 (39.9)</td>
<td>132 (39.3)</td>
<td>0.025</td>
<td>0.875</td>
<td></td>
</tr>
</tbody>
</table>

* Multiple responses

The table above shows a comparison of the knowledge of ways by which hypertension can be prevented among rural and urban respondents. A higher proportion of students in the rural schools knew that alcohol 179 (53.3%), cigarettes 171 (50.9%), high sugar soft drinks 145 (43.2%) and excess salt intake 134(39.9%) should be avoided to prevent hypertension in comparison to students in the urban schools. (Alcohol 159(47.3%), cigarettes 153(45.5%) high sugar soft drinks 142(42.3%) and excess salt intake 132(39.3%)
A higher proportion of students in the urban schools knew that to avoid hypertension, high fat food should be avoided 136(40.5%), stress should be avoided 215(64.0%), portion sizes reduced 84(25.0%), regular medical checkup should be done 194 (57.7%) and regular exercises should be done177(52.7%) in comparison to students in the rural schools119(35.4)208(61.9%),75(22.3%),189 (56.3%),152(45.2)
The same proportion of students in both rural and urban schools knew that hypertension could be avoided by regular consumption of fruits and vegetables: Rural schools157(46.7%) Urban schools157(46.7%).The table above shows that there is no statistically significant association between students' knowledge of ways by which hypertension can be prevented and being in a rural or public school. This applies to all the knowledge variables.
Table 7: Comparison of the knowledge of ways by which hypertension can be managed among rural and urban respondents.

<table>
<thead>
<tr>
<th>Ways hypertension can be managed</th>
<th>Rural (n=336)</th>
<th>Urban (n=336)</th>
<th>$\chi^2$</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drugs</td>
<td>181 (53.9)</td>
<td>185 (55.1)</td>
<td>0.096</td>
<td>0.757</td>
</tr>
<tr>
<td>Maintain healthy weight</td>
<td>164 (48.8)</td>
<td>152 (45.2)</td>
<td>0.860</td>
<td>0.354</td>
</tr>
<tr>
<td>Eat balanced diet</td>
<td>202 (60.1)</td>
<td>188 (56.0)</td>
<td>1.198</td>
<td>0.274</td>
</tr>
<tr>
<td>Regular physical activity</td>
<td>179 (53.3)</td>
<td>172 (51.2)</td>
<td>0.292</td>
<td>0.589</td>
</tr>
<tr>
<td>Avoidance of stress</td>
<td>46 (13.7)</td>
<td>80 (23.8)</td>
<td>11.292</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

*Statistically significant analysis

The table above shows a comparison of the knowledge of ways by which hypertension can be managed among rural and urban respondents. A higher proportion of rural and urban respondents indicated that hypertension can be managed by eating a balanced diet in comparison to the proportions of respondents who indicated that hypertension can be managed with the use of drugs, maintaining a healthy weight, engaging in regular physical activity and avoiding stress. A higher proportion of students in the urban schools indicated that hypertension can be managed by using drugs 185(55.1%), and by avoiding stress 80(23.8%) in comparison to students in the rural school: (Use of drugs 181 (53.9%), avoidance of stress 46(13.7%). The association between knowledge of the avoidance of stress to manage hypertension and being in a rural or an urban school was statistically significant.

A higher proportion of students in the rural schools indicated that hypertension can be managed by maintaining a healthy weight 164(48.8%), eating a balanced diet 202(60.1%) and doing regular exercises 179(53.3%) in comparison to students in the urban schools. (Maintaining a healthy weight 152(45.2%), eating a balanced diet 188(56.0%), doing regular exercises 172(51.2%). The association between the use of the above variables to manage hypertension and being in a rural or an urban school was not statistically significant.
Table 8: Comparison of the overall knowledge scores for hypertension of rural and urban respondents.

<table>
<thead>
<tr>
<th>Knowledge score</th>
<th>Frequency (%)</th>
<th>( \chi^2 )</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rural (n=336)</td>
<td>Urban (n=336)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>160 (47.6)</td>
<td>157 (46.7)</td>
<td>0.054</td>
<td>1</td>
</tr>
<tr>
<td>Poor</td>
<td>176 (52.4)</td>
<td>179 (53.3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall knowledge score SD)</td>
<td>(46.7 ± 24.0)</td>
<td>45.1 ± 23.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Good ≥ 50%, Poor < 50%  

The table above shows a comparison of the overall knowledge scores for hypertension of rural and urban respondents. Less than 50% of the students had good knowledge scores, rural 160(47.6%), urban 157(46.7%). The overall knowledge score of the rural respondents is higher than that of the urban respondents. No statistically significant association was found between the overall level of knowledge among respondents and being in rural or public schools. The mean knowledge score was higher for students in the rural schools 46.7±24.0 in comparison to that of students in the urban school 45.1±23.9. The difference was not statistically significant.
Table 9: Comparison of the associations between socio-demographic characteristics & overall knowledge of rural and urban respondents.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rural (n = 336)</th>
<th>Urban (n = 336)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Knowledge of Hypertension (%)</td>
<td>Knowledge of Hypertension (%)</td>
</tr>
<tr>
<td></td>
<td>Good (n = 160)</td>
<td>Poor (n = 176)</td>
</tr>
<tr>
<td>Age (year)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;15</td>
<td>108 (46.9)</td>
<td>122 (53.0)</td>
</tr>
<tr>
<td>&gt;16</td>
<td>52 (49)</td>
<td>54 (50.9)</td>
</tr>
<tr>
<td>χ², df, p, Fisher exact p</td>
<td>0.058, 1, p=0.81</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>83 (50.6)</td>
<td>81 (49.4)</td>
</tr>
<tr>
<td>Female</td>
<td>77 (44.8)</td>
<td>95 (55.2)</td>
</tr>
<tr>
<td>χ², df, p</td>
<td>1.149, 1, 0.284</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yoruba</td>
<td>111 (49.1)</td>
<td>115 (50.9)</td>
</tr>
<tr>
<td>Others</td>
<td>49 (44.5)</td>
<td>61 (55.4)</td>
</tr>
<tr>
<td>χ², df, p</td>
<td>0.62, 1, 0.43</td>
<td></td>
</tr>
<tr>
<td>Religion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Christianity</td>
<td>105 (46.9)</td>
<td>119 (53.1)</td>
</tr>
<tr>
<td>Islam</td>
<td>51 (48.1)</td>
<td>55 (51.9)</td>
</tr>
<tr>
<td>Others</td>
<td>4 (66.7)</td>
<td>2 (33.3)</td>
</tr>
<tr>
<td>χ², df, p, Fisher exact p</td>
<td>1.570, 2, 0.814, 0.749</td>
<td>5.619, 2, 0.230, 0.236</td>
</tr>
<tr>
<td>Type of school</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>81 (48.2)</td>
<td>87 (51.8)</td>
</tr>
<tr>
<td>Private</td>
<td>79 (47.0)</td>
<td>89 (53.0)</td>
</tr>
<tr>
<td>χ², df, p</td>
<td>0.048, 1, 0.827</td>
<td></td>
</tr>
<tr>
<td>Class</td>
<td></td>
<td></td>
</tr>
<tr>
<td>JSS</td>
<td>71 (42.5)</td>
<td>96 (57.5)</td>
</tr>
<tr>
<td>SSS</td>
<td>89 (52.7)</td>
<td>80 (47.3)</td>
</tr>
<tr>
<td>χ², df, p</td>
<td>3.23,1, 0.07</td>
<td></td>
</tr>
<tr>
<td>Father’s education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; Primary</td>
<td>47 (42.3)</td>
<td>64 (57.7)</td>
</tr>
<tr>
<td>&gt;Secondary</td>
<td>113 (50.2)</td>
<td>112 (49.8)</td>
</tr>
<tr>
<td>χ², df, p</td>
<td>0.137,1, 0.71</td>
<td></td>
</tr>
<tr>
<td>Mother’s education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; Primary</td>
<td>62 (50)</td>
<td>62 (50)</td>
</tr>
<tr>
<td>&gt;Secondary</td>
<td>98 (46.2)</td>
<td>114 (53.8)</td>
</tr>
<tr>
<td>χ², df, p</td>
<td>5.641, 1, 0.228</td>
<td></td>
</tr>
</tbody>
</table>

* Statistically significant

The table above shows that the associations between age, sex, ethnicity, religion, type of school, class, mother and fathers education and the overall knowledge scores for hypertension in rural respondents was not statistically significant. The associations between age, sex, ethnicity, religion, type of school, class, mother and fathers education and the overall knowledge scores for hypertension in urban respondents was not statistically significant.
Table 10: Comparison of the presence of a risk factor of hypertension among rural and urban respondents: Family history.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (%)</th>
<th>Rural (n=336)</th>
<th>Urban (n=336)</th>
<th>χ²</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Family history of hypertension</td>
<td>Yes</td>
<td>57 (17.0)</td>
<td>32 (9.5)</td>
<td>8.200</td>
<td>2</td>
<td>0.017*</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>178 (53.0)</td>
<td>190 (56.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Don’t know</td>
<td>101 (30.0)</td>
<td>114 (33.9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertensive in the family</td>
<td>n = 57</td>
<td>n = 32</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Father</td>
<td>11 (19.3)</td>
<td>7 (21.9)</td>
<td>0.084</td>
<td>1</td>
<td>0.772</td>
<td></td>
</tr>
<tr>
<td>Mother</td>
<td>16 (28.1)</td>
<td>5 (15.6)</td>
<td>1.761</td>
<td>1</td>
<td>0.185</td>
<td></td>
</tr>
<tr>
<td>Sister</td>
<td>4 (7.0)</td>
<td>2 (6.3)</td>
<td>0.019</td>
<td>1</td>
<td>0.890</td>
<td></td>
</tr>
<tr>
<td>Brother</td>
<td>1 (1.8)</td>
<td>1 (3.1)</td>
<td>0.175</td>
<td>1</td>
<td>0.675</td>
<td></td>
</tr>
<tr>
<td>Grandfather</td>
<td>12 (21.1)</td>
<td>5 (15.6)</td>
<td>5.281</td>
<td>1</td>
<td>0.022*</td>
<td></td>
</tr>
<tr>
<td>Grandmother</td>
<td>11 (19.3)</td>
<td>7 (21.9)</td>
<td>0.084</td>
<td>1</td>
<td>0.772</td>
<td></td>
</tr>
</tbody>
</table>

* Statistically significant

The table above shows a comparison of the presence of a risk factor of hypertension among rural and urban respondents: Family history of hypertension: A higher proportion of students in the rural schools 57 (17.0%) gave a family history of hypertension in comparison to students in urban schools 32 (9.5%). There was a statistically significant association between a family history of hypertension and being in a rural or an urban school. A higher proportion of students from the rural schools 12(21.1%) gave a history of their grandfather being hypertensive in comparison to students in the urban schools 5 (15.6%). There was a statistically significant association between a grandfather being hypertensive and being in a rural or urban school.
Table 11: Table showing a comparison of the presence of risk factors of hypertension among rural and urban respondents: cigarette smoking, use of alcohol, addition of extra salt to food

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (%)</th>
<th>χ²</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ever smoked</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>16 (4.8)</td>
<td>4.025</td>
<td>1</td>
<td>0.045*</td>
</tr>
<tr>
<td>No</td>
<td>320 (95.2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age of initiation of cigarette smoking</strong></td>
<td>n = 16</td>
<td></td>
<td>1</td>
<td>0.256</td>
</tr>
<tr>
<td>&lt; 10</td>
<td>6 (37.5)</td>
<td>1.284</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>≥ 10</td>
<td>10 (62.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Current smoker: A student who has smoked at least one cigarette in the past 30 days</strong></td>
<td>n = 16</td>
<td></td>
<td>1</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>No</td>
<td>12 (75.0)</td>
<td>16.6</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>4(25.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number of cigarettes smoked</strong></td>
<td>n=16</td>
<td></td>
<td>4</td>
<td>0.308</td>
</tr>
<tr>
<td>0</td>
<td>12 (75.0)</td>
<td>4.803</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2 (12.5)</td>
<td></td>
<td></td>
<td>0.316†</td>
</tr>
<tr>
<td>2</td>
<td>1 (6.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1 (6.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0 (0)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ever use of alcohol</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>31 (9.2)</td>
<td>1</td>
<td>0.010*</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>305 (90.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Drink alcohol daily</strong></td>
<td>n = 31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>2 (6.5)</td>
<td>0.309</td>
<td>1</td>
<td>0.578</td>
</tr>
<tr>
<td>No</td>
<td>29 (93.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Add extra salt to food</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>61 (18.2)</td>
<td>1.342</td>
<td>1</td>
<td>0.247</td>
</tr>
<tr>
<td>No</td>
<td>275 (81.8)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Frequency of adding extra salt</strong></td>
<td>n = 61</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rarely</td>
<td>5 (8.2)</td>
<td>20.080</td>
<td>2</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>Sometimes</td>
<td>32 (52.5)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always</td>
<td>24 (39.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Statistically significant † Fisher exact p

A higher proportion of students in the urban schools 29(8.6%) gave a history of ever smoking in comparison to students in the rural schools 16(4.8%) There was a statistically significant association between a history of ever smoking and being in a rural or urban school. There was also a statistically significant association between being a smoker and being in a rural or urban school.
urban school. A higher proportion of students in the urban schools 53 (15.8%) gave a history of ever using alcohol in comparison to students in the rural schools 31 (9.2%). There was a statistically significant association between a history of ever using alcohol and being in a rural or urban school. A higher proportion of students in the rural schools 24 (39.3%) gave a history of adding extra salt to food always in comparison to students in the urban schools 20 (27.4%). There was a statistically significant association between adding extra salt to food always and being in a rural or urban school.
A higher proportion of students in the urban schools took sugary drinks every day in comparison to students in the rural schools. A higher proportion of students in the urban school engaged in physical activity 1 – 3 times per week in comparison to students in the rural schools. A higher proportion of students in the urban schools engaged in physical activity for less than 30 minutes every day in comparison to students in the rural schools. There was a statistically significant association between the frequency of taking sugary drinks, frequency of engaging in physical activity, number of minutes of physical activity done per day and being in a rural or urban school.

Table 12: Comparison of the presence of risk factors of hypertension among rural and urban respondents

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (%)</th>
<th>Rural (n=336)</th>
<th>Urban (n=336)</th>
<th>$\chi^2$</th>
<th>Df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast food consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>297 (88.4)</td>
<td>283 (84.2)</td>
<td>2.465</td>
<td>1</td>
<td>0.116</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>39 (11.6)</td>
<td>53 (15.8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of fast food consumption</td>
<td>n = 297</td>
<td>n = 283</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Once in a while</td>
<td>11 (3.7)</td>
<td>135 (48)</td>
<td>5.996</td>
<td>3</td>
<td>0.424</td>
<td></td>
</tr>
<tr>
<td>1 – 3 times a week</td>
<td>227 (76)</td>
<td>127 (44.9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 – 6 times a week</td>
<td>17 (5.7)</td>
<td>9 (3.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Everyday</td>
<td>42 (14.1)</td>
<td>12 (4.2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption of sugary drinks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>313 (93.2)</td>
<td>304 (90.5)</td>
<td>1.604</td>
<td>1</td>
<td>0.205</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>23 (6.8)</td>
<td>32 (9.5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of taking sugary drinks</td>
<td>n = 313</td>
<td>n = 304</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 -3 times a week</td>
<td>250 (80)</td>
<td>227 (75)</td>
<td>12.984</td>
<td>2</td>
<td>0.024*</td>
<td></td>
</tr>
<tr>
<td>4 -6 times a week</td>
<td>30 (9.6)</td>
<td>24 (7.9)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Everyday</td>
<td>33 (10.5)</td>
<td>53 (17.4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engagement in physical activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>287 (85.4)</td>
<td>271 (80.7)</td>
<td>2.704</td>
<td>1</td>
<td>0.100</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>49 (14.6)</td>
<td>65 (19.3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency of doing physical activity</td>
<td>n = 287</td>
<td>n = 271</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 – 3 times a week</td>
<td>187 (65)</td>
<td>201 (74)</td>
<td>14.055</td>
<td>2</td>
<td>0.029*</td>
<td></td>
</tr>
<tr>
<td>4 – 6 times a week</td>
<td>23 (8.0)</td>
<td>14 (5.1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Everyday</td>
<td>77 (26.8)</td>
<td>56 (20.7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of minutes of physical activity/day</td>
<td>n = 287</td>
<td>n = 271</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 30min</td>
<td>99 (34.4)</td>
<td>129 (47.6)</td>
<td>14.513</td>
<td>3</td>
<td>0.002*</td>
<td></td>
</tr>
<tr>
<td>Thirty minutes</td>
<td>118 (41.1)</td>
<td>77 (28.4)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One hour</td>
<td>56 (19.5)</td>
<td>44 (16.2)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two hours</td>
<td>14 (4.9)</td>
<td>21 (7.7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Statistically significant
Table 13: Comparison of the presence of risk factors of hypertension among rural and urban respondents

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (%)</th>
<th>$\chi^2$</th>
<th>Df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intake of fruit and vegetable</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>301 (89.6)</td>
<td>299 (89.0)</td>
<td>0.062</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td>35 (10.4)</td>
<td>37 (11.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Frequency of fruits &amp; vegetables intake</strong></td>
<td>n = 301</td>
<td>n = 299</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 – 3 times a week</td>
<td>185 (61.5)</td>
<td>188 (62.9)</td>
<td>4.586</td>
<td>2</td>
</tr>
<tr>
<td>4 – 6 times a week</td>
<td>30 (10)</td>
<td>25 (8.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Everyday</td>
<td>86 (28.6)</td>
<td>86 (28.8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Portions of fruits &amp; vegetables intake per day</strong></td>
<td>n = 301</td>
<td>n = 299</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 – 3 portions</td>
<td>290 (96.3)</td>
<td>282 (94.3)</td>
<td>0.53</td>
<td>1</td>
</tr>
<tr>
<td>4 – 6 portions</td>
<td>11 (3.7)</td>
<td>17 (5.7)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ever had blood pressure checked</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>51 (15.2)</td>
<td>74 (22.0)</td>
<td>5.199</td>
<td>1</td>
</tr>
<tr>
<td>No</td>
<td>285 (84.8)</td>
<td>262 (78.0)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Statistically significant

Majority of the students in the rural 301 (89.6%) and urban schools 299 (89%) took fruits and vegetables. Majority of the students in the rural 182 (60%) and urban schools 183 (61%) took fruits and vegetables 1 – 3 times per week. A higher proportion of students in the rural schools 287 (95%) took one to three portions of fruits and vegetables per day in comparison to students in the urban schools 168 (56%) There was a statistically significant association between portion of fruits and vegetables taken per day and being in a rural or urban school. A higher proportion of students in the urban schools 74 (22.0%) had their blood pressures checked before in comparison to students in the rural schools 51 (15.2%). There was a statistically significant association between a history of previous blood pressure check and being in a rural or urban school.
Table 14: Distribution of respondents by blood pressure and prevalence of hypertension

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (%)</th>
<th>$\chi^2$</th>
<th>Df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Systolic blood pressure-for-age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 50th percentile (low)</td>
<td>158 (47.0)</td>
<td>8.680</td>
<td>3</td>
<td>0.034*</td>
</tr>
<tr>
<td>50th – 90th percentile (normal)</td>
<td>122 (36.3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90th – 95th percentile (prehypertension)</td>
<td>17 (5.1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 95th percentile (hypertension)</td>
<td>39 (11.6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean systolic blood pressure</td>
<td>111.6 ± 14.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Diastolic blood pressure-for-age</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 50th percentile (low)</td>
<td>158 (47.0)</td>
<td>18.051</td>
<td>3</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>50th – 90th percentile (normal)</td>
<td>134 (39.9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>90th – 95th percentile (prehypertension)</td>
<td>26 (7.7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 95th percentile (hypertension)</td>
<td>18 (5.4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean diastolic blood pressure</td>
<td>65.1 ± 10.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hypertensive</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes (prevalence)</td>
<td>44 (13.1)</td>
<td>5.167</td>
<td>1</td>
<td>0.023*</td>
</tr>
<tr>
<td>No</td>
<td>292 (86.9)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Statistically significant

Hypertensive = Systolic BP > 95th percentile or diastolic BP > 95th percentile or both systolic and diastolic BP > 95th percentile (Mean of three different readings taken 30 minutes apart)

A higher proportion of students in the rural schools 39 (11.6%) had a systolic blood pressure for age > 95th percentile in comparison to students in the urban schools 21 (6.3%). There was a statistically significant association between systolic blood pressure > 95th percentile and being in a rural or urban school. The mean systolic and diastolic blood pressures of rural respondents were found to be higher than those of urban respondents. There was a statistically significant difference between the mean systolic and diastolic blood pressures of rural and urban respondents. A higher proportion of students in the rural schools 18(5.4%) had a diastolic blood pressure for age > 95th percentile in comparison to students in the urban schools 7(2.1%). There was a statistically significant association between diastolic blood pressure > 95th percentile and being in a rural or urban school. A higher proportion of students in the rural schools 44(13.1%) were found to be hypertensive in comparison to students in the urban schools 26(7.7%). There was as statistically significant association between being hypertensive and being in a rural or urban school.
The Venn diagram above shows that the number of rural respondents with hypertension includes those with 1.) Just systolic hypertension (26) 2.) Both systolic and diastolic hypertension (13) and 3) those with diastolic hypertension (5) $26 + 13 + 5 = 44$

**Figure 1: Venn diagram of the distribution of hypertension in rural schools**

The Venn diagram above shows that the number of urban respondents with hypertension includes those with 1.) Just systolic hypertension (19) 2.) Both systolic and diastolic hypertension (2) and 3) those with diastolic hypertension (5) $19 + 2 + 5 = 26$

**Figure 2: Venn diagram of the distribution of hypertension in urban schools**
Table 15: Comparison of the anthropometric measurements (Mean+/−Standard Deviation) of rural and urban respondents

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean ± Standard deviation</th>
<th>Student’s t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rural (n=336)</td>
<td>Urban (n=336)</td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>46.1 ± 9.9</td>
<td>48.1 ± 12.3</td>
<td>2.224</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.56 ± 0.11</td>
<td>1.58 ± 0.11</td>
<td>2.491</td>
</tr>
<tr>
<td>Body Mass Index (kg/m²)</td>
<td>18.8 ± 3.4</td>
<td>19.0 ± 4.0</td>
<td>0.643</td>
</tr>
<tr>
<td>Waist circumference</td>
<td>69.7 ± 7.0</td>
<td>71.8 ± 8.4</td>
<td>3.466</td>
</tr>
<tr>
<td>Hips circumference (cm)</td>
<td>85.0 ± 9.6</td>
<td>87.6 ± 9.9</td>
<td>3.478</td>
</tr>
<tr>
<td>Waist-hip-ratio</td>
<td>0.83 ± 0.11</td>
<td>0.82 ± 0.07</td>
<td>0.602</td>
</tr>
</tbody>
</table>

* Statistically significant

diff = difference

The mean weight and height of students in the rural school was 46.1+/−9.9 and 1.56+/− 0.11.
The mean weight and height of students in the urban school was 48.1+/−12.3 and 1.58+/− 0.11.
There was a statistically significant difference between the mean weight and height of rural and urban respondents. However, the difference in the mean BMI of rural and urban respondents was not statistically significant.
Table 16: Simple logistic regression of presence of hypertension on family history of hypertension

<table>
<thead>
<tr>
<th>Predictor variable</th>
<th>Rural</th>
<th></th>
<th></th>
<th>Urban</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p-value</td>
<td>Crude odds ratio</td>
<td>95% CI</td>
<td>p-value</td>
<td>Crude odds ratio</td>
<td>95% CI</td>
</tr>
<tr>
<td>Family history of hypertension</td>
<td>&lt; 0.001*</td>
<td>3.97</td>
<td>1.99</td>
<td>7.93</td>
<td>0.020*</td>
<td>3.28</td>
</tr>
<tr>
<td>Yes</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Statistically significant

The table above shows that in the rural schools, respondents with a family history of hypertension were 3.97 times more likely to be hypertensive in comparison to those without a family history of hypertension. While in the urban schools, respondents with a family history of hypertension were 3.28 times more likely to be hypertensive in comparison to those without a family history. The findings were statistically significant.
Table 17: Table showing a comparison of the prevalence of micro albuminuria among rural and urban respondents

<table>
<thead>
<tr>
<th>Variable</th>
<th>Frequency (%)</th>
<th>$\chi^2$</th>
<th>df</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rural (n=144)</td>
<td>Urban (n=144)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microalbuminuria</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive (prevalence)</td>
<td>20 (13.8)</td>
<td>10 (6.9 )</td>
<td>3.743</td>
<td>1</td>
</tr>
<tr>
<td>Negative</td>
<td>124 (86.1)</td>
<td>134( 93.0)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The prevalence of microalbuminuria among the respondents was found to be 20 (13.8%) rural and 10 (6.9) urban. There was no statistical significant association between testing positive for microalbuminuria and the location of the schools.
CHAPTER FIVE

DISCUSSION

A total of 672 adolescents participated in this study 336 in rural schools and 336 in urban schools. The respondents aged 15 years and less were in the majority in both groups. This could be explained by this being the period when most adolescents can be made to remain in school by their parents. Students in the rural schools were significantly older than those in the urban schools. This could be as a result of living in a rural setting and starting school later than urban respondents. There were more female respondents than male respondents in both rural and urban schools. Though this difference was not statistically significant, the higher proportion of females could be explained by the increased awareness of gender equality. There were more students of Yoruba ethnicity in comparison to those from other ethnic groups such as the Igbo and Hausa in both schools, however significantly higher in rural schools and this may be a reflection of the study setting. The results also showed that a higher proportion of the mothers of students in urban schools had secondary and tertiary education in comparison to the mothers of students in the rural schools. This may be due to better socioeconomic conditions and more opportunities for better education in the urban areas. A statistically significant association was observed between mothers’ level of education and the location of schools (rural and urban).

Results of awareness and knowledge of hypertension among adolescents in this study showed that 305 (90.8%) rural and 293 (87.2%) urban were aware of hypertension. This is higher than the results of a study done among urban secondary school students in Palestine (61%) \(^{135}\) and another done on rural adolescents in India (28%) \(^{135}\) Yet another study done on adults in an urban area in Sudan revealed that 46% of the respondents were aware of hypertension.\(^{135}\) This
may be due to the fact that these countries are muslin countries which are conservative and are less exposed to the outer world. The results of this study also showed that majority of the respondents in this study acquired the information about hypertension from family members. This could be because family members are people the respondents interact with regularly and intimately. Other sources of information include school, television/radio, health professionals, the internet, newspapers, books and magazines, relatives and friends. In a study done in rural south-western Nigeria on adolescents, family, friends and opinion leader were identified as the main sources of general medical information among adolescents. In a study done in Poland, school was reported to be the main source of information about hypertension. This could be because Poland considered to be an advanced country, has a good school health education programme.

A higher proportion of rural respondents had better knowledge of the correct meaning of hypertension, knowledge that hypertension is a lifelong disease and knowledge that hypertension has symptoms in comparison to urban respondents. These findings are similar to the findings of a study done in Iran on adults which revealed that lack of correct information and improper understanding of hypertension did not apply to rural areas, rather it was widely reported in urban areas. The higher knowledge among rural respondents in comparison to the urban in this study could be because the rural respondents were older, also being resident and schooling in a rural setting prevents them from being distracted from learning and obtaining information in comparison to the urban respondents. In a study conducted in an urban city in India among first year university students on the knowledge of risk factors of hypertension, very few participants (28%) understood the meaning of hypertension.
This is in contrast to the findings of this study where more than 40% of the respondents in rural and Urban schools knew the correct meaning of hypertension though higher for rural respondents as already mentioned. This difference could be due to the content and mode of health information passed in different countries. This study also revealed that a higher proportion of the respondents, rural (56.5%) and urban (48.8%) knew that chest pain was a symptom of hypertension. This could be because people in non-medical professions associate any symptom from the chest region where the heart is located with stress. This is higher than the proportion that knew headache, dizziness, sweating, irritability and blurred vision to be symptoms of hypertension. This study also revealed that rural respondents had better knowledge of all the symptoms of hypertension generally than urban respondents. In contrast, a study which was done in Poland revealed that urban adolescents had better knowledge about hypertension in to rural adolescents. The explanation for this according to the study done in Poland lies in the learning process which varies for adolescents of different regions and different social backgrounds.

A statistically significant association was found between the correct knowledge of the following as symptoms of hypertension (chest pain and blurred vision) and the location of the schools. The results also show that the proportion of respondents in both rural 248 (73.8%) and urban schools 214 (63.7%) who knew that the heart could be damaged by hypertension is higher than the proportion who knew other organs such as the eyes, brain and kidney that could be damaged by hypertension. This could be because the heart is regarded as the seat of emotions such as anxiety and fear and hypertension has been associated with such emotions which can cause stress.

Knowledge of the ways by which hypertension can be managed revealed a statistically significant association only between avoidance of stress and the location of the schools. This could be because family members and friends whom the respondents have associated with
have termed stress and hypertension to mean the same thing. Many adults also believe that stress is the cause of hypertension. Though a slightly higher proportion of rural respondents 160 (47.6%) than urban respondents (46.7%) had good overall knowledge scores of hypertension, that difference was not statistically significant.

This study also determined and compared the prevalence of hypertension among secondary school students in rural and urban LGAs of Lagos State. The prevalence of hypertension in this study was 13.1% for rural respondents and 7.7% for urban respondents, though the difference between these proportions was not statistically significant. This is in contrast to a similar study done in Bangladesh among rural and urban adolescents where the prevalence of hypertension was higher in urban respondents (1.5%) in comparison to rural respondents (0.2%)\textsuperscript{137} The urban prevalence found in this study is lower than the 11% found in an urban area in Sudan. The rural prevalence of 13.1% is however similar to that found in rural Sudan 15.8% \textsuperscript{138} and the prevalence of 15.7% found in a study done on students of a tertiary institution in Benue State.\textsuperscript{139} The observed urban prevalence rate of 7.7% is less than 10.7% reported by a study done on adolescents in Kogi State but higher than that obtained in some other studies.\textsuperscript{87} The difference in prevalence rates may be due to differences in the methodologies and criteria for diagnoses of hypertension and regional variations secondary to changes in socio economic circumstances of the communities and lifestyle. These prevalence rates are within the prevalence range of (0.1 – 17.5%) reported by most of the previous studies among adolescents in Nigeria.\textsuperscript{140} This prevalence is also similar to the rate reported among Mexican adolescents.\textsuperscript{140} This study also found the mean systolic and diastolic blood pressures were higher in rural respondents in comparison to urban respondents and a difference that was statistically significant. This is different from what was found in studies done in Bangladesh, two Indian studies and a West African study where urban population adolescents had higher blood pressures than the rural and the difference was significant.
This could be attributed to the fact that the rural areas in this study have experienced a lot of population migration from the urban to the rural for accommodation, the rural respondents were older and the rural areas studied are not typical rural areas.

The implication of this finding is that hypertension exists in adolescents in rural and urban areas of Lagos state. The prevalence of hypertension among adolescents in this study calls for concern because it was found to be high. Hypertension has been shown to track with age and for this reason, these adolescents with hypertension will be at a higher risk of developing cardiovascular disease in adulthood if left untreated.

In this study, age was found to be associated with hypertension. Similar findings found in this study have been documented by another Nigerian study that found that age was associated with an increase in blood pressure among adolescent specifically in mid adolescence. 

The results of this study revealed a higher prevalence of hypertension among females. A study done among adolescents in Finland also found a higher prevalence among females while an Indian study also done on adolescents found no difference at all. Another study done on 16–18 year old adolescents in the middle east revealed that the prevalence of hypertension was higher among boys, this is comparable to a study done on adolescents in Lisbon, Portugal, and in Ekiti state, Nigeria.

In most studies, the prevalence was higher in urban than in rural areas. Though a higher proportion of urban respondents (3.9%) were overweight/obese in comparison to the rural respondents (1.5%), this study did not find a significant association between overweight/obesity and hypertension. This is in contrast to a study which was done in Saudi Arabia on Adolescents where the prevalence of hypertension increased with increasing Body mass index (BMI).
This study determined and compared the presence of the risk factors of hypertension among secondary school students in both rural and urban LGAs of Lagos State. In this study, the following risk factors of hypertension were found to be significantly associated with the location of the schools: A family history of hypertension, history of ever smoking and history of ever using alcohol. Rural respondents had slightly higher scores for a family history of hypertension while urban respondents had higher scores for Ever smoking and ever use of alcohol. Though the prevalence of hypertension was higher in respondents with a family history of hypertension, location did not affect this as the prevalence was similar, (33.3%) rural and (28.1%) urban respectively.

In a study done on urban school children in India, hypertension was found to be associated with a family history of hypertension.\textsuperscript{142} In another study done in the United States of America; adolescent hypertension was also shown to correlate with a family history of hypertension.\textsuperscript{42}

This study result also agrees with another work done by Jameson et al in the United States of America. \textsuperscript{142} However, against expectations, smoking and alcohol intake were not associated with hypertension in this study. This is similar to the findings of an Indian study on adolescent hypertension \textsuperscript{142} and another study done in south west Nigeria on adolescent hypertension.\textsuperscript{143} This finding may be due to the lower quantities of cigarettes smoked, alcohol consumed and shorter duration of consumption of these products in comparison to adults. The possibility that these young smokers and consumers of alcohol may continue to adulthood has been documented by earlier researchers.\textsuperscript{87} The prevalence of obesity and overweight has been increasing over the years among adolescent in many parts of the world. Obesity is a principal risk factor for arterial hypertension. Reducing Body Mass Index (BMI) results insignificant lowering of blood pressure levels and this is one of the pillars of non – pharmacological management of the disease.\textsuperscript{144, 145} In this study overweight and obesity were not associated
with hypertension. This study also did not find a significant association between physical activity and hypertension. It has been documented that spending more time in physical activity plays an important role in preventing and delaying the onset of hypertension.

The prevalence of micro albuminuria in the general population is reported to be 10 – 15%. In the United States of America (USA), a lower prevalence of 7.8% was reported in the general population of children, adolescents and adults. In Africa there is paucity of data on the prevalence of microalbuminuria among adolescents. In Nigeria, a study in Benin City reported a 19% prevalence of micro albuminuria among healthy adolescents and young adult offspring of hypertensive parents. This study noted a high prevalence of micro albuminuria 13.8% rural and 6.9% urban. These findings are lower than a prevalence of 33.2% found in a study among adolescents in Port Harcourt, Nigeria and the prevalence of 19% reported in Benin City, Nigeria. The lower prevalence observed in this study may be due to the methodology used.

CONCLUSION
The results of this study suggest that awareness about hypertension is high among the rural and urban study participants with a higher proportion of rural study participants being more aware of hypertension. Specific knowledge of hypertension was poor among the rural and urban study participants. This study revealed a relatively high prevalence of hypertension among rural and urban respondents. The following risk factors of hypertension were found among the study participants, A family history of hypertension, always adding extra salt to food, taking sugary drinks every day, eating only 1-3 portions of fruits/vegetables per day, engaging in physical activity 1-3 times a week, engaging in physical activity for less than 30 minutes a day, history of ever smoking, history of ever using alcohol with rural respondents having slightly higher scores for the first three variables and urban respondents having slightly higher scores for the last four variables. A family history of hypertension was found to be the major determinant of adolescent hypertension. The prevalence of microalbuminuria was high among rural and urban respondents.

RECOMMENDATIONS
1) It is therefore recommended that periodic screening and monitoring of the blood pressure of adolescents should be incorporated into the school health programme.

2) General public health education on adolescent hypertension and its associated risk factors should be strengthened as complications of hypertension may negatively influence quality of life.

3) Public health programmes that aim to reduce hypertension should focus primarily on adolescents in rural and urban areas.

4) Children should be educated about good lifestyle and healthy food habits.

5) Awareness programmes should encourage parents and guardians to continue to educate their children about hypertension at home.

6) Furthermore, routine urine screening for microalbuminuria in adolescents in rural and urban areas should be carried out regularly for early detection of microalbuminuria and prevention of renal damage.

REFERENCES


137. BugajeMA, YakubuAM, Ogala WN Prevalence of Adolescent Hypertension in ZariaNig J of Paediatrics 2005; 32: (4) 77-82.


APPENDIX I
HEALTH RESEARCH AND ETHICS COMMITTEE RESPONDENTS
INFORMED CONSENT FORM

HREC approval number ADM/DCST/HREC/_______

cxvii
A research study is designed to answer specific questions. When you are a research participant, the researcher will follow the rules of the research study (protocol) as closely as possible, without compromising your health.

**Title of the research:** RURAL – URBAN COMPARISON OF THE KNOWLEDGE, PREVALENCE AND ASSOCIATED RISK FACTORS OF HYPERTENSION AMONG SECONDARY SCHOOL STUDENTS IN LAGOS STATE.

**Name and Affiliation of Researcher:** DR (MRS.) OLAYINKA OLUFUNMILAYO COKER, a resident Doctor in the Department of Community Health, Lagos University Teaching Hospital.

**Purpose of Research** THIS STUDY WILL SEEK TO COMPARE THE KNOWLEDGE, PREVALENCE AND ASSOCIATED RISK FACTORS OF ARTERIAL HYPERTENSION AMONG STUDENTS ATTENDING SECONDARY SCHOOLS IN A RURAL LGA OF LAGOS STATE WITH STUDENTS ATTENDING SECONDARY SCHOOLS IN AN URBAN LGA OF LAGOS STATE.

**Procedure of Research** THE INTERVIEWER WILL ASK QUESTIONS TO OBTAIN INFORMATION ABOUT YOUR BACKGROUND, KNOWLEDGE OF HYPERTENSION AND RISK FACTORS OF HYPERTENSION. YOUR BLOOD PRESSURE, HEIGHT, WEIGHT, BMI AND WAIST CIRCUMFERENCE WILL BE MEASURED.
If you chose to participate, You will be interviewed with a questionnaire and I expect you to answer as truthfully as possible.

Possible risks

There are no risks involved in this study

Voluntariness

Your participation in this study is entirely voluntary. Your decision to participate or not in this study will not prejudice you. You can choose to withdraw from the research at any time.

Confidentiality

All information collected in this study will be given code numbers, this cannot be linked to you in anyway and your name will not be used in any publication or reports from this study. The results of this study may be presented at scientific or medical meetings or published in scientific journals. However, your identity will not be disclosed.

What happens to research participants and communities when research is over?

The researcher will inform you of the outcome of the research through a medical journal and presentation at the next available meeting. There is no conflict of interest whatsoever on the part of the researcher.

Participant responsibilities

As a participant, your responsibilities include:

- Present yourself for the interview and the taking of BP and anthropometric measurements.
- Answer all questions asked properly
- Tell the research interviewer if you change your mind about being in the study.

Statement of person obtaining informed consent:
I have fully explained this research to ____________ and have given sufficient information, including issue concerning risks and benefits, to make an informed decision.

Date: ___________; Signature: ___________

Name: ___________________________________

**Statement of person giving consent:**

I have read the description of the research or have had it translated into the language I understand. I have also talked it over with the doctor to my satisfaction. I understand that my participation is voluntary. I know enough about the purpose, methods, risks and benefits of the research study to judge that I want to take part in it. I understand that I may freely stop being part of this study at any time. I have received a copy of this consent form and additional information sheet to keep for myself.

Date: ___________; Signature: _________________

Name: ___________________________________ **Researchers contact:**

Name: DR (MRS.) OLAYINKA OLUFUNMILAYO COKER

Department: DEPARTMENT OF COMMUNITY HEALTH AND PRIMARY CARE

LAGOS UNIVERSITY TEACHING HOSPITAL

Phone: 08023021327, 08093933356; E-mail: yinkacoker14@gmail.com, olayinkacoker14@yahoo.com

**LUTH Health Research and Ethics Committee Contact:** LUTH Health Research and Ethics Committee, Room 107, Administration Building, LUTH, Idi – Araba, Lagos

**APPENDIX II**

**QUESTIONNAIRE**

Local Government Area………………………………………………………………………………
Name of school: ...........................................................................................................

Participants number ..............................................

Date:............................................................................................... 

SECTION A: SOCIODEMOGRAPHIC DETAILS

I would like to begin by asking you a few questions about yourself

1. What was your age as at your last birthday (    )

2. Interviewer: Sex of the respondent? (    ) 1 = Male 2 = Female

3. Which ethnic group do you belong to: 1) Hausa (  ) 2) Yoruba (  ) 3) Ibo (  ) 4) Others (Specify) …………

4. What is your religion: 1) Christianity (  ) 2) Islam (  ) 3) Others (  )

5. What class are you in: 1) JSS1 (  ) 2) JSS2 (  ) 3) JSS3 (  ) 4) SSS1 (  )

5) SSS2 (  ) 6) SSS3 (    )

6. What is your Fathers level of Education: 1) No Formal Education (  ) 2) Primary school level (  ) 3) Secondary school level (  ) 4) Tertiary level (  ) 5) Don’t know (  )

7. What is your Mothers level of Education: 1) No Formal Education (  ) 2) Primary school level (  ) 3) Secondary school level (  ) 4) Tertiary level (  ) 5) Don’t know (  )

SECTION B: KNOWLEDGE OF HYPERTENSION AMONG ADOLESCENTS

8. Have you heard the word Hypertension or High blood pressure before? 1) Yes (  ) 2) No (  )

9. If Yes, What is your source of Information about hypertension? (Multiple responses allowed)

a) Family members (  )

b) School (  )

c) Television or radio (  )

d) Internet (  )

e) Newspapers, books or magazines(  )

f) Health professionals (  )

g) Relatives (  )
h) Friends

i) Other places (Specify)………………...
10) What is Hypertension? 1) High blood pressure ( ) 2) I don’t know ( ) 3) Others(Specify)…………

11) Hypertension is dangerous? 1) Yes ( ) 2) No ( ) 3) Don’t know ( )

12) Is Hypertension part of aging? 1) Yes ( ) 2) No ( ) 3) Don’t know ( )

13) Is Hypertension a lifelong disease? 1) Yes ( ) 2) No ( ) 3) Don’t know ( )

14) Does Hypertension have any symptoms? 1) Yes ( ) 2) No ( ) 3) Don’t know ( )

15) If Yes to 14 above, what are the symptoms of Hypertension
   a) Headache 1) Yes ( ) 2) No ( ) 3) Don’t know ( )
   b) Dizziness 1) Yes ( ) 2) No ( ) 3) Don’t know ( )
   c) Sweating 1) Yes ( ) 2) No ( ) 3) Don’t know ( )
   d) Irritability 1) Yes ( ) 2) No ( ) 3) Don’t know ( )
   e) Chest pain 1) Yes ( ) 2) No ( ) 3) Don’t know ( )
   f) Blurred vision 1) Yes ( ) 2) No ( ) 3) Don’t know ( )
   g) Others (Specify).

16) Can untreated Hypertension lead to damage of some organs of the body? 1) Yes ( ) 2) No ( ) 3) Don’t know ( )

17) If Yes to 16 above, what organs of the body do you think can be damaged?
   a) The Heart 1) Yes ( ) 2) No ( ) 3) Don’t know ( )
   b) The Eyes 1) Yes ( ) 2) No ( ) 3) Don’t know ( )
   c) The Brain 1) Yes ( ) 2) No ( ) 3) Don’t know ( )
   d) The Kidneys 1) Yes ( ) 2) No ( ) 3) Don’t know ( )
   e) Others (Specify)

18) Can Hypertension be prevented? 1) Yes ( ) 2) No ( ) 3) Don’t know ( )

19) If Yes to 18 above, How can Hypertension be prevented? Is it by?
   a) Avoiding Alcohol abuse 1) Yes ( ) 2) No ( ) 3) Don’t know
b) Avoiding Cigarette smoking  
   1) Yes ( ) 2) No ( ) 3) Don’t know

c) Avoiding soft drinks high in sugar  
   1) Yes ( ) 2) No ( ) 3) Don’t know

d) Avoiding High fat foods  
   1) Yes ( ) 2) No ( ) 3) Don’t know

e) Avoiding Stress  
   1) Yes ( ) 2) No ( ) 3) Don’t know

f) Regularly eating fruits and vegetables  
   1) Yes ( ) 2) No ( ) 3) Don’t know

g) Reducing portion sizes  
   1) Yes ( ) 2) No ( ) 3) Don’t know

h) Having regular medical check-up  
   1) Yes ( ) 2) No ( ) 3) Don’t know

i) Doing regular exercises  
   1) Yes ( ) 2) No ( ) 3) Don’t know

j) Avoiding excess salt intake  
   1) Yes ( ) 2) No ( ) 3) Don’t know

k) Others (Specify) ........................................

20) Is Hypertension manageable?  
   1) Yes ( ) 2) No ( ) 3) Don’t know

21) If Yes to 20 above, what are the ways by which Hypertension can be managed.
   
   a) Drugs  
      1) Yes ( ) 2) No ( ) 3) Don’t know

   b) Maintaining a healthy weight  
      1) Yes ( ) 2) No ( ) 3) Don’t know

   c) Eating a balanced Diet  
      1) Yes ( ) 2) No ( ) 3) Don’t know

   d) Regular exercise  
      1) Yes ( ) 2) No ( ) 3) Don’t know

   e) Avoidance of stress  
      1) Yes ( ) 2) No ( ) 3) Don’t know

   f) Others (Specify)

SECTION C: RISK FACTORS OF HYPERTENSION AMONG ADOLESCENTS

22) Is any member of your Family hypertensive?  
   1) Yes ( ) 2) No ( ) 3) Don’t know

23) If Yes to 23 above, whom?  
   a) Father ( )

   b) Mother ( )

   c) Sister ( )

   d) Brother ( )
24) Have you ever tried or experimented with cigarette smoking? Even if it is one or two puffs 1) Yes ( ) 2) No ( )

25) How old were you when you first tried cigarette smoking...........

26) During the past 30 days (one month) on how many days did you smoke cigarettes? ........................................

27) During the past 30 days (one month), on the days you smoked, how many cigarettes did you smoke .........................

28) Do you drink alcohol? 1) Yes ( ) 2) No ( )

29) If Yes to 28 above is it every day 1) Yes ( ) 2) No ( )

30) If Yes to 29 above What type of alcohol do you drink?..............

31) How many bottles of alcohol per day do you drink? ....................... 

32) How many years have you been drinking alcohol? .........................

33) Do you add extra salt to your meals 1) Yes ( ) 2) No ( )

34) If Yes to 33 above, How often do you add salt: 1) Always ( ) 2) Sometimes ( ) 3) Rarely ( )

35) Do you take foods such as Meat pie, cakes, scotch eggs, fried chicken?
1) Yes ( ) 2) No ( )

36) If Yes to 35 above, how often do you take them? 1) Every day ( ) 2) One to three times a week ( ) 3) Four to six times a week ( )

37) Do you take sugary drinks such as Coca–cola, Fanta, Sprite? 1) Yes ( ) 2) No ( )

38) If Yes to 37 above, how often do you take them? 1) Every day ( ) 2) One to three times a week ( ) 3) Four to six times a week ( )

39) How many bottles of soft drink do you take in a day? 1) One bottle ( ) 2) Two bottles ( ) 3) Three bottles ( ) 4) Four bottles ( )

40) Do you engage in physical activity? Yes ( ) No ( )

41) If Yes to 40 above, is it? 1) Every day ( ) 2) One to three times a week ( ) 3) Four to six times a week ( )

42) How many minutes of physical activity do you do in a day. 1) < 30 minutes  2) Thirty minutes ( ) 3) One hour ( ) 4) Two hours ( )
43) Do you take Fruits and vegetables? 1) Yes ( ) 2) No ( )

44) If Yes to 43 above, how often do you take Fruits and vegetables? Is it 1) every day ( ) 2) One to three times a week ( ) 3) Four to six times a week ( )

45) How many portions of fruits and vegetables do you eat in a day? 1). One to three portions ( ) 2) Four to six portions ( )

46) Have you ever had your Blood Pressure checked? 1) Yes ( ) 2) No ( )

47) If Yes, was your Blood Pressure elevated? 1) Yes ( ) 2) No ( )

48) If Yes, Are you presently on medication for High blood pressure? 1) Yes ( ) 2) No ( )

ANTHROPOMETRIC VARIABLES

49) Blood pressure (mmhg) 1)

2)

3)

50) Weight (kg)……………. 

51) Height (meters)……………………

52) BMI (kg/m²) = (weight (kg) / height (m)²

53) Waist circumference………..

54) Hip circumference…………………

55) Waist/Hip Ratio…………………

56) Result of Urinalysis…………………....

APPENDIX I11

Distribution of respondents by their schools (Rural and Urban)

<table>
<thead>
<tr>
<th>NAME OF SCHOOL</th>
<th>FREQUENCY (%)</th>
<th>FREQUENCY (%)</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
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</tbody>
</table>

cxxv
<table>
<thead>
<tr>
<th>School Name</th>
<th>Rural (n = 336)</th>
<th>Urban (n = 336)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government Senior College/Ajara Junior Grammar</td>
<td>42 (12.5)</td>
<td></td>
</tr>
<tr>
<td>State High School</td>
<td>42 (12.5)</td>
<td></td>
</tr>
<tr>
<td>Frontline College</td>
<td>42 (12.5)</td>
<td></td>
</tr>
<tr>
<td>Jumes Infant Jesus College</td>
<td>42 (12.5)</td>
<td></td>
</tr>
<tr>
<td>Ayangburen High School</td>
<td>42 (12.5)</td>
<td></td>
</tr>
<tr>
<td>United High School</td>
<td>42 (12.5)</td>
<td></td>
</tr>
<tr>
<td>Tindip College</td>
<td>42 (12.5)</td>
<td></td>
</tr>
<tr>
<td>Uncle Bayus College</td>
<td>42 (12.5)</td>
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<tr>
<td>EletuOdibo Secondary School</td>
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<td>AjeComprehensive Secondary School / Lagos City</td>
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<td>Agape Baptist College</td>
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<td>42 (12.5)</td>
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</tbody>
</table>
APPENDIX1V

ADOLESCENT (10-19) YEARS ASSENT FORM

HREC approval number _______________ ADM/DCST/HREC/APP/1240
____________________
A research study is designed to answer specific questions. When you are a research participant, the researcher will follow the rules of the research study (protocol) as closely as possible, without compromising your health.

Title of the research: RURAL – URBAN COMPARISON OF THE KNOWLEDGE, PREVALENCE AND ASSOCIATED RISK FACTORS OF HYPERTENSION AMONG SECONDARY SCHOOL STUDENTS IN LAGOS STATE.

Name and Affiliation of Researcher: Dr (Mrs.) O.O Coker a senior resident Doctor in the Department of Community Health, Lagos University Teaching Hospital.

Introduction

Non communicable diseases are the leading cause of death in the world. The leading cause of Non communicable disease deaths are cardiovascular diseases (17million) deaths annually. The increasing burden of cardiovascular diseases is largely due to the rising prevalence of many cardiovascular disease risk factors particularly hypertension. Hypertension has been reported in the young population in many countries of the world including Nigeria and can progress into adulthood thus contributing to the increase in cardiovascular morbidity and mortality in adults.

Purpose of Research

To determine and compare the knowledge, prevalence and associated risk factors of hypertension among students in secondary schools in rural and urban areas of Lagos state.

Procedure of Research

If you chose to participate, I will be interviewing you with a questionnaire (Interviewer administered pretested, structured questionnaire) to determine your knowledge of hypertension and also to determine the risk factors of hypertension present among you.(secondary school students) . Blood pressures will be taken among participants to determine the prevalence of hypertension. Anthropometric assessment such as Weight, Height, Waist circumference and Hip circumference will be taken. BMI will be calculated and a urinalysis will be done. Please answer the questions as truthfully as possible.

Benefits

You will have the opportunity to discuss with the researcher/interviewer to enhance your knowledge about hypertension and its risk factors. This study will draw attention to the issue of Adolescent hypertension worldwide, in Africa and in Nigeria. It will add to the body of knowledge on the burden of Adolescent hypertension in Nigeria. The results of this study
will contribute to the development of National and International health policies for the prevention and control of Adolescent hypertension. Also participants will have access to medical advice from the researcher throughout the duration of the study at no added cost.

**Possible risks**

There are no risks involved in this study.

**Voluntariness**

Your participation in this study is entirely voluntary. You can choose to withdraw from the research at any time.

**Confidentiality**

All information collected in this study will be given code numbers, this cannot be linked to you in anyway and your name will not be used in any publication or reports from this study.

The results of this study may be presented at scientific conferences or published in scientific journals. However, your identity will not be disclosed.

**What happens to research participants and communities when research is over?**

The researcher will inform you of the outcome of the research through the local government.

**Participant responsibilities**

As a participant, your responsibilities include:

- Following the instructions of the interviewer/researcher
- Answering your questions as truthfully as possible
- Asking questions to clarify issues
- Telling the interviewer/researcher if you change your mind about being in the study.

**Statement of person obtaining informed consent:**

I have fully explained this research to ______________________ and have given sufficient information on issues concerning risks, benefits and how to make an informed decision.

Date: _____________________Signature: __________________________

Name: _______________________________________________

**Statement of Adolescent (10-19) years giving assent;**
I have read the description of the research and it has been explained to me. I have also talked it over with the researcher/interviewer to my satisfaction. I understand that my participation is by free will. I know enough about the purpose, methods, risks and benefits of the research to decide if I want to take part in it. I understand that I may freely stop being part of this study at any time. I have received a copy of this assent form and additional information sheet to keep for myself.

Date: _____________________ Signature: __________________________

Name: ______________________________________________________

Researchers’ contacts:
Dr (Mrs.) O.O Coker
Department of Community Health
Email- olayinkacoker12@yahoo.com
Phone- 08093933356

LUTH Health Research and Ethics
LUTH Health Research and Ethics committee,
Room 107, Administration Building, LUTH
Idi- Araba, Lagos