FACTORS ASSOCIATED WITH PREDIABETES MELLITUS AND GLYCEMIC LEVEL OF SECONDARY SCHOOL ADOLESCENTS IN IBADAN SOUTH WEST LOCAL GOVERNMENT AREA, NIGERIA.

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF MASTERS IN PUBLIC HEALTH (EPIDEMIOLOGY)

DEPARTMENT OF EPIDEMIOLOGY AND MEDICAL STATISTICS, FACULTY OF PUBLIC HEALTH, COLLEGE OF MEDICINE, UNIVERSITY OF IBADAN

JANUARY, 2015

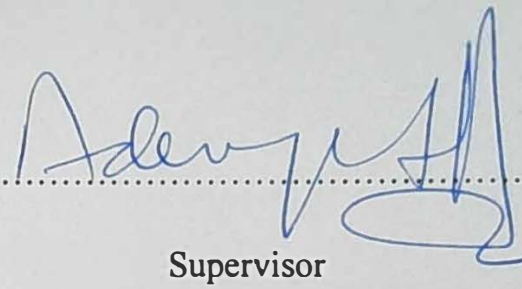
DECLARATION

The work reported in this dissertation was undertaken by me at the Department of Epidemiology and Medical Statistics of the University of Ibadan. This dissertation has not been submitted to any other examining body in support of any application for another degree or qualification.

Arigbede Oluwakemi Olayinka

CERTIFICATION

This is to certify that **Arigbede Oluwakemi Olayinka** carried out this work in the department of Epidemiology and Medical Statistics, Faculty of Public Health, College of Medicine, University of Ibadan, Nigeria.



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DEDICATION

This dissertation is dedicated to Almighty God, who made this project possible from the onset to the completion.

ACKNOWLEDGEMENTS

I hereby express my profound gratitude to my supervisor, Dr. I.A Adeoye for her guidance, patience and encouragement from the onset of this project to the completion. I also appreciate the contribution of Dr Yusuf my co- supervisor. I also want to appreciate the input of Dr Jarett (pediatric Endocrinologist) and Dr F.M Abbiyesuku of the department of chemical pathology.

I appreciate my Lecturers Dr Akinyemi, Dr Dairo, Dr Fagbamigbe, Mr Afolabi, Mr Afolabi Nathaniel for the impartation of knowledge in the course of the study.

I also want to express my sincere appreciation to Mr Idowu Department of Community Medicine, who went to the field with me and supervised the pricking for the fasting blood glucose screening. I appreciate Mr Ogunlabi of the departmental office.

I also want to express my profound gratitude to Dr Ogunbode, for his support throughout the program.

I thank my parents and all other relatives for the provision, care and patience throughout the degree program.

I also want to express my sincere gratitude to my friend, lover and brother Olanrewaju Daodu for his support throughout the program.

I also want to appreciate my colleagues who contributed in one way or the other. I thank Tunde, Femi, Tayo, Deola and every other person in contributed in one way or the other.

ABSTRACT

Introduction: Diabetes mellitus and impaired glycemic levels is an emerging public health problem amongst children and adolescents in developed and developing countries. In Nigeria there, is sparse documentation on the prevalence of diabetes and its risk factors amongst adolescents. This study therefore will provide the necessary evidence required for prevention of the disease and its associated morbidity and disability. The aim of the study was to access the factors associated with diabetes mellitus and glycemic level of secondary school adolescents in Ibadan South West Local Government Area (ISWLG), Nigeria.

Method: A cross-sectional survey was carried out using a multi stage cluster sampling technique to select 500 students from public and private secondary schools in ISWLG. A semi-structured, interviewer administered, pre-tested questionnaire was used to elicit information on socio-demographic characteristics, physical activity, dietary behavior and sedentary behavior. The height, weights, blood pressure and fasting blood glucose was taken. Pre-diabetes was defined as FBS >100mg/dl, insufficient physical activity defined as <5 days of at least 60mins of moderate physical activity, sedentary behavior defined as >2hours of television viewing and video games daily, overweight and hypertension defined as BMI for age > 2 S.D and systolic blood pressure $\geq 95^{th}$ percentile. Data analysis was done using univariate (frequencies and proportions), chi-square for test of association, independent t-test and ANOVA to compare means, logistic and linear regression at 5% level of significance.

Results: The mean age of the respondents was 14.6±1.54 years. Fifty-three percent were females, 69.2% attended private school and 81.3% were Yorubas. Prevalence obtained from this study were 3.8%, 6.4%, 32.9%, 8.4%, 30.4% and 16.6% for pre-diabetes, overweight, pre-hypertension, hypertension, physical inactivity and sedentary behavior respectively. The mean glycemic level of the respondents was 85.4±8.3. There was a statistically significant difference (p= 0.001) in the mean glycemic level of pupils who attend public schools (83.5±8.2) and those who attend private schools (86.2±8.2)

There was a difference in the mean glycemic levels of those who were overweight (86.0±6.2), underweight (85.3±7.4), and normal weight (85.6±8.6). (f = 0.107, p = 0.89). There was no statistically significant association between physical activity (x^2 = 0.002, p = 0.77), blood

pressure (x^2 = 1.61, p = 0.45), type of school (x^2 = 2.37, p = 0.12). Adolescents who had hypertension had a 41% higher risk of developing pre diabetes (OR = 2.42, 95% C.I = 0.604-9.697, p = 0.21), compared to those who had normal blood pressure.

Conclusion: Risk factors of diabetes are prevalent amongst the secondary school adolescents in ISWLG population. It was observed that overweight/obesity and elevated blood pressure was a determinant of pre diabetes. Screening for this condition and its risk factors is emphasized to prevent the pernicious effect of diabetes.

Word count: 445.

Keywords: diabetes mellitus, pre diabetes, screening, risk factors.

TABLE OF CONTENTS

CHAPTER TWO: LITERATURE REVIEW

CHAPTER FIVE: DISCUSSION CONCLUSION AND RECOMMENDATIONS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX

LIST OF ABBREVIATIONS (ACRONYMS)

IDF	-	International Diabetes Federation
ADA	-	American Diabetes Association
DAN	-	Diabetes Association of Nigeria
WHO	-	World Health Organization
DM	-	Diabetes Mellitus
T1DM	-	Type 1 Diabetes Mellitus
T2DM	-	Type 2 Diabetes mellitus
IBSWLG	-	Ibadan South West Local Government
IFG	-	Impaired Fasting Glycemia
IGT	-	Impaired Glucose Tolerance
NCD	-	Non Communicable Diseases
IDDM	-	Insulin Dependent Diabetes Mellitus
NIDDM	-	Non Insulin Dependent Diabetes Mellitus
SBP	-	Systolic Blood Pressure
DBP	-	Diastolic Blood Pressure
FBG	-	Fasting Blood Glucose
BMI	-	Body Mass Index

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Type 2 Diabetes mellitus (T2DM), a non communicable disease (NCD) previously described in the adult population has recently been recognized as a disease of public health importance among children. (Ogden CL et al, 2006). World health Organization (WHO) & International Diabetes federation (IDF) 2006 defined diabetes mellitus as "chronic metabolic disease characterized by hyperglycemia and disturbances of carbohydrate, fat, and protein metabolism. This condition occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces". Reports from the American Diabetes Association states that: "Before 1980, T2DM was rarely reported and accounted for less than 2% of all cases of childhood DM". However there has been a recent increase in the prevalence of this disease in children and adolescents of several populations. This upsurge is equal to a corresponding increase in the prevalence of obesity, physical inactivity, sedentary lifestyle and adoption of westernized lifestyles. (Ogden CL et al, 2006). The American Diabetes Association has thereby tagged it an "emerging epidemic".

The prevalence of diabetes mellitus (DM) is increasing globally, and sub-Saharan Africa has also recorded such increase. In 2010, 12.1 million people were estimated to be living with diabetes in Africa, and this is projected to increase to 23.9 million by 2030. (Sicree R et al, 2009). Insulin Dependent Diabetes Mellitus (IDDM) also known as Type 1 diabetes accounts for the majority of cases of diabetes in children. It is usually associated with autoimmunity and absolute insulin deficiency, although may not be absolute at clinical onset of the disease. Non insulin Dependent Diabetes (NIDDM) also known as Type 2 diabetes is now being reported amongst children, it is associated with insulin resistance and lifestyle traits such as unhealthy diet, sedentary behavior/physical inactivity, obesity. (Devendra D, et al. 2004). Whilst very little has been documented on

diabetes in Nigeria, T2DM accounts for majority (about 90%) of cases amongst the adult population (Familoni et al, 2008).

Type 2 Diabetes Mellitus which is the sixth-leading cause of death amongst adults (Simpson et al; 2003), with 70% of this deaths attributed to cardiovascular disease (CVD) has been shown to increase the risk for other NCDs like coronary heart disease, congestive heart failure and cerebrovascular disease. (Bassey NA et al, 2012). Early and prolonged presence of hyperglycemia results in dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart and blood vessels imposing long term complications such as heart disease, stroke, blindness, kidney failure, and limb amputation. (Obasi & Agba 2014). In general, diabetes leads to a reduction in the patients' quality of life and life expectancy.

The onset of T2DM is insidious and asymptomatic, hence patients and guardians are not alerted about the illness for several years, this supports the high prevalence of undiagnosed diabetes which has been reported to be as high as (50–85%) in both developed and developing countries. (Motala AA et al, 2008; Amoah AGB et al, 2002). The incidence and prevalence of DM is sparsely documented in Nigeria, although the associated risk factors are more common. Hence, the importance of risk assessment of the various factors that is associated with this chronic condition and the need to measure glycemic level within the adolescent population has a basis for early prevention and management.

School Health, an important branch of public health serves as one of the most cost effective platform for health interventions. WHO described school health as "a strategic means to prevent important health risks among the youth" which if targeted is an economical and powerful means of raising community health, and more importantly in future generations". One of the objectives of school health is prevention of disease and early diagnosis, treatment and follow up of defects is achieved by screening students for risk factors for various diseases. The WHO global school health initiative stated that "Research in both developed and developing countries demonstrates that school health programmes can simultaneously reduce common health problems, increase the efficiency

of the educational system and advance public health education and social and economic development of a nation" (WHO). Therefore schools can create a platform for screening children and adolescents for hyperglycemia, elevated blood pressure risk factors for other chronic disease.

Therefore from the aforementioned, the aim of this study is to access the blood glucose level and risk factors associated with diabetes amongst school aged adolescents in Ibadan, Oyo State. South West Nigeria.

1.2 PROBLEM STATEMENT

Type 2 DM has been reported in children in several populations especially in the developed countries United States (Fagot-Campagna A et al. 2000), Canada (Dean H. 1998), United Kingdom (Ehtisham S. et al. 2001), Australia (Davis E, 2002), Japan, (Cockram CS, 2000) Taiwan (Wei JN, et al. 2003) and India (Ramachandran A, et al. 2003). In Japan for instance, 80% of all new cases of diabetes in children and adolescents are diagnosed as Type 2. (Cockram CS. 2000).

According to International Diabetes Federation, the African continent accounts for approximately 13.6 million people with diabetes and Nigeria accounts for the highest number of people with diabetes and impaired glucose tolerance (with approximately 1,218,000 and 3,85 million people affected respectively (IDF 2000). Even though Type 2 diabetes if developed at an earlier stage such has during adolescence has been discovered to lead to severe complications, this has been poorly documented in Nigeria.

The increase in type 2 diabetes among children and adolescents has emerged in parallel with an alarming rise in the number of young people who have become overweight or obese due to change from traditional diets to westernized diet, physical inactivity and sedentary behavior.

Studies have been carried out on the prevalence of Type 1diabetes in children in several countries of the world, but prevalence of Type 2 Diabetes has been sparsely documented in children and adolescents in Nigeria. The aim of this study therefore is to access the factors that are associated with diabetes mellitus and mean glycemic level of secondary

school adolescents in Ibadan South West Local Government Area. Reports from this study will serve as a baseline data for other future studies.

1.3 JUSTIFICATION OF THE STUDY

Estimates showed that in the year 2000, there were 171 million people in the world with diabetes and it is projected to increase to about 366million by 2030. This increase in prevalence is expected to be more in regions including sub sahara Africa. Data from WHO shows that Nigeria has the greatest number of people living with diabetes in Africa. (Wild S et al, 2004). T2DM is a chronic debilitating disease associated with severe complications such as traumatic leg amputations, renal and kidney failure, blindness, erectile dysfunction, infections of the skin, female genital tract and urinary tract infections. Abundant evidence also shows that patients with type 1 diabetes or type 2 diabetes are at a high risk for several cardiovascular disorders: coronary heart disease, stroke, peripheral arterial disease, cardiomyopathy, and congestive heart failure and poses severe risks for families, member states and the entire world. (Obasi and Agba. 2014)

T2DM is associated with tremendous financial and human costs. it has been reported to pose substantial cost to both society and its citizens which are incurred not only for direct costs of medical care but also indirect costs including loss of productivity resulting from diabetes related morbidity and premature mortality. Because individuals with diabetes tend to use more medical services, than non-diabetics, they are likely to acquire higher medical expenditure and also out-of-pocket expenses for medical bills and medications. Hence, emphasis is placed on prevention by monitoring its risk factors.

Type 2 diabetes is usually insidious and can remain in an asymptomatic stage for several years, hence, screening for diabetes mellitus is an important measure in detecting the pre-diabetic stages and undiagnosed diabetes in order to avert pernicious effects of hyperglycemia and associated complications. (American Diabetes Association, 2003).

Studies on screening of school aged children for visual acuity, hearing impairments and nutritional status have been carried out in developed countries but much fewer ones in sub-Sahara Africa. Also, there are reports on the trend, prevalence, factors and management of Type 1 DM, little attention has been placed on pre diabetes and Type 2 DM in children and adolescents especially in developing countries.

This study will therefore provide the much needed evidence needed in the prevention of DM in children and the reduction of the associated morbidity and mortality'. It will serve as a basis of early detection and prevention of diabetes and its pre diabetes stage in Nigerian children. It will also serve as a baseline data for future reference and policy of primordial and primary prevention of diabetes in children and adolescents.

The aim of this study therefore is to access the factors that are associated with diabetes and to determine the mean glycemic level of adolescents in Ibadan southwest local government, Oyo state, Nigeria.

1.4 RESEARCH QUESTIONS

1. What is the prevalence of Pre diabetes among secondary school adolescents in Ibadan?
2. What is the prevalence of the various risk factors associated with type 2 diabetes?
3. What is the mean glycemic level of secondary school adolescents in Ibadan?
4. What factors are associated with the glycemic level?

1.5 Objectives of the study

1.5.1 General objective

To determine the factors associated with diabetes mellitus and mean glycemic level of secondary school adolescents in ISWLGA, Nigeria.

1.5.2 Specific objectives

1. To determine the prevalence of Pre diabetes among secondary school adolescents in Ibadan
2. To determine the risk factors that are associated with diabetes
3. To determine the mean glycemic level of secondary school adolescents in Ibadan
4. To determine the factors that are associated with the glycemic level.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Diabetes mellitus (DM) is a chronic metabolic disorder that is characterized by chronic hyperglycemia caused by an absolute or relative insulin deficiency or both, which results in disorder of carbohydrates, protein and fat metabolism, it is estimated to affect, 4% of the world's population and a doubling of this figure is expected in the near future, especially in the African and Asian continents (Engelgau, et al; 2003). DM is also defined as a syndrome characterized by disturbed metabolism of carbohydrate, protein and fat, it is caused by an absolute or relative deficiency of insulin (Ayoola, 2008). The prevalence of diabetes mellitus (DM) and other non-communicable disease is rising in African communities; this can be attributed to the adoption of western lifestyles which includes reduced physical activity, sedentary lifestyles, and ingestion of calorie dense foods, which in turn contributes to obesity which is a risk factor for the development of diabetes. (Nyenwe EA et al; 2003).

2.2 Epidemiology

The prevalence of diabetes is increasing rapidly worldwide and the World Health Organization (WHO 2003) has predicted that by 2030 the number of adults with diabetes would have almost doubled worldwide, from 177 million in 2000 to 370 million. However, (Shaw et al, 2010) also estimated that the worldwide prevalence of diabetes among adults in 2010 was 285 million (6.4%) and this value is predicted to rise to around 439 million (7.7%) by 2030. The incidence varies substantially in different parts of the world, because of environmental and lifestyle factors.

DM is one of the most common chronic diseases in children and adolescents; about 151,000 people below the age of 20 years have diabetes, when DM occurs in childhood, it is routinely assumed to be type 1, or juvenile-onset diabetes. However, in the last 2 decades, T2DM has been reported among U.S. children and adolescents with increasing frequency. Also, studies. (Van Dam 2000), (Padoa CJ. 2011) conducted in Europe showed an increase in the frequency of type 1 diabetes, especially in young children. Type 2 diabetes mellitus (T2DM) is becoming more common in adolescents, particularly in the per pubertal period, and accounts for a significant proportion of youth onset

diabetes in certain at risk populations, the epidemics of obesity and the low level of physical activity among young people, as well as exposure to diabetes in utero, may be major contributors to the increase in type 2 diabetes during childhood and adolescence. Type 2 diabetes in children and adolescents already appears to be a sizable and growing problem among U.S. children and adolescents (Liese AD et al; 2006).

The prevalence of diabetes in African countries is increasing with lifestyle changes associated with rapid urbanization and westernization. Traditional rural communities still have very low prevalence, at most 1-2%, except in some specific high risk groups where as 1-13% or more adults in urban communities have diabetes due to high urban growth rate, dietary changes, reduction in physical activity, and increasing obesity, it is estimated that the prevalence of diabetes is due to triple within the next 25 years. (Sobngwi. E 2001).

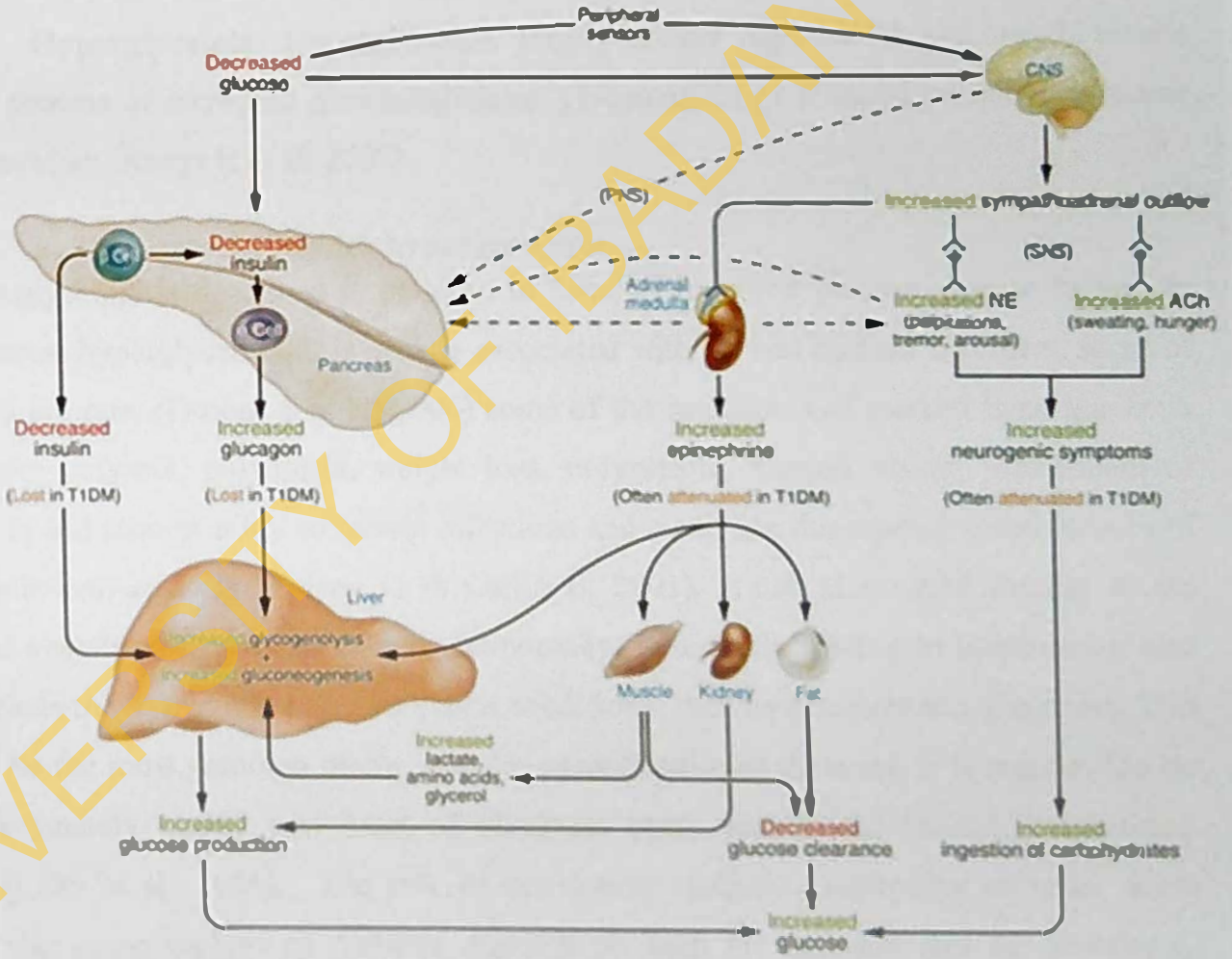
2.3 Pathophysiology

Insulin is the principal hormone that regulates the uptake of glucose from the blood into most cells of the body, especially liver, muscle, and adipose tissue, deficiency of insulin or the insensitivity of its receptors plays a central role in all forms of diabetes mellitus. (ADA 2014)

Glucose in the body is obtained from the intestinal absorption of food, the breakdown of glycogen, and gluconeogenesis (ADA 2014). Insulin therefore plays a critical role in balancing glucose levels in the body, (Shoback et al 2011). After eating, insulin is released into the blood by beta cells (β-cells), found in the islets of Langerhans in the pancreas, in response to rising levels of blood glucose likewise lower glucose levels result in decreased insulin release from the beta cells and in the breakdown of glycogen to glucose. This process is mainly controlled by the hormone glucagon, which acts in the opposite manner to insulin. (Kim E. Barrett, et al 2012). If the amount of insulin available is insufficient, and cells respond poorly to the effects of insulin (insulin insensitivity or insulin resistance), or if the insulin itself is defective, glucose will not be absorbed properly by the body cells that require it, and it will not be stored appropriately

in the liver and muscles. The net effect is persistently high levels of blood glucose, poor protein synthesis, and other metabolic derangements, such as acidosis. (Shoback et al 2011)

However, when the glucose concentration in the blood remains high over time, the kidneys will reach a threshold of reabsorption, and glucose will be excreted in the urine (glycosuria). (Robert K. Murray et al 2012). The diagram below shows the mechanism of glucose and insulin reaction.



Source: diabetesmanager.pbworks.com

Fig 2.1: Mechanism of glucose and insulin reaction.

Kohei KAKU 2010, in a review reported that impaired insulin secretion and increased insulin resistance is the main pathophysiological feature of type 2 diabetes and they both jointly contribute to the development of this disease. However, this has changed and because obesity has become rampant in the adolescent population, there are many young people with insulin resistance and type 2 diabetes.

2.4 Glycaemia: It is defined as the presence of sugar in the blood; it is affected by the process of gluconeogenesis, where glucose is produced from non-carbohydrate sources such as glycerol, fatty acids and glucogenic amino acids. After a meal, glycemic levels increase as carbohydrates are broken down into simpler sugars such as glucose and absorbed from the intestine into the bloodstream.

2.5 Hyperglycemia: Hyperglycemia simply means high blood glucose. It results from process of increased gluconeogenesis, glycogenesis or reduced peripheral glucose regeneration (Keays R et al; 2007).

2.5.1 Factors associated with hyperglycemia

Hyperglycemia is described in children in form of impaired plasma glucose tolerance, and stress hyperglycemia. It is usually associated with several distinct disorders, some of which are rare. (Drobac S et al; 2004) some of the symptoms of marked hyperglycemia include; polyuria, polydipsia, weight loss, polyphagia, blurred vision, impairment of growth and susceptibility to certain infections and acute life threatening consequences of diabetic-keto-acidosis (Valeria G & Carlin E; 2001). It can also cause damage to the blood vessels of the retina (diabetic retinopathy) potentially leading to blindness, it also increases the risk of other serious vision conditions, such as cataracts and glaucoma. This may be the most common micro vascular complication of diabetes. It is responsible for approximately 10,000 new cases of blindness every year in the United States alone. (Fong DS et al; 2004). The risk of developing diabetic retinopathy or other micro vascular complications of diabetes depends on both the duration and the severity of hyperglycemia, and the presence of hypertension. (Fong DS et al; 2004).

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2.6 Hypoglycemia: Hypoglycaemia means low blood glucose levels; it is one of the most common acute complications of the treatment of diabetes. It can result from excess insulin thereby leading to over reduction of the blood glucose level.

2.7 Classification of diabetes

(Al-Hassan 2003) defined the major categories of diabetes as: insulin-dependent DM (IDDM) or type 1, noninsulin-dependent DM (NIDDM) or type 2, secondary DM or type S, impaired glucose tolerance (IGT), gestational diabetes. while (Gutteridge, I. 1999) listed the major categories as type 1, type 2, specific diabetes types and gestational diabetes. another classification by (Alberti & Zimmet 1998) listed the classes as Type 1, Type 2, Gestational Diabetes Mellitus and Other Types

According to WHO & IDF (2006) diabetes mellitus is of three main types: type 1, type 2 and gestational diabetes.

2.7.1 Type 1 diabetes: Also known as insulin-dependent diabetes mellitus (IDDM) is a severe, chronic form of diabetes which is characterized by beta cell destruction an autoimmune process usually leading to absolute insulin deficiency. This deficiency results in the metabolic derangements associated with IDDM. In addition to the loss of insulin secretion, the function of pancreatic α-cells is also abnormal and there is excessive secretion of glucagon in IDDM patients. Normally, hyperglycemia leads to reduced glucagon secretion; however, in patients with IDDM, glucagon secretion is not suppressed by hyperglycemia (Raju and Raju, 2010). Although insulin deficiency is the primary defect in IDDM, there is also a defect in the administration of insulin. Its onset is usually acute, developing over a period of a few days to weeks, 95% of people with Type 1 diabetes develop the disease before the age of 25. It is characterized by increased sugar levels in the blood and urine, excessive thirst, frequent urination, acidosis, and wasting.

2.7.2 Type 2 diabetes: Also known as non-insulin dependent diabetes mellitus (NIDDM) is a form of diabetes that typically appears first in adulthood and is exacerbated by obesity and an inactive lifestyle. Under normal physiological conditions, plasma glucose concentrations are maintained within a narrow range, despite wide fluctuations in supply and demand, through a tightly regulated and dynamic interaction between tissue sensitivity to insulin (especially in liver) and insulin secretion (DeFronzo, 1988). In type 2 diabetes the two main pathological defects are impaired insulin secretion and impaired insulin action through insulin resistance (Holt, 2004). When this resistance develops and as the need for insulin rises, the pancreas gradually loses its ability to produce sufficient amounts of insulin to regulate blood sugar. This Insulin resistance when also triggered by some factors such as: advance in age, weight gain, and increased sedentary life result in diabetes. It is the most common form and often has no symptoms, is usually diagnosed by tests that indicate glucose intolerance, and is treated with changes in diet and an exercise regimen (WHO & IDF, 2006)

2.7.3 Gestational diabetes: it is a form of glucose intolerance which occurs when pregnant women without a previous history of diabetes develop a high blood glucose level. (WHO 2013) It is common among obese women and women with a family history of diabetes. After pregnancy, 5 to 10 per cent of women with gestational diabetes are found to have type 2 diabetes. Also, women who had gestational diabetes have a 35 to 60 per cent chance of developing diabetes in the next 10-20 years.

Table 2.1: Differences between TIDM and T2DM

Features	Type 1 (IDDM)	Type 2 (NIDDM)
Genetics	Polygenic	Polygenic
Age of onset	6 months to young adulthood	Usually pubertal or later
Clinical presentation	Most often acute, rapid	From slow (often insidious) to severe
Body mass	Low(wasted) to normal	Obese
Autoimmunity	Yes	No
Plasma insulin	Low or absent	Normal to high initially
Plasma glucagon	High, can be suppressed	High, resistant to suppression
Plasma glucose	Increased	Increased
Insulin sensitivity	Normal	Reduced
Parents with diabetes	2-4%	80%
Therapy	Insulin	Weight loss, thiazolidinediones, metformin, sulfonylureas, insulin

Source: Guyton and Hall (2006)

2.8 Type 2 Diabetes in children

Recent studies have found incidence of type 2 diabetes amongst children and adolescent. A study carried out in the United States to estimate the prevalence of diagnosed and undiagnosed T2DM among US adolescents, analyzed a nationally representative cross-section of 11,888 adolescents aged 12–19 years. In this study, those who reported a

previous diabetes diagnosis and were either taking an oral hypoglycemic agent (with or without insulin) were classified as having T2DM while those who reported using insulin alone were classified as having type 1 diabetes. Undiagnosed diabetes however was determined by carrying out a fasting blood glucose screening, those who had a fasting blood glucose concentration of ≥126 mg/dl was assumed to be type 2. The estimates of the prevalence of type 1 and type 2 diabetes in these study were 0.48% and 0.36%, respectively, from this study T2DM accounted for half of adolescent diabetes in the United States and one third are undiagnosed (Demmer, et al. 2013), emphasis is placed on screening. This can be compared to a similar study carried out in the United States employing the same design, adolescents reported either having diabetes or not and those who did not have were screened. The results from this study using population-based sample weights, showed that the proportion of T2DM reported was equivalent to 39 005 US adolescents with type 2 diabetes and 2 769 736 with impaired fasting glucose levels.(Duncan, Glen E 2006)

In another retrospective cohort study carried out in the united kingdom (UK) to investigate the prevalence of childhood diabetes over an 8 year period, a cohort comprising of all children and adolescents who received an anti-diabetic drug served as a proxy for diabetes itself, this method however is incompetent because the prevalence observed from this study will be under reported, not all children and adolescent who had diabetes would have presented in the hospital for treatment. However, the reports showed that insulin use increased from 1.08 per 1000 children in 1998 to 2.10 in 2005. Also the use of anti diabetic drug increased from 0.006 per 1000 children in 1998 to 0.05 in 2005. This study supports the reports from other studies that the prevalence of childhood diabetes is rising rapidly. (Hsia et al 2009).

In a study to determine the prevalence of type 2 diabetes among 6 to 18 year-old Kuwaiti children, students were selected from 182 randomly selected schools using the educational districts' registers as a sampling frame. Prevalence rates were adjusted to the 2002 Kuwaiti population, the diagnosis of type 2 diabetes was based on the World Health Organization and the American Diabetes Association criteria. In this study, Type 2 diabetes was identified in 45 of the 128,918 children surveyed, thereby giving an overall prevalence of 34.9 per 100,000. It was also reported that children with type 2 diabetes

previous diabetes diagnosis and were either taking an oral hypoglycemic agent (with or without insulin) were classified as having T2DM while those who reported using insulin alone were classified as having type 1 diabetes. Undiagnosed diabetes however was determined by carrying out a fasting blood glucose screening, those who had a fasting blood glucose concentration of ≥126 mg/dl was assumed to be type 2. The estimates of the prevalence of type 1 and type 2 diabetes in these study were 0.48% and 0.36%, respectively, from this study T2DM accounted for half of adolescent diabetes in the United States and one third are undiagnosed (Demmer, et al. 2013), emphasis is placed on screening. This can be compared to a similar study carried out in the United States employing the same design, adolescents reported either having diabetes or not and those who did not have were screened. The results from this study using population-based sample weights, showed that the proportion of T2DM reported was equivalent to 39 005 US adolescents with type 2 diabetes and 2 769 736 with impaired fasting glucose levels.(Duncan, Glen E 2006)

In another retrospective cohort study carried out in the united kingdom (UK) to investigate the prevalence of childhood diabetes over an 8 year period, a cohort comprising of all children and adolescents who received an anti-diabetic drug served as a proxy for diabetes itself, this method however is incompetent because the prevalence observed from this study will be under reported, not all children and adolescent who had diabetes would have presented in the hospital for treatment. However, the reports showed that insulin use increased from 1.08 per 1000 children in 1998 to 2.10 in 2005. Also the use of anti diabetic drug increased from 0.006 per 1000 children in 1998 to 0.05 in 2005. This study supports the reports from other studies that the prevalence of childhood diabetes is rising rapidly. (Hsia et al 2009).

In a study to determine the prevalence of type 2 diabetes among 6 to 18 year-old Kuwaiti children, students were selected from 182 randomly selected schools using the educational districts' registers as a sampling frame. Prevalence rates were adjusted to the 2002 Kuwaiti population, the diagnosis of type 2 diabetes was based on the World Health Organization and the American Diabetes Association criteria. In this study, Type 2 diabetes was identified in 45 of the 128,918 children surveyed, thereby giving an overall prevalence of 34.9 per 100,000. It was also reported that children with type 2 diabetes

had a significantly higher frequency (51.1%) of a positive family history of diabetes than children of a similar age without type 2 diabetes (22.2%). This study concluded that type 2 diabetes in adult Kuwaitis is spreading to children and adolescents, making it an emergency public health problem and efforts need to be initiated to address prevention strategies of type 2 diabetes in youth.(Moussa et al. 2008)

(Otaigbe BE, 2011.) In Port Harcourt, Rivers State, Nigeria presented the case report of a 9 year old overweight female with a BMI of 28kg/ın2 and a strong family history of DM in at least two generations who presented with polyuria and weight loss and whose mother had gestational diabetes and is on oral hypoglycaemics. The report showed that family history of DM and high socio-economic class was a major risk factor of T2DM.

A documented study on screening in Nigeria was a cross sectional study (Bassey NA, Peterside O 2012) of 1008 students aged 10 to 18 years from 12 secondary schools in Port Harcourt, urine glucose was determined using a dipstick urinary multistix strip. The prevalence of glycosuria in this study was 0.7% with males having a higher prevalence (1.2%) than females (0.2%). This study found a relationship between elevated blood pressure and glycosuria was statistically significant however, there was no statistically significant relationship between glycosuria and body mass index categories, waist hip ratio, acanthosis nigricans and family history of diabetes, though the urine screening method is not a gold standard for screening for diabetes, the study supports a rising incidence of diabetes in children and adolescents.

2.9 Risk factors of diabetes

The risk factors for type 2 diabetes in young people are similar to those for adults and comprise both modifiable and non-modifiable determinants. The non-modifiable risk factors are; age, family history, insulin resistance as a result of puberty and ethnicity (Alberti et al; 2007, Amed et al; 2010). The modifiable risk factors are poor diet and physical inactivity, both of which lead to overweight and obesity another risk factor. (Amed et al 2010) labeled obesity as the most important modifiable risk factor for the development of type 2 diabetes in youth. The reports of American Diabetes Association 2000 shows that up to 85% of children with diabetes are either overweight or obese at

diagnosis. Internationally, type 2 diabetes rates are considered to have increased in line with obesity rates (Amed et al. 2010a; Flint & Arslanian 2011; Rosenbloom et al. 1999).

In Australia, there are high rates of overweight and obesity in the population as a whole but also among children and young people. In 2011–12, 25% of Australian children aged 5–17 were overweight or obese (ABS 2013).

Diabetes Care 2000 estimated that for every kilogram increment in self-reported body weight, the risk for diabetes increases by about 9%. Findings from a large cohort of US men, the Health Professionals Follow-up Study, showed a 7.3% increased risk of diabetes for every kilogram of weight gained (Koh-Banerjee P et al, 2004). In a study to ~~determine~~ the prevalence of pre diabetes and its risk factors amongst US adolescents, it was observed that Overweight adolescents had a 2.6-fold higher rate than those with ~~normal~~ weight (1.3-5.1). Adolescents with two or more cardio metabolic risk factors had a 2.7-fold higher rate than those with none (1.5-4.8). Adolescents with hyper ~~insulinemia~~ had a 4-fold higher prevalence (2.2-7.4) than those without. (~~Duncan,~~ Glen E (2006). Similarly, In the Nurses' Health Study, the risk of type 2 diabetes decreased with increasing amounts of total physical activity. Compared with women with the lowest level of total physical activity, those with the highest level had a 46% lower risk, independent of major risk factors for diabetes. Moreover, the inverse dose-response relationship persisted after controlling for BMI (Hu FB et al, 1999).

Amongst the modifiable risk factors, residence seems a major determinant since urban residents have a 1.5 to 4 fold higher prevalence of diabetes compared to their rural counterpart. This is attributable to lifestyle changes associated with urbanization. (Gill G 1997). Urban lifestyle in Africa is characterized by changes in dietary habits involving an increase in consumption of refined sugars and saturated fat, and a reduction in fiber intake, reduction in physical activity associated with urban lifestyle (Sharma S, 1996).

In a study amongst school aged children in Port-harcourt Nigeria, Glycosuria was found more in subjects with elevated blood pressure (4.1%) followed by subjects with positive family history of DM (1.7%). (Peterside O et al; 2012). Though this study screened for diabetes using glycosuria, Urine method, which is not the gold standard for blood glucose testing, elevated blood pressure accounts for a risk factor. In another study, 62% of

persons with Type 2 DM in the northern part of Nigeria were estimated to be hypertensive (Bello-Sani and Anumah; 2009)

2.10 Pre diabetes:

Impaired fasting glucose (IFG) and impaired glucose tolerance (IGT) are considered to constitute "pre-diabetes." In a study to estimate the prevalence of IFG, IGT, and pre-diabetes among U.S. adolescents using data from a nationally representative sample. Fasting blood glucose and 2-h glucose during an oral glucose tolerance test was used to assess the prevalence of IFG, IGT, and pre-diabetes, the prevalence of IFG, IGT, and pre-diabetes were 13.1, 3.4, and 16.1%, respectively. (Duncan, Glen E 2006).

2.11 Glycemic control

This is used to refer to the typical levels of blood glucose in a person with diabetes. Evidence suggests that many of the long-term complications of diabetes, especially the micro vascular complications, are as a result of several years of hyperglycemia (elevated levels of glucose in the blood). Good glycemic control, has therefore become an important goal of diabetes care, recent research have suggested that the complications of diabetes may be caused by genetic factors (Tarnow L et al;2008) or, in type 1 diabetics, by the continuing effects of the autoimmune disease which first caused the pancreas to lose its insulin-producing ability.(Adams DD et al; 2008). In achieving a "Perfect glycemic control" glucose levels should always remain normal (70–130 mg/dl, or 3.9-7.2 mmol/L) and indistinguishable from a person without diabetes. (Huang, ES et al 2007). However, poor glycemic control refers to persistently elevated blood glucose and glycosylated hemoglobin levels, which may range from (200–500 mg/dl or 11-28 mmol/L). Glycated hemoglobin sometimes also HbA1c) is a form of hemoglobin that is measured primarily to identify the average plasma glucose concentration over prolonged periods of time. In diabetes mellitus, higher amounts of glycated hemoglobin, indicating poorer control of blood glucose levels, have been associated with cardiovascular disease, nephropathy, and retinopathy. Monitoring HbA_{1c} in type 1 diabetic patients may improve outcomes. (WHO 2013)

2.12 Diagnosis of diabetes:

Diabetes is diagnosed by the presence of elevated blood glucose (hyperglycemia) with or without symptoms of diabetes or its complications. The Plasma blood glucose can be raised without having the usual DM complication. Diagnosis can be done either using blood or urine, however, urine test does not tell the current level of glucose in the urine. It only provides information on the presence of glucose, which is why blood glucose testing is the primary and accurate test for actual glucose levels. An individual is said to be Diabetic if he/she has:

Table 2.2: Criteria for diagnosis of diabetes

Symptoms of diabetes plus casual/random plasma glucose concentration (≥11.1 mmol/l or ≥200 mg/dl).	Casual is defined as any time of day without regard to time since last meal.
Fasting blood glucose (≥7.0 mmol/l or ≥126 mg/dl).	Fasting is defined as no caloric intake for at least 8 hours.
2 hour post load glucose (≥11.1 mmol/l or ≥ 200 mg/dl) during an OGTT	
HbA1c ≥6.5.	

Pre-diabetes includes Impaired Glucose Tolerance (IGT) and Impaired Fasting Glycaemia (IFG)

- IGT: 2 hour post load plasma glucose (7.8-11.1 mmol/l or 140-199 mg/dl)
- IFG: plasma glucose (5.6-6.9 mmol/l or 100-125 mg/dl)

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Hyperglycemia not high enough to meet diagnosis of diabetes but greater than normal values is categorized as Pre diabetes (Impaired fasting glucose IFG or impaired glucose tolerance IGT). Individuals with either IFG or IGT show no symptoms and are diagnosed during screening process. Diabetes risk for individuals with IFG or IGT is 5 to 7 fold increase compared to those with normal blood sugar (Grundy 2012)

2.13 Incidence and prevalence of diabetes

Type 2 DM has been reported in children in the United States (Fagot-Campagna A et al. 2000), Canada (Dean H. 1998), United Kingdom (Ehtisham S. et al. 2001), Australia (Davis E, 2002), Japan, (Cockram CS, 2000) Taiwan (Wei JN, et al. 2003) and India (Ramachandran A, et al. 2003). National population data on the prevalence of type 2 diabetes remain limited and are unavailable for many countries. Therefore, the precise burden of type 2 diabetes in children is still unknown. However, given the rising prevalence of overweight in children, the problem is likely to be substantial.

The largest study on diabetes in children is from Japan, with about 7 million children studied between 1976 and 1997 (Kitagawa T et al; 1998). Over the 21-year period, the incidence of type 2 diabetes increased 10-fold in children ages 6–12 year (0.2 per 100,000/year from 1976 to 1980 vs 2.0 per 100,000/year from 1991 to 1995) and almost doubled among children 13–15 year old (7.3 vs 13.9 per 100,000/year). Currently, type 2 diabetes accounts for 80% of all childhood diabetes in Japan.

Data from the United States and Canada also indicate an increasing prevalence of diabetes in children. In Cincinnati, Ohio, the annual incidence of type 2 diabetes in children and adolescents 10–19 year old increased 10-fold between 1982 and 1994 (0.7 per 100,000 vs 7.2 per 100,000) (Pinhas-Hamiel O et al; 1996). Type 2 diabetes accounted for 16% of all new diagnoses of diabetes in children up to 19 year of age and accounted for 33% of new cases among patients ages 10–19 year (Pinhas-Hamiel O et al; 1996). In Chicago, Illinois, the 10-year average annual incidence of type 2 diabetes among African American and Latino children and adolescents (ages 0–17 year) increased by 9% per year from 1985.(Lipton R et al; 2002).

In the sub-sahara Africa region, nine countries have conducted prevalence surveys and reported data on type 2 diabetes (T2DM) in the last decade (Balde NM et al; 2007). Two of these countries have conducted population surveys with the assistance of the World

Health Organization's 'STEPwise Approach to Chronic Disease Surveillance Management'. Prevalence in the general population of T2DM recorded in these studies ranged from 0.6% in rural Uganda to 12% in urban Kenya (Christensen DL et al; 2009). A low to medium prevalence (0-7%) was recorded in Cameroon (Sobngwi et al 2002), Ghana (Amoah et al, 2002), Guinea(Balde et al, 2007), Kenya (Christensen et al. 2009), Nigeria (Oladapo et al 2010), South Africa (Motala et al, 2008) and Uganda (Maher et al, 2010) and a very high prevalence (> 10%) was recorded in Zimbabwe. (Motala AA et al; 2008).

Variation between urban and rural populations was frequently observed, with a higher prevalence recorded in urban populations (Aspray TJ et al; 2000). Prevalence recorded in Christensen's Kenyan survey ranged from 2% in rural areas to 12% in urban areas.

Over the past 3 decades, diabetes has been increasing steadily in Nigeria. In 2008, Nigeria had an incidence rate of over 12 million diabetic patients (Population Reference Bureau 2008), while the incidence rate was 4.7 percent of the population in 2011 (Oguntola; 2011).

WHO and IDF (2006) also reported that Nigeria has the greatest number of people living with diabetes in Africa. Over a decade ago, the prevalence of DM was 2.2% (Akinkugbe and Akinyanju; 1997). Isolated reports from some regions of Nigeria have found prevalence rates to range from 0.9-15% (Okeoghene et al; 2007). Crude prevalence rates of 7.7 and 5.7% were, estimated for males and females in Port Harcourt, southern part of Nigeria (Nyenwe et al; 2003).

A study of the prevalence of DM in Nigeria showed that T2DM is the most common type of DM accounting for about 90% of cases (Familoni, Olatunde and Raimi, 2008).

2.14 Complications/burden of the disease

Diabetes and its complications impose significant economic consequences on individuals, families, health systems and countries. This threat is growing and the number of people, families and communities afflicted is increasing. This growing threat is an under-appreciated cause of poverty and hinders the economic development of many countries (WHO, 2009).

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Generally, the injurious effects of hyperglycemia are separated into macro vascular complications (coronary artery disease, peripheral arterial disease, and stroke) and micro vascular complications (diabetic nephropathy, neuropathy, and retinopathy).

The broad range of complications arising from diabetes could be micro vascular retinopathy, nephropathy, and neuropathy; and macro vascular ischemic heart disease, stroke and peripheral vascular disease (Chinenye & Young 2011). Diabetes is the leading cause of non traumatic amputation, blindness and kidney failure. (WHO 2014) stated that people with diabetes are 10 times more likely to have limb amputation than non-diabetic people.

The major complication of diabetes which is increased cardiovascular disease is responsible for 50% - 80% deaths among people with diabetes (WHO 2014). These complications are associated not only with reduced life expectancy but also quality of life. Diabetes increases the risk that an individual will develop cardiovascular disease (CVD). It is the primary cause of death in people with either type 1 or type 2 diabetes. (Paterson AD et al; 2007). In fact, CVD accounts for the greatest component of health care expenditures in people with diabetes. (Hogan P et al; 2000). Among macro vascular diabetes complications, coronary heart disease has been associated with diabetes in numerous studies beginning with the Framingham study.

More recent studies have shown that the risk of myocardial infarction (MI) in people with diabetes is equivalent to the risk in non-diabetic patients with a history of previous MI. (Haffner SM et al; 1998). These discoveries have led to new recommendations by the ADA and American Heart Association that diabetes be considered a coronary artery disease risk equivalent rather than a risk factor. (Buse JB et al; 2007). Diabetes is also a strong independent predictor of risk of stroke and cerebrovascular disease, as in coronary artery disease. (Lehto S et al; 1996)

2.15 Prevention and control

The optimal strategy for preventing any disease requires knowledge of its modifiable risk factors. Randomized controlled trials have shown that individuals at high risk of developing diabetes can be introduced to interventions that significantly decrease the rate of onset of diabetes. These interventions include intensive lifestyle modification programs that have been shown to be very effective. This includes a 5-10% weight loss, and moderate physical activity of approximately 30min/day is recommended. Among Pima Indian children and adolescents free from diabetes, future type 2 diabetes is predicted by weight relative to height and concentrations of serum insulin and plasma glucose. (McCance DR et al; 1994).

2.16 Management of diabetes

The main goal of diabetes management is to restore carbohydrate metabolism to as close to a normal state as possible. To achieve this goal, individuals with an absolute deficiency of insulin require insulin replacement therapy, which is given through injections or an insulin pump. Insulin resistance, in contrast, can be corrected by dietary modifications and exercise. Other goals of diabetes management are to prevent or treat the many complications that can result from the disease itself and from its treatment. Education should be given by team members with special expertise and knowledge of the dietary, exercise, and psychological needs of youth with type 2 diabetes.

2.17 Treatment

The initial treatment of T2DM should be tailored to the symptoms and severity of the clinical presentation, including assessment for DKA and its appropriate care. Insulin may be required for initial metabolic stabilization if significant hyperglycemia and ketosis is present, even in the absence of ketoacidosis. Metformin is the initial pharmacologic treatment of choice.

Lifestyle changes in diet and exercise are also essential to increase insulin sensitivity and should be recommended for all individuals with type 2 diabetes.

CHAPTER THREE

STUDY METHODOLOGY

3.1 Study Area

The study was conducted in Ibadan, Oyo state, Nigeria. Ibadan is located in southwestern Nigeria, 128km inland northeast of Lagos and 530km Southwest of Abuja, the Federal capital. Ibadan is the third largest city in Nigeria after Lagos and Kano.

There are eleven (11) Local Governments Areas in Ibadan which consist of 5 urban local governments: Ibadan north, North east, North west South east and south west and 6 semi-urban local government areas: Akinyele, Ido, Egbeda, Lagelu, Oluyole and Ona ara.

Ibadan can be classified into social classes based on the characteristics, quality of building, building environment, general social characteristics of residents and infrastructural developments as:

High class areas: The residents are high income earners and live in fortified houses. The areas that fall in this category include Agodi GRA, Jericho GRA, Old and new Bodija, Oluyole, Ring Road.

Low class areas: This represents areas where majority of housing and the housing environment are indigenous. The residents are essentially low income earners. The areas in this category include: Beere, Oje, Orita Aperin, Idi Ayunre, Ojo Oba e.t.c.

Ibadan south west local government (ISWLG) has an area of 40km^2 and a population of 282,585 at the 2006 census, it is bounded in the west by Ido local government, east by Ibadan North and South East Local Governments Areas, bounded in the North by Ibadan North West and Ido and in the south by Oluyole Local Government Area. Its headquarters is at Oluyole Estate Ibadan.

ISWLG is classified as one of the high class areas, it has Government residential areas like Iyaganku GRA, Aleshinloye GRA, Ring road e.t.c. Residents in this area are majorly high income earners and have access to fast food joints like KFC, Tantalizers, and Domino's pizza. Also located in this area are recreational facilities such as shop rite, Jericho mall e.t.c. There is a major secondary health facility and several other primary

health care facilities located in this area. There are 81 government approved secondary schools in this area, 52 private secondary schools and 29 public secondary schools. The school administration begins with the principal as the school head, followed by the vice principals and bursar, the head of departments, teachers, school prefect and students.

3.2 Study Population

Pupils between the ages (10-19year) that were enrolled in a secondary school in ISWLG Area Ibadan, Nigeria were selected for this study.

3.3 Study design

A cross-sectional school-based study was carried out. Adolescents between the ages 10-19 years in the selected public and private schools were enrolled for the study.

3.4 Sample Size Determination.

Sample size estimation for single proportion at 95% Confidence level will be used to calculate the minimum sample size

$$n = \frac{(Z\alpha/_2)^2 \times pq}{d^2}$$

Where:

n is the desired sample size.

z is the standard normal deviate set at 1.96 [corresponding to 95% confidence interval];

p is the proportion in the target population estimated to have a particular characteristic, the proportion of T2DM in age group 10-19. = (3.6%) [Vargas I et al, 1999]

q = 1-p

and d is the precision at 2.5% level.

p = 3.6%

q = 1- P = 96.4%

d = 2.5%

$$n = \frac{(Z\alpha/_2)^2 \times pq}{d^2}$$

$$n = \frac{1.96^2 \times 0.036 \times 0.964}{0.025 \times 0.025}$$

$$= 213.31$$

Adjusting for non-response rate of 10% and due to cluster sampling a design effect of 2 was applied = 473.54

The minimum sample size for the study will approximately be = 475

3.5 Sampling Technique

A total of 475 participants were recruited by employing a multi stage sampling technique.

STAGE 1: 3 wards were randomly selected from the 10 wards in ISWLGA.

STAGE 2: A total of 9 schools (2 private and 1 public) were randomly selected from a list of all the schools in each ward.

STAGE 3: A simple random sampling (balloting) was used to select equal number of students from a class in each school.

3.5.1 Inclusion criteria:

(1) All adolescents that are enrolled in a school (between ages 10 and 19 years)

3.5.2 Exclusion criteria:

(1) Students suffering from severe, debilitating illness at time of study.

(2) Unwillingness by students/parents to give informed consent.

3.6 Data collection

Information was elicited by administering semi-structured pretested questionnaire. Research assistants were trained on collection of data from the participants. 7 broad items were collected which include: socio demographic characteristics, dietary pattern, physical activities, family history, fasting blood glucose, blood pressure, and anthropometric measurements of weight, height and family history of DM. The instruments for data

collection was pre-tested in a Ore-Ofe-Oluwa Secondary School in Ibadan north east local government area using 10% of the sample size, this was carried out in other to test the reliability of the instruments and also to ensure clarity of questions.

All questionnaires were stripped of its identifiers, only the principal investigator and other qualified personnel will be allowed to have access to the data.

Anthropometric Measurement: Measurements were taken by investigators and research assistants who received adequate training in these procedures.

Weight: Measurement was taken using a digital weighing scale after checking for zero error at each measurement and the reading was taken to the nearest 0.1 kg. Respondents were weighed standing still and without support with arms hanging freely by the sides of the body and palms facing the thighs. The participant were barefoot, belts and other accessories were removed and pockets emptied with body weight evenly distributed between both feet.

Height: Measurement was taken with a stadiometer to the nearest 0.5 cm with the subjects barefoot or with socks, standing erect with heels together and looking straight ahead, two measurements were taken required in order to reduce error and therefore obtain a more accurate calculation of BMI. The BMI for age was calculated by imputing the necessary information into WHO Anthro plus software version 1.0.4.

WHO Anthro plus is a World Health Organization software for personal computers, it was developed to monitor the growth of school-age children and adolescents. Three indicators that are included in Anthroplus are weight-for-age, height-for-age and BMI-for-age. This software enables monitoring growth in individuals and populations of children from birth to 19 years of age.

Fasting blood glucose: It was measured by using an Accu-check glucometer; the glucose monitor was calibrated using positive and negative standard for accurate readings. A qualified laboratory scientist was employed for the measurement of fasting blood glucose. Pupils who were recruited into the study were asked to skip their breakfast on

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the day of the examination. Blood sample was obtained by a finger prick using lancets after cleaning the finger tip with methylated spirit. Blood sugar level was measured by placing a drop of blood taken from a finger tip, on a strip of plastic containing chemicals and electrodes. A chemical reaction between the glucose in the blood and the chemicals on the strip gives rise to an electrical current or colour change, which is then read by the meter as indicating the blood glucose level. Blood glucose meter reading was expressed as mg/dl. Strips were discarded appropriately after each reading. Readings will be classified as;

Normal level: <126 mg/dl

Hypoglycemic: < 60 mg/dl.

Impaired Fasting Glycemia: 100 - 125mg/dl

Hyperglycemic: >126 mg/dl.

Blood pressure (BP): Measurements were taken by using digital sphygmomanometer (Omron). This was to avoid observers bias which is associated with mercury sphygmomanometer .Students were asked to seat with arms flexed. If anxious, they were allowed to wait a few minutes before the blood pressure was taken with the length of the cuff's bladder covering at least or equal to 80% of the circumference of the upper arm. Systolic BP (SBP) was recorded during deflation of the cuff at the 1st Korotkoff sound and diastolic BP (DBP) recorded when the 5th sound disappears. Three BP readings were obtained at 5-minute interval between readings, and the mean was recorded as the subject's blood pressure reading.

Dietary habit: it was accessed using a 7 days food frequency questionnaire, respondents were told to tick the number of times they ate a particular class of food in the past 7 days. The habit were classified as:

Never: Ate the food 0 time in the past 7 days.

Rarely: Ate the food 1-2 times in the past 7 days.

Occasionally: Ate the food 3-4 times in the past 7 days

Frequently: Ate the food 5-7 times in the past 7 days.

Physical activity: physical activity was measured by calculating the average time each respondent spent on physical activity in the past 7 days. It was classified as:

None: 0 days of Physical activity

Insufficient: 1-2 days of at least 60mins of moderate physical activity.

Sufficient: 4 or more days of at least 60mins of moderate physical activity.

Sedentary behavior: Sedentary behavior was measured by calculating the average time each respondent spent on watching television (t.v) and playing video games daily. This was classified as:

Present: More than 2hours of t.v viewing daily

Absent: less than 2 hours of t.v viewing daily.

3.7 STUDY VARIABLES

Dependent Variables: The dependent variable in this study are:

1. Pre diabetes
2. Mean glycemic levels.

Independent Variables: The independent variables in this study include: age, gender, religion, type of school, dietary pattern, level of physical activity, family history of Diabetes mellitus, obesity and blood pressure.

3.7.1 VARIABLES DEFINITION

Adolescent : Person aged 10 to 19 years

Glycaemia: This refers to the concentration of sugar or glucose in the blood. It is expressed as milligrams per deciliter (mg/dl) or millimole per decilitre (mmol/dl).

Hypoglycaemia: Fasting blood sugar less than or equal to 60 mg/dl.

Hyperglycemia: Fasting blood sugar of greater than or equal to 126mg/dl

Impaired fasting Glycemia: Fasting blood sugar of 100-125mg/dl

Body mass index (BMI): Ratio of the weight to the square of the height /length.

Hypertension in childhood: It is defined as an average systolic or diastolic blood pressure greater than the standard cut off, table in appendix vii.

3.8 Data Analysis: Data was entered, cleaned and analyzed using Statistical Package for Social Sciences (SPSS) version 20 and was backed-up in an external hard-drive. Data was cleaned to check for inconsistencies. Summary and inferential statistics were used and results were interpreted as statistically significant at 5% level or less ($p \leq 0.05$).

The details of the analysis of the various variables is shown below

Table 3.1: Data analysis table

	Variables	Test
1.	Means of Age, height, weight, blood pressure, fasting blood glucose.	Descriptive statistics: Mean, standard deviation
2.	Prevalence of pre diabetes, obesity, physical inactivity, sedentary behaviour.	Frequencies and proportion
3.	Associations between pre diabetes and diet, physical activity, BMI, sedentary behaviour, blood pressure.	Chi square
4.	Compare means between the groups of school, BMI, blood pressure.	Independent t- test and Anova
5.	Predictors of pre diabetes	Logistic regression
6.	Predictors of glycemic level	Linear regression

3.9 Ethical Considerations

Ethical approval for study implementation will be obtained from the Ethical Review Committee, of the Ministry of Health, Oyo State. Permission will also be obtained from the Ministry of Education, Oyo State and the authorities of each selected school.

3.8 **Data Analysis:** Data was entered, cleaned and analyzed using Statistical Package for Social Sciences (SPSS) version 20 and was backed-up in an external hard-drive. Data was cleaned to check for inconsistencies. Summary and inferential statistics were used and results were interpreted as statistically significant at 5% level or less ($p \leq 0.05$).

The details of the analysis of the various variables is shown below

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	Variables	Test
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Informed consent: An informed consent form will be made available in English and Yoruba to be signed by the parents/guardian of the participant, study participants gave their assent before active data collection commenced.

Confidentiality of data: All forms and documents were stripped of participant's names'; unique numbers/identifiers will be used for identification. Only concerned individuals will be allowed to handle documents containing participants' information.

Beneficence to participants: All participants will be given counsel on the importance of maintaining a healthy weight, diet and lifestyle

Non-maleficence to participants: The risk of harm to study participants was estimated as low. Participants with hyperglycemia were informed and referred to the appropriate school authority. Password protected computerized systems will be used for data management.

Voluntariness: Participation in this research was entirely voluntary. Eligible individuals will be assured of their choice to either participate in the study or not.

3.10 Dissemination of results

The results of this study will be disseminated to the health administrators (permanent secretaries and directors in MOH) and policy makers of health in the state.

CHAPTER FOUR

RESULTS

4.1 Socio demographic characteristics of study participants.

Table 4.1 shows the frequency distribution of the respondents by age, sex, religion, ethnicity, father and mothers occupation and type of school. More than half (52.6%) of those who had pre diabetes were in the age group 15-19 while 47.4% were in the age group 10-14 with a mean age of 14.6±1.54. Pre-diabetes was reported more amongst the females (52.6%) and 81.8% were Yorubas. A greater proportion of the fathers of those who had pre diabetes were self-employed compared to the non pre diabetes (55% vs. 63%). Similarly a greater proportion (71%) of the mothers of the respondents who had pre diabetes was self-employed. Majority of those who had pre-diabetes (84.2%) and non pre-diabetes (67.4%) attended private schools.

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Table 4.1: Socio demographic characteristics of study participants

Characteristics	Pre- diabetes n=19 N (%)	No pre diabetes. n = 457 N (%)
Age (years)		
10-14	9(47.4)	229(50.4)
15-19	10(52.6)	225(49.6)
Sex		
Male	10(52.6)	211(46.2)
Female	9(47.4)	246(53.8)
Religion		
Christianity	11(57.9)	292(64.2)
Islam	8(42.1)	161(35.4)
Ethnicity		
Yoruba	15(78.9)	369(81.3)
Igbo	2(10.5)	58(12.8)
Hausa	0(0.0)	4(0.9)
Others	2(10.5)	23(5.1)
Mother's occupation		
Civil servant	4(12.5)	88(20.6)
Professional	5(15.6)	53(12.4)
Trader	10(71.9)	265(62.1)
Father's occupation		
Civil servant	3(16.7)	89(20.2)
Professional	5(27.8)	53(12.0)
Trader	10(55.6)	278(63.0)
Type of school		
Public	3(15.8)	149(32.6)
Private	16(84.2)	308(67.4)

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Characteristics	Pre- diabetes n=19 N (%)	No pre diabetes. n = 457 N (%)
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Christianity	11(57.9)	292(64.2)
Islam	8(42.1)	161(35.4)
Ethnicity		
Yoruba	15(78.9)	369(81.3)
Igbo	2(10.5)	58(12.8)
Hausa	0(0.0)	4(0.9)
Others	2(10.5)	23(5.1)
Mother's occupation		
Civil servant	4(12.5)	88(20.6)
Professional	5(15.6)	53(12.4)
Trader	10(71.9)	265(62.1)
Father's occupation		
Civil servant	3(16.7)	89(20.2)
Professional	5(27.8)	53(12.0)
Trader	10(55.6)	278(63.0)
Type of school		
Public	3(15.8)	149(32.6)
Private	16(84.2)	308(67.4)

4.2 Frequency distribution of type of school by socio demographic status

Table below shows the distribution of the respondents' lifestyle characteristics by type of school. It is shown that amongst those who attended private schools, 4.9% had diabetes and 95.1% did not, it can also be reported that 94.6% of those who attended public school were hypertensive while 90.2% of those who attended public school were pre hypertensive. Also observed is that amongst those who attended public schools 82.6% took carbonated drinks frequently while 77.9% of those who attended private schools took carbonated drinks frequently.

Table 4.2: Frequency distribution of type of school by socio demographic status

	Public	**Private**
	N= 154	**N= 346**
Pre diabetes		
Yes	3(2.0)	16(4.9)
No	149(98.0)	308(95.1)
Blood pressure		
Hypertensive	141(94.6)	293(90.2)
Normotensive	8(5.4)	32(9.8)
Sedentary behaviour		
Present	16(13.3)	41(18.4)
Absent	104(86.7)	182(81.6)
Carbonated drinks		
Frequently	123(82.6)	257(77.9)
Not frequently	26(17.4)	73(22.1)
Fruits and vegetables		
Frequently	111(72.5)	243(72.3)
Not frequently	42(27.5)	93(27.7)
Snacks and pastries		
Frequently	109(71.2)	247(73.3)
Not frequently	44(28.8)	90(26.7)
Physical activity		
Insufficient	46(29.9)	106(30.6)
Sufficient	108(70.1)	240(69.4)

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Snacks and pastries		
Frequently	109(71.2)	247(73.3)
Not frequently	44(28.8)	90(26.7)
Physical activity		
Insufficient	46(29.9)	106(30.6)
Sufficient	108(70.1)	240(69.4)

4.3 Frequency distribution of fathers' educational status

Figure 4.1 shows the distribution of educational status of the respondents' father. About 66% of the respondents' father had tertiary education, 29% had secondary while 3.8% had primary level of education.

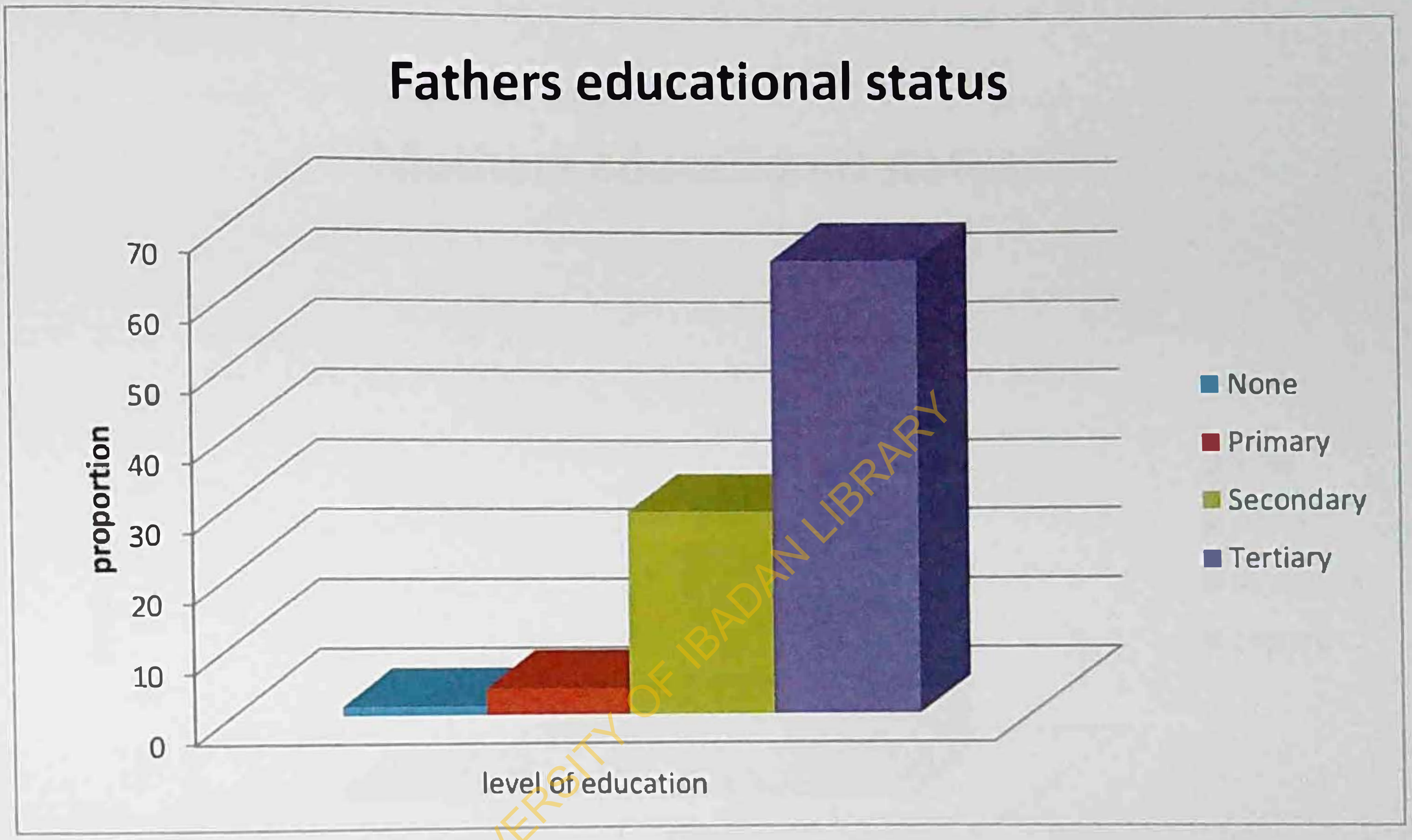

Fig 4.1: Frequency distribution of fathers' educational status

4.4 Frequency distribution of mothers' educational status

Figure 4.2 shows the distribution of educational status of the respondents' parents. About 61% of the respondents' mother had tertiary education, 32% had secondary education while 5.4% had a primary level of education.

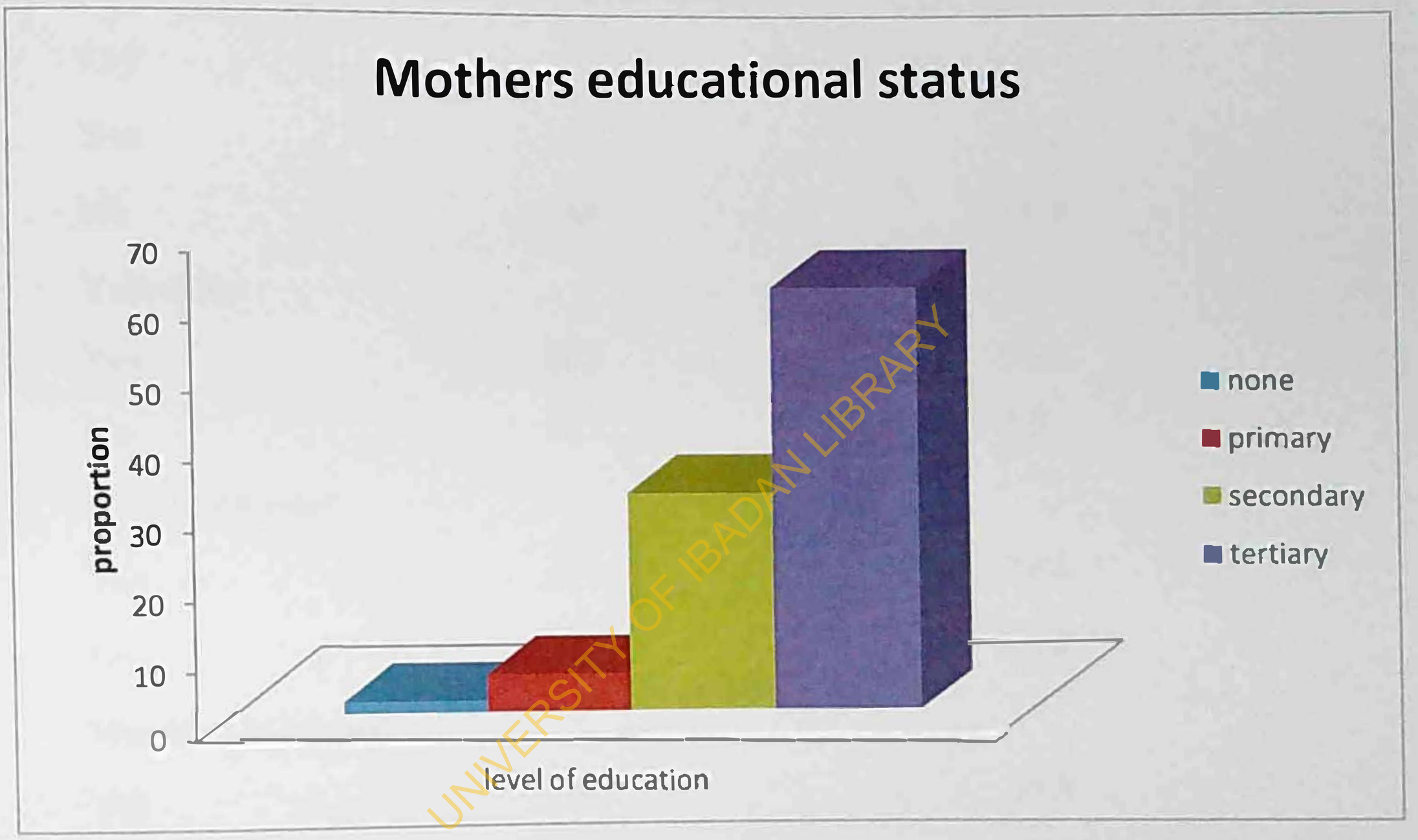

Fig 4.2: Frequency distribution of mothers' educational status

4.5: Frequency distribution of respondents' household items

Table 4.3 shows the distribution of the respondents household items, it is observed that 71.1% of the respondents has a car, 98.0% has a television set, 39.2% has an Air conditioner and 36.8% had a washing machine.

Table 4.3: Frequency distribution of respondents' household items

House hold items	Frequency n=495	Proportion (%)
Car		
Yes	352	71.1
No	143	28.9
Television		
Yes	485	98.0
No	10	1.8
Air conditioner		
Yes	194	39.2
No	301	60.8
Washing machine		
Yes	182	36.8
No	313	63.2

4.6: Lifestyle characteristics of study participants

Table 4.4 shows results of lifestyle characteristics of study participants. Amongst the respondents who did not eat fruits and vegetables frequently, 4.7% had pre diabetes compared to 95.3% who did not have pre diabetes. Amongst those who reported having sufficient physical activity, 4.0% had pre diabetes while 96.0% did not have pre diabetes. Amongst those who reported having a 1st degree family with diabetes, 6.2% had pre diabetes while 93.8% did not have. Also amongst those who had normal blood pressure, 7.1% had pre diabetes while 96.6% didn't. It was also observed that 7.5% of those who had hypertension had pre diabetes while 92.5% did not have pre diabetes.

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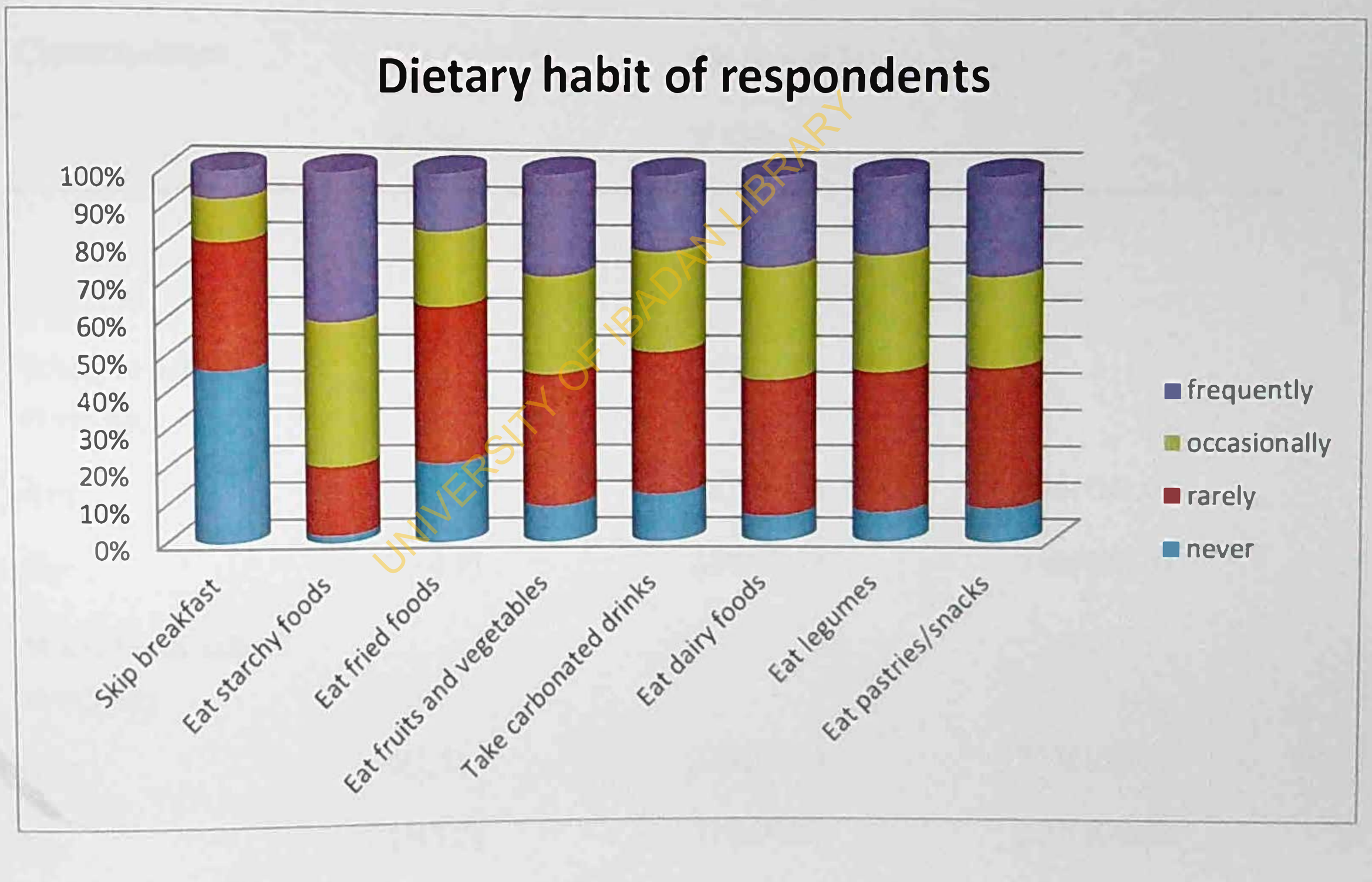
Table 4.4 Lifestyle characteristics of study participants

Characteristics	Pre diabetes		
	Yes n = 19	No n= 433	Total
	N (%)	N (%)	
Frequently eat fruits and vegetables			
Yes	13(3.8)	326(96.2)	339(100.0)
No	6(4.7)	121(95.3)	127(100.0)
Physical activity			
Insufficient	6(4.1)	142(94.9)	148(100.0)
Sufficient	13(4.0)	315(96.0)	328(100.0)
1st degree family			
Present	1(6.2)	15(93.8)	16(100.0)
Absent	17(4.0)	410(96.0)	427(100.0)
2nd degree family			
Present	5(8.3)	55(91.7)	60(100.0)
Absent	13(3.4)	368(96.6)	381(100.0)
Sedentary behaviour			
Present	0(0.0)	54(100.0)	54(100.0)
Absent	10(3.7)	263(96.3)	273(100.0)
BMI			
Normal	1(1.6)	61(98.4)	62(100.0)
Underweight	17(4.6)	35(95.4)	373(100.0)
Overweight	1(3.6)	27(96.4)	28(100.0)
Blood pressure			
Normal	9(3.4)	258(96.6)	267(100.0)
Pre hypertension	7(4.6)	146(95.4)	153(100.0)
Hypertension	3(7.5)	37(92.5)	40(100.0)

4.7 Dietary habit of participants

The chart below shows the frequency distribution of the consumption of some food items amongst the respondents, it is shown that, in the past one week, prior to the survey 40.2% of the respondents ate starchy foods, 27.6% ate fruits and vegetables, 27.3% ate pastries and snacks, 24.8% ate any kind of dairy food, 20.7% took carbonated drinks and 15.6% ate fried foods frequently.



Frequently: 5-7 days a week

Occasionally: 3-4 days a week

Rarely: 1-2 days a week

Never: 0 days a week

Fig 4.3: Dietary habit of participants.

4.8. Physical activity level of respondents.

The table 4.5 shows the results of the physical activity level of the respondents. Amongst those who walked to school every day, 2.7% had pre diabetes. Amongst those who walked home from school daily 2.5% had pre diabetes and amongst those who had insufficient level of physical activity was 4.1% had pre diabetes.

Table 4.5: Physical activity level of respondents.

	Pre diabetes		Total
Characteristics	Yes (n = 19)	No (n =457)	
	N (%)	N (%)	
Walk to school everyday			
Yes	5(2.7)	181(97.3)	186(100.0)
No	14(4.9)	274(95.1)	288(100.0)
Walk from school everyday			
Yes	6(2.5)	235(97.5)	241(100.0)
No	13(5.7)	216(94.3)	229(100.0)
Physical activity level			
Insufficient	6(4.1)	142(95.9)	148(100.0%)
Sufficient	13(4.0)	315(96.0)	328(100.0)

4.9 Sedentary behavior of respondents

Table 4.6 shows sedentary behavior exhibited by respondents. The proportion of respondents with pre diabetes and non pre diabetes amongst those who spent less than two hours watching television was 3.7% vs. 96.3%.The proportion of respondents with pre diabetes and non pre diabetes amongst those who spent less than two hours playing video games was 6.2% vs. 93.8%.

Table 4.6: Sedentary behavior of respondents.

	Pre diabetes		Total
Behavior	Yes (n=19)	No (n=457)	
	N (%)	N (%)	
Daily television viewing			
Less than 2hours	10(3.7)	263(96.3)	273(100.0)
More than 2 hours	0(0.0)	54(100)	54(100.0)
Daily playing of video games			
Less than 2 hours	9(6.2)	136(93.8)	145(100.0)
More than 2 hours	0(0)	17(100)	17(100.0)

4.10 Proportion of respondents who had elevated blood pressure

The table 4.7 shows the proportion of participants who had elevated blood pressure. More than half 278(58.6%) had normal blood pressure, 156(32.9%) had pre- hypertension and 40(8.4%) were hypertensive.

Table 4.7: Proportion of respondents who had elevated blood pressure

Blood pressure	Frequency	Percentage (%)
Normal	278	58.7
Pre-hypertension	156	32.9
Hypertension	40	8.4
Total	474	100.0

4.10 Proportion of respondents who had elevated blood pressure

The table 4.7 shows the proportion of participants who had elevated blood pressure. More than half 278(58.6%) had normal blood pressure, 156(32.9%) had pre- hypertension and 40(8.4%) were hypertensive.

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Blood pressure	Frequency	Percentage (%)
Normal	278	58.7
Pre-hypertension	156	32.9
Hypertension	40	8.4
Total	474	100.0

4.11 Proportion of respondents who are overweight/obese.

Table 4.8 shows the Body Mass Index distribution of the study participants. Majority of the respondents 80.2% were observed to be underweight while 6.4%. were overweight.

Table 4.7: Proportion of respondents who are overweight/obese

BMI category	Frequency	Proportion
Underweight	388	80.2
Normal	65	13.4
Overweight	31	6.4
Total	484	100

4.12 Proportion of respondents with family history of Diabetes.

Table 4.8 indicates the proportion of respondents who had a 1st and 2nd degree family with diabetes. The result shows that 19(4.1%) of the respondents had a 1st degree family with diabetes while 67 (14.5%) had a 2nd degree family with diabetes.

Table 4.9: Proportion of respondents with family history of diabetes.

	Frequency	Percentage (%)
1st degree relation		
Positive	19	4.1
Negative	446	95.9
Total	465	100.0
2nd degree relation		
Positive	67	14.5
Negative	396	85.5
Total	463	100.0

4.13: Proportion of respondents in the pre-diabetes stage

Table 4.10 shows the percentage distribution of respondents glycemic status. 19(3.8%) of the respondents had Impaired fasting glycemia and 14(2.9%) had hypoglycemia.

Table 4.10: Proportion of respondents in the pre-diabetes stage

Glycemic level	Frequency	Proportion
Normal	443	88.6
Hypoglycaemia	14	2.9
Impaired fasting glycemia	19	3.8
Total	476	100

4.14 Respondents awareness of diabetes

Figure 4.4 below shows that most of the respondents (86%) have heard of diabetes before the screening while 14% were not aware.

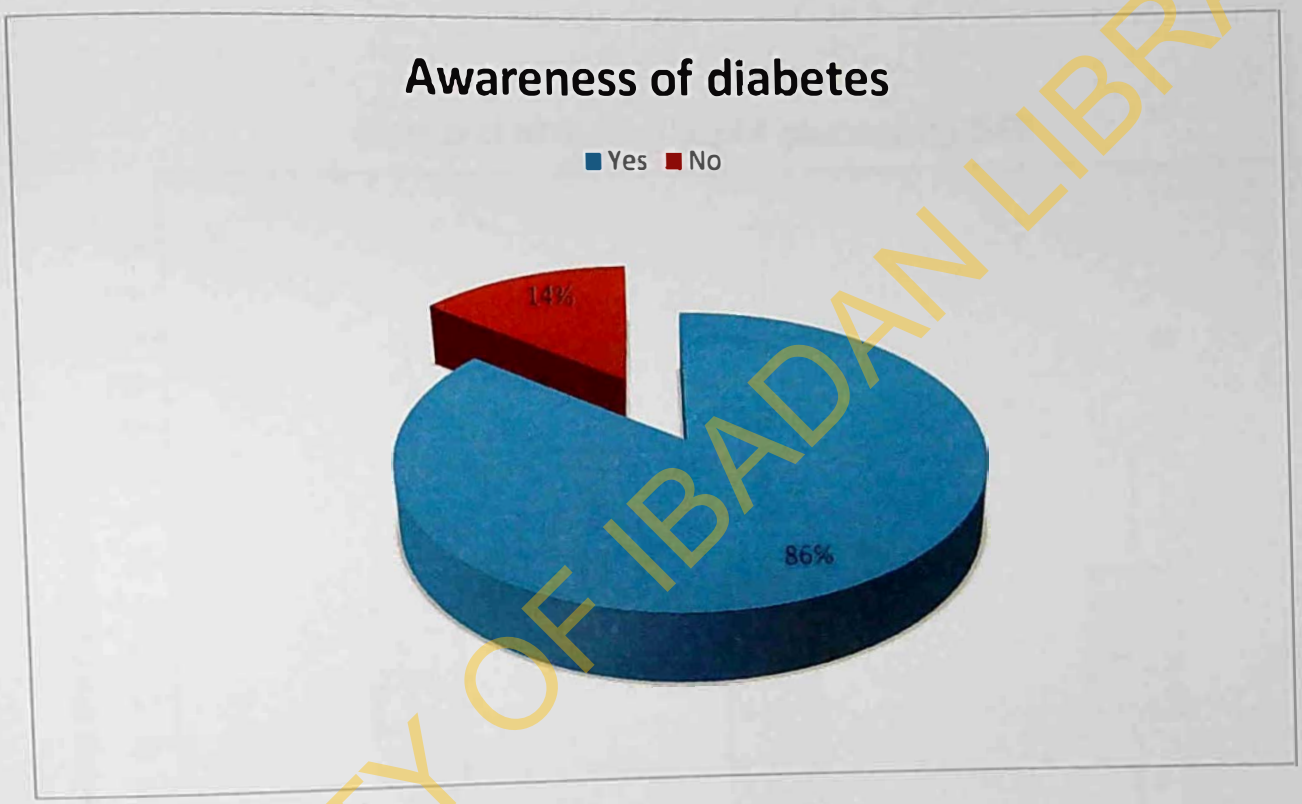

Figure 4.4: Respondents awareness of diabetes

4.15 Respondents fasting blood glucose by BMI

The figure below shows a box plot of the respondents fasting blood glucose against BMI, it is shown that respondents who have normal weights and overweight have the same median, however their median is higher when compared to that of those who are underweight. It also showed that there are outliers amongst those who were overweight.

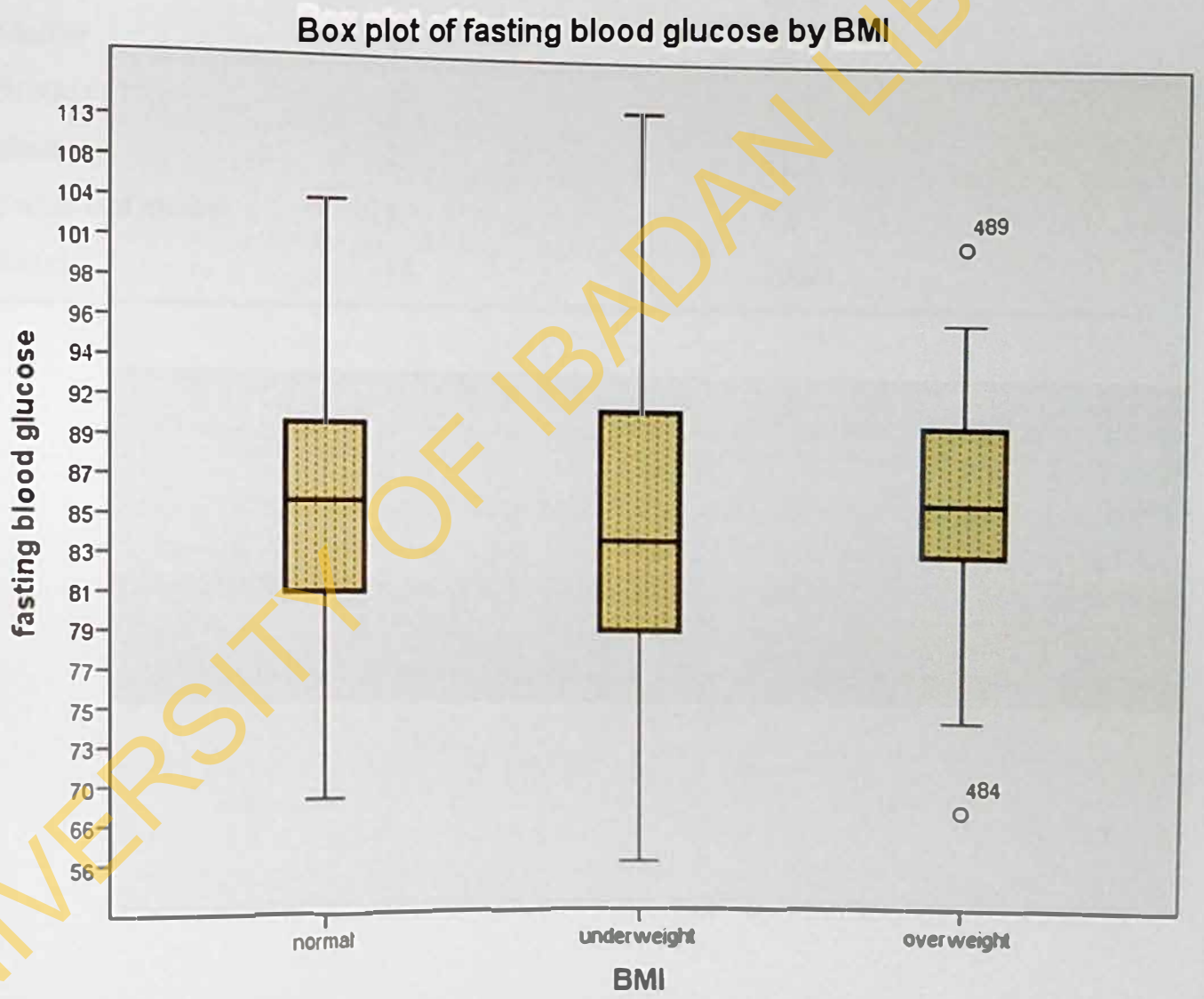

Fig 4.5 Respondents fasting blood glucose by BMI

4.16: First degree family who had diabetes

The table below indicates the 1st degree relatives who were reported to have diabetes amongst the respondents 44.4% had fathers with diabetes and 22.2% had mothers with diabetes.

Table 4.11: First degree family who had diabetes

Relation	Frequency	Proportion
Self	1	5.6
Father	8	44.4
Mother	4	22.2
Brother	2	11.1
Sister	2	11.1
Father and mother	1	5.6
Total	18	100.0

4.17: Second degree family who had diabetes

Table 4.12 below shows the proportion of 2nd degree relatives who were reported to have diabetes amongst the respondents, 56.5% had grandparents with diabetes and 17.4% had uncles, with diabetes.

Table 4.12: Second degree family who had diabetes

Relation	Frequency	Proportion
Uncle	12	17.4
Aunt	7	10.1
Cousin	8	11.6
Grandparents	39	56.5
Other members	2	2.9
Total	69	100.0

4.18: Association between pre diabetes and its risk factors.

Table 4.13 shows the relationship between pre diabetes and some of its determinants. Out of the respondents who attended private school, 16(4.9%) had pre diabetes and amongst those who attended public school, 3(2.0%) had pre diabetes. This association was however not statistically significant (x^2= 0.03, p = 0.86). Amongst those who had hypertension, 3(7.5%) had pre diabetes, and amongst those who had pre hypertension 7(4.6%) had pre diabetes, the association was not statistically significant (x^2= 1.61, p = 0.45).

4.18: Association between pre diabetes and its risk factors.

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Table 4.13: Association between pre diabetes and its risk factors

	Pre diabetes				
	Yes	No	Total	X^2	p-value
Sex					
Male	10(4.5)	211(95.5)	221(100.0)	0.306	0.580
Female	9(3.5)	246(96.5)	255(100.0)		
Age					
10-14	9(3.8)	229(96.2)	338(100.0)	0.069	0.793
15-19	10(4.3)	225(95.7)	235(100.0)		
Type of school					
Public	3(2.0)	149(98.0)	152(100.0)	2.373	0.123
Private	16(4.9)	308(95.1)	324(100.0)		
Fruits and Vegetables					
Not frequently	13(3.8)	326(96.2)	339(100.0)	0.187	0.665
Frequently	6(4.7)	121(95.3)	127(100.0)		
Eat Pastries					
Not frequently	11(3.2)	331(96.8)	342(100.0)	2.377	0.123
Frequently	8(6.4)	117(93.6)	125(100.0)		
Carbonated drinks					
Not frequently	14(3.8)	351(96.2)	365(100.0)	0.502	0.479
Frequently	5(5.5)	86(94.5)	91(100.0)		
Physical activity					
Insufficient	5(4.1)	142(95.9)	147(100.0)	0.002	0.963
Sufficient	13(4.0)	315(96.0)	328(100.0)		
Blood pressure					
Normal	9(3.4)	258(96.6)	267(100.0)	1.612	0.447
Pre- hypertension	7(4.6)	146(95.4)	153(100.0)		
Hypertension	3(7.5)	37(92.5)	40(100.0)		

4.19 Association between blood pressure and pre diabetes

Table 4.14 shows bivariate analysis of blood pressure and pre diabetes. Amongst those who had pre hypertension, 7(4.6%) had pre diabetes, and amongst those who hypertension, 3(7.5%) had pre diabetes. The association was however not statistically significant (x^2 =1.612, p = 0.447).

Table 4.14: Association between blood pressure and pre diabetes

	Pre diabetes			
	Yes	No	Chi square value	p-value
Blood pressure				
Pre hypertension	7(4.6)	146(95.4)		
Normal	9(3.4)	258(96.6)	1.612	0.447
Hypertension	3(7.5)	37(92.5)		

4.20: Association between physical activity and pre diabetes

The table below shows the bivariate analysis of physical activity and pre diabetes. Amongst the respondents who had sufficient physical activity, 13(4.0%) had pre diabetes while amongst those who had insufficient physical activity 6(4.1%) had pre diabetes. The association was however not statistically significant. ($x^2 = 0.002$, $p = 0.96$).

Table 4.15: Association between physical activity and pre diabetes

	Pre diabetes			
	Yes	No	X^2	p value
Physical activity				
Insufficient	6(4.1)	142(95.9)		
Sufficient	13(4.0)	315(96.0)	0.002	0.96

4.21: Association between dietary habit and pre diabetes.

Table 4.16 shows that amongst those who ate fruit and vegetables frequently, 10(30.3%) had pre diabetes while amongst those who did not eat fruits and vegetables frequently 23(69.7%) had pre diabetes. The association however was not statistically significant (x^2 = 0.17, p= 0.68).

Table 4.16: Association between dietary habit and pre diabetes

	Pre diabetes			
	Yes	No	X^2	p-value
Eat fruits and vegetables				
Not frequently	23(69.7)	316(73.0)		
Frequently	10(30.3)	117(27.0)	0.167	0.68

4.22: Comparison of mean glycemic level by respondents' characteristics.

Table 4.17 shows the comparison of mean glycemic level by the respondents' characteristics. There is a statistically significant difference (t 474 = -2.476, p= 0.001) in the mean glycemic level of pupils who attend public schools (0.967±0.27) and those who attend private schools (1.031±0.26). Mean glycemic level of males (86.23±7.9) is statistically significantly different (t 474 = 2.186, p= 0.024) compared to females (84.58±8.54). There was however no statistically significant difference in the mean glycemic level between the groups of physical activity level (t 474 = -8.38, p= 0.403) and blood pressure (t 458 = 0.633, p= 0.527).

Table 4.17: Comparison of mean glycemic level by respondents characteristics

Characteristics	Mean	Standard deviation	t	P value
Sex				
Male	86.23	7.9		
Female	84.58	8.5	2.186	0.024
Type of school				
Public	83.54	8.2		
Private	86.19	8.2	-3.286	0.001
Physical activity				
Insufficient	84.87	8.7		
Sufficient	85.56	8.1	-8.38	0.403
Blood pressure				
Normotensive	85.47	8.06		
Hypertensive	84.60	10.9	0.633	0.527

Table 4.17: Comparison of mean glycemic level by respondents characteristics

Characteristics	Mean	Standard deviation	t	P value
Sex				
Male	86.23	7.9		
Female	84.58	8.5	2.186	0.024
Type of school				
Public	83.54	8.2		
Private	86.19	8.2	-3.286	0.001
Physical activity				
Insufficient	84.87	8.7		
Sufficient	85.56	8.1	-8.38	0.403
Blood pressure				
Normotensive	85.47	8.06		
Hypertensive	84.60	10.9	0.633	0.527

4.23: BMI and Mean glycemic level

Table below shows that mean glycemic level was not significantly different (F= 0.107, p = 0.89) across the BMI groups: overweight (86.00±6.2), underweight (85.32±7.4) and normal (85.59±8.6).

Table 4.18: BMI and Mean glycemic level

BMI	Mean	Standard deviation	F	P value
Underweight	85.32	7.44	0.107	0.898
Normal	85.59	8.63		
Overweight	86.00	6.230		

4.24: Factors associated with pre-diabetes

Table 4.19 below shows the results of the logistic regression of pre diabetes and its determinants. Those who had pre hypertension had a 24% higher chance of developing pre diabetes (OR = 1.240, 95% C.I= 0.438-3.511, p = 0.69) compared to those who had normal blood pressure, likewise respondents' who had hypertension had a 41% chance (OR = 2.42, 95% C.I= 0.60-0.69, p = 0.21) compared to those who had normal blood pressure.

Table 4.19: Factors associated with pre-diabetes

Variable	Odds ratio	95% Confidence Interval	P value
Sex			
Female (ref.)	1.000		
Male	0.320	0.277-2.116	0.607
Type of school			
Private (ref)	1.000		
Public	0.320	0.083 – 1.231	0.097
Physical activity			
None (ref.)	1.000		0.188
Insufficient	0.212	0.037-1.224	0.083
Sufficient	0.325	0.081-1.298	0.112
Blood pressure			
Normal(ref)	1.000		0.365
Pre hypertension	1.240	0.438-3.511	0.626
Hypertension	2.419	0.604-9.697	0.243
BMI			
Underweight (ref.)	1.000		0.343
Normal	0.238	0.030-1.894	0.175
Overweight	0.504	0.062-4.074	0.520

4.25: Factors associated with Pre diabetes.

This table shows the results of logistic regression of pre diabetes and dietary habit. It shows that those who ate fried foods frequently had a 55% chance of (OR = 1.55, 95% C.I = 0.412-5.862, p = 0.52) having pre diabetes compared to those who did not eat fried foods frequently. Also those who took carbonated drinks (OR = 1.09, 95% C.I = 0.318 – 3.753, p = 0.89) and ate pastries and snacks (OR = 2.28, 95% C.I = 0.77-6.70, p = 0.14) frequently had a 9% and 27% respectively higher chance of being pre diabetic.

Table 4.20: Factors associated with pre diabetes.

Variable	Odds ratio	95% Confidence interval	P value
Skip breakfast			
Not frequently (ref)	1.000		
Frequently	0.674	0.085-5.363	0.709
Eat starchy foods			
Not frequently (ref)	1.000		
Frequently	0.721	0.257-2.022	0.534
Eat fried foods			
Not frequently (ref)	1.000		
Frequently	1.554	0.412-5.862	0.515
Eat fruits and vegetables			
Not frequently	1.000		
Frequently	0.930	0.295-2.927	0.907
Take carbonated drinks			
Not frequently	1.000		
Frequently	1.092	0.318-3.753	0.889
Eat pastries/snacks			
Not frequently	1.000		
Frequently	2.279	0.774-6.705	0.135

4.26 Factors associated with Pre diabetes

Table 4.21 shows a logistic regression analysis of factors associated with pre diabetes. For every unit change in weight of the respondents, there is a corresponding 0.951 (95% C.1= 0.890-1.017, p = 0.140) decrease in the fasting blood glucose. There was also a corresponding 1.029 increase in the fasting blood glucose for every unit increase in the SBP. (95% C.1= 0.980-1.081, p = 0.249)

Table 4.21: Factors associated with Pre diabetes

Variable	Odds ratio	95% C.I	P value
Weight	0.951	0.890– 1.017	0.140
Systolic blood pressure	1.029	0.980 – 1.081	0.249
BMI for Age	1.389	0.898 – 2.148	0.140

4.27: Factors associated with mean glycemic level.

Table 4.22 below shows the results of linear regression of glycemic level and some of its predictors. It is observed that for every unit change in the BMI for age and systolic blood pressure there is a corresponding positive increase in the fasting blood glucose. (β = 0.250, 95% C.I= -0.255-3.264, p = 0.089) and (β = 0.025, 95% C.I= -0.63-0.102, p = 0.645) respectively. However, this increase is not statistically significant.

Table 4.22: Factors associated with mean glycemic level.

Variables	B	Confidence Interval	P value
BMI for Age	0.250	-0.255 – 3.264	0.088
Age	0.083	-0.244 – 1.141	0.204
Systolic blood Pressure	0.025	-0.63 – 0.102	0.645

CHAPTER FIVE

DISCUSSION

5.1 Socio demographic characteristics

Majority of the respondents who had pre diabetes in this study were in the age group 15-19. Males and private school students were predominant amongst those who had pre diabetes. There were more Christians, and yorubas amongst the respondents' who had pre diabetes. Amongst those who had pre diabetes, majority reported their mothers and fathers to be traders.

5.2 Prevalence of pre-diabetes

In this study, only 3.8% of the study participants had impaired fasting glycemia (IFG), also referred to as pre diabetes. However, one (0.2%) of the study participants from a private school confirmed having diabetes and has been undergoing treatment while others were newly diagnosed of pre diabetes. Expectedly, studies from developed countries report higher prevalence of diabetes and impaired blood glucose compared to developing countries. For example a study amongst 4370 adolescents in the United States reported a prevalence of 11% (Duncan G.E 2006). A similar study also carried out in the US to estimate the prevalence of IFG and pre-diabetes among adolescents using data from nationally representative samples reported an unadjusted prevalence of IFG, IGT, and pre-diabetes as 13.1%, 3.4%, and 16.1%, respectively where boys had a 2.4-fold higher prevalence of pre-diabetes than girls, this is comparable to my finding where the occurrence of impaired blood sugar was higher among boys. In a study conducted in rural South African community to determine the prevalence of pre-diabetes among persons from age 15 a prevalence of 1.5% was reported (Motala et al. 2008).

In Nigeria, only one published article has documented the screening of school adolescents for diabetes using the presence of glycosuria. A prevalence of 0.7% was reported in this study with males accounting for the higher proportion of adolescents with

diabetes (Bassey, Peterside 2012). Rate obtained from this study is low and could be attributed to the method (glycosuria) used in the screening, since blood is the gold standard of screening for diabetes.

5.3 Mean glycemic level

This study showed that students, who attended private schools, had a higher mean glycemic level compared to those who attended public schools. This could be attributed to the high socio economic class of students who attend private schools, students who belong to this group could afford to eat more snacks and pastries, and seldom partook in physical activity because of their reliance on automobile and automated gadgets, they also have access to domestic staffs which further reduces their level of physical activity. Studies have revealed that the prevalence of the metabolic syndrome significantly increases with high socio-economic status in both developing and developed countries. (Agirbasli M et al. 2006, Mirhosseini NZ et al. 2009, Buckland G 2008). This is also supported by a cross-sectional assessment conducted amongst a representative sample of 693 high-school students in Vietnam in 2007, where a positive association was reported between metabolic syndrome and socioeconomic status students who were in the high socio economic class from wealthy families and were physically inactive because their parents usually provide them with a "modern" life, including up-to-date recreational facilities such as televisions, computers, and other technical household devices and helpers that reduce the level of activity needed for daily household chores. Besides, wealthier families are more likely to be able to purchase ample food including energy dense foods and drinks. (Trang HHD Nguyen et al. 2010)

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5.4 Risk factors of Pre diabetes

5.4.1 Prevalence of Obesity

In this study the prevalence of overweight and obesity were 4.8% and 1.7% respectively, with the private schools contributing the higher proportion of the overweight participants. This can be attributed to the unhealthy dietary habit amongst these students. As these students consumed more snacks, took carbonated drinks frequently and visited fast food restaurants regularly. This finding is comparable to findings of other researchers in Nigeria, with prevalence rates of obesity among adolescents ranging from 0.3% - 5%. (Ansa VO et al, 2000; Akinpelu A.O et al, 2008 ; Ben- Bassey UP et al, 2007 ; Senbanjo IO et al, 2007). The United States Preventive Services Task Force (USPSTF) has reported the prevalence of overweight/ obesity to be as high as 13-14% amongst children and adolescents. In developing countries a rise in the occurrence of childhood and adolescent obesity is also being observed especially in the urban areas because of a change in lifestyle due to increased affluence. It has been shown that this change in lifestyle is an important factor in the global epidemic of overweight and obesity. A cross-sectional prospective survey carried out on a sample of 1504 randomly selected adolescents, from six public secondary schools in Lagos Nigeria assessed the influence of lifestyle and socioeconomic class on the prevalence of overweight and obesity amongst adolescents from rural and urban centres. The overall prevalence rates obtained for overweight and obesity in the urban area was higher (3.7% vs 0.4%), than in the rural areas (3.0% and 0.0%) (Ben-Bassey et al. 2007). In another study Bamidele et al. (2011) to determine the prevalence and socio-demographic determinants of under-weight and pre-obesity among in-school adolescents in a Local Government Area in Osun state Nigeria, none of the study participants was obese while 3.8% of them were pre-obese and 41.3% of them were underweight. Findings from this study showed that respondents' gender, parents employment status, higher educational level of mothers, being a first child, and living with both parents was a major determinant of the pre-obese status.

Ben-Bassey, (2007) stated that change in lifestyle is an important factor in the global epidemic of overweight and obesity that is observed in many of the urban centres of the

developing countries, this can be explained by results of the school based survey carried out by Oduwole Abiola, (2012) to determine the prevalence of obesity among Nigerian adolescents. It was reported that the prevalence of overweight and obesity were 13.8% and 9.4%, respectively and the high prevalence could be attributed to the high socio economic status of these respondents, who were described as being physically inactive, because they relied on being conveyed to school by drivers and had access to junk food and snacks.

5.4.2 Prevalence of Hypertension

Pre-hypertension and hypertension was observed amongst the adolescents in this study. Pre hypertension was more common amongst respondents from private schools than public schools. It was also observed that there were more females who were pre hypertensive. This prevalence is higher compared to one reported in a cross-sectional study in Central Delhi involving all 315 students of 9(th) and 11(th) grades. The findings showed that 1.6% had systolic hypertension while 4.1% of the participants were systolic pre-hypertensive. BMI and gender were found to be independent predictors for systolic hypertension (Anand et al, 2014). In another school-based study Oduwole et al. (2012) reported the prevalence of male systolic pre-hypertension was 1.6% and that of female students was 0.4%. These studies show that hypertension is fast emerging as a major health problem amongst school adolescents, particularly in urban areas. Hence, the need for investigation and routine blood pressure screening for prompt referral of students with elevated blood pressure and to rule out the secondary causes of elevated BP such as renal failure and heart diseases.

5.4.3 Prevalence of Physical inactivity and sedentary behavior

Physical inactivity and sedentary behavior is linked to obesity which is a major risk factor for diabetes. In this study, insufficient physical activity and no physical activity at all was

observed majorly amongst children of the high socio economic class. This can be explained by an undue dependence on appliances for daily house chores as some of these adolescents reported having either a vaccum cleaner or washing machine, hence no active participation in house chores. Whereas, adolescents from the public schools reported having to wash their own clothes and those of other family members.

Also, females were more physically inactive compared to males, they reported not willing to participate in school physical activities hence they stayed back at their classes however the boys were always willing to attend physical activity classes. Sedentary behavior was observed more amongst the private school students who spend more than 2hours a day watching television.

In a study Ceschini et al. (2009) carried out to determine the prevalence of physical inactivity and associated factors among 3,845 high school students from state's public schools in the city of São Paulo, prevalence of physical inactivity among the adolescents was 62.5%. It was observed from this study that physical inactivity among adolescents was high in all the geographic areas evaluated, and that socio demographic and behavioral factors contributed significantly to physical inactivity. Also, in another study kiiiiiy67to estimate the prevalence of physical inactivity among adolescents in the city of Maringá. A prevalence of 56.9% was reported for physical inactivity amongst the respondents. In another cross-sectional study to report time and prevalence of leisure time, sedentary and active behaviors in adolescents from schools in 14 districts in Scotland, it was observed that television viewing occupied the most leisure time, a minority watched more than 4 h of TV per day, with more at weekends. Other main sedentary behaviors for boys were homework, playing computer/video games, and motorized transport and, for girls, homework, motorized transport, and sitting and talking. (Biddle et al. 2009)

5.4.4 Predictors of Pre diabetes

A study carried out amongst adolescents in the United States. C. Li et al. (2009) documented that overweight adolescents had a 2.6-fold higher rate than those with normal weight. This result can be compared to another study to determine whether long term weight gain and weight loss are associated with subsequent risk of type 2 diabetes in overweight, non-diabetic adults. It was observed that there was a significant increase in diabetes risk after minor weight gain. (Helaine E Resnick et al. 2000). Motala et al. (2008) also identified that the independent risk factors associated with diabetes included family history, other risks factor for diabetes was reported by Reinehr, Thomas (2013), in a study carried out to access the risk factors of type 2 diabetes amongst children and adolescents, it was documented that mean age, gender, obesity and 1st and 2nd degree family history was found to be the major determinants. In a study to assess the prevalence of risk factors for T2DM, 1066 fifth-grade children were screened using American Diabetes Association guidelines, children who reported watching TV/playing video games 2 or more hours/day, were 73% more likely, to be at risk.(Urrutia-Rojas & Menchaca 2006)

Carter et al. (2010) in a study carried out to investigate the independent effects of intake of fruit and vegetables on incidence of type 2 diabetes reported that greater intake of green leafy vegetables was associated with a 14% reduction in risk of type 2 diabetes. Also, increased daily intake of green leafy vegetables significantly reduced the risk of type 2 diabetes, however in this study fruits and vegetables intake was not a major predictor of diabetes amongst the adolescents, it however showed an association between dietary habit and pre-diabetes. It was observed that those who took carbonated drinks, skip breakfast, and ate starch foods frequently had about 6%, 19% and 56% higher risk respectively of developing pre diabetes.

Fletcher et al. (2002), in a systematic review listed that genetic, environmental, and metabolic risk factors are interrelated and contribute to the development of type 2 diabetes mellitus, and individuals with a strong family history of diabetes mellitus, age, obesity, and physical inactivity had the highest risk for developing type 2 diabetes.

In a study conducted in Ho Chi Minh City, Vietnam, physical inactivity was identified as a risk factor for metabolic syndrome. It was reported that those who spent <43 minutes/day had a higher risk of developing metabolic syndrome compared to those who spent >103 minutes/day on moderate to vigorous physical activity. (Trang HHD Nguyen, et al. 2010).

5.5 CONCLUSION

Pre-diabetes a condition which precedes diabetes is 3.8% prevalent amongst adolescents in Ibadan South West Local government area. Although the prevalence is low, the risk factors for pre diabetes was observed in this population, it however suggests that precautionary measures should be taken which includes screening for the risk factors of diabetes and other chronic diseases at an early stage, and schools provides an effective platform for this. Also it is shown that socioeconomic status of parents and sex of the respondents was a major determinant of glycemic level. In conclusion, the risk factors for diabetes were prevalent among adolescents in this community especially those who attended private schools which served as a proxy for high socio economic class. Some of the limitations of this study were mis- classification of the mother as having gestational diabetes, it was a cross sectional study, causal inference could not be made and some of the participants may not be residing with their parents hence, lack of information on family history of diabetes. This study has been useful and as served as a baseline data to determine the prevalence of pre-diabetes amongst these adolescents and also to assess its risk factors.

5.6 RECOMMENDATION

Intervention measures for schools

- Healthy eating should be encouraged amongst school students.
- Physical activity should be encouraged amongst the students by incorporating a compulsory physical activity of not less than 30 minutes into all schools daily time table.

Screening for Risk factors

- Policies should be put in place that will encourage routine screening in schools, not just for diabetes but also other metabolic diseases and their risk factors
- Blood Pressure check-up for children and adolescents is thus recommended to take remedial action on time.
- Regular screening of the students for diabetes is advised for preventing the emergence of complications later in life

Research

- It is recommend that more studies should be carried out in amongst children and adolescents, as this study could cover limited number of adolescents.

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APPENDIX II

RISK ASSESMENT OF DIABETES MELLITUS AND MEAN GLYCEMIC LEVEL OF SECONDARY SCHOOL ADOLESCENTS IN IBADAN SOUTH WEST LOCAL GOVERNMENT AREA, NIGERIA.

Informed consent form

My name is Arigbede Oluwakemi, a postgraduate student of the Faculty of Public Health. University of Ibadan, Oyo state. Nigeria. Due to the recent rise in the incidence of Type 2 Diabetes amongst Adolescents, I am carrying out a research to access the risk of diabetes mellitus and mean glycemic level amongst school aged adolescents in this community. In this study, you will be asked questions about your dietary pattern, physical activities. Finger will be pricked with a sterilized needle to measure random blood glucose, heights, weight and blood pressure will be taken. The process of taking these measurements will not cause you any harm or injury.

Please note that answers provided will be treated with confidentiality and would not be exposed to a third party. You have the right to choose whether or not to participate in this study. Marks will not be awarded for right or wrong answer. The information you give will be utilized to develop programs and also help to find a solution to this condition.

By signing below, you have agreed to partake in the study.

....

Signature/Thumbprint of Participant Interview Date

APPENDIX III

SECTION A: SOCIO-DEMOGRAPHIC CHARACTERISTICS

1. Sex: (1) Male ☐ (2) Female ☐
2. How old were you as at your last birthday? ☐☐
3. What class/form are you in? ☐☐
4. What is your ethnicity: (1) Hausa ☐ (2) Igbo ☐ (3) Yoruba ☐ (4) Others _____
5. What is your religion? (1) Christianity ☐ (2) Islam ☐ (3) Traditional ☐ (4) Others (Specify)_____
6. Who do you presently live with? (1) Both parents ☐ (2) Father alone ☐ (3) Mother alone ☐ (4) Brother/Sister ☐ (5) other relatives ☐ (6) Other *(please specify)*.....
7. What is your birth position? (1) First ☐ (2) Second ☐ (3) Third ☐ (4) Fourth ☐ (5) Other *(please specify)* _____
8. How many brother/sisters do you have? _____
   What is your Father's highest level of education (1) No formal education ☐ (2) Primary School ☐ (3) Secondary school ☐ (4) Post-secondary (5) Tertiary
9. What is your Mother's highest level of education (1) No formal education ☐ (2) Primary School ☐ (3) Secondary school ☐ (4) Post-secondary (5) Tertiary
10. What is your Father's Occupational status (1) Civil servant (2) Health professional (3) Trader (4) Farmer (5) others(specify)_____
11. What is your Mother's Occupational status? (1) Civil servant (2) Health professional (3) Trader (4) Farmer (5) others(specify)_____
12. Your parents are currently (1) Living together (2) Divorced (3)Separated (4)Widowed

Which of these household items do you have in your house?

13. Car	(1). Yes (2) No	19. Motorcycle	(1). Yes (2) No
14. Television	(1). Yes (2) No	20. Radio	(1). Yes (2) No
15. Air conditioner	(1). Yes (2) No	21. Kerosene stove	(1). Yes (2) No
16. Washing machine	(1). Yes (2) No	22. Running tap	(1). Yes (2) No
17. Generator	(1). Yes (2) No		
18. Electric cooker	(1). Yes (2) No		

23. What type of house do you live in? (1) Private flat (2) Rented flat (3) face me and face you (4) Shop (5) Others (specify)_____

SECTION B: FOOD CONSUMPTION PATTERN

In the past 24 hours (yesterday), list out the foods you ate

24.	Breakfast	
25.	Snacks	
26.	Lunch	
27.	Snacks	
28.	Dinner	

Food frequency questionnaire.

In the past 7days , how many times did you?

Food groups	Never(0time)	Rarely(1-2times)	Occasionally (3-4 times)	Frequently (5-7 times)
Skip breakfast?				
Eat starchy foods e.g. Rice, spaghetti, garri/eba, yam				
Eat Fried foods e.g. potato chips, French fies. e.t.c				
Eat dairy products e.g. Milk, cheese, egg e.t.c				
Eat cereals e.g. Corn flakes, golden morn, pap, custard, oats e.t.c.				
Eat fruits and vegetables e.g. Oranges, mango, pine apple, watermelon e.t.c.				
Eat legumes e.g beans, soya beans, akara, moin moin?				
Eat carbonated drinks e.g: coke, pepsi, sprite, Fanta e.t.c				
Eat pastries/ snacks e.g. Meat/chicken pie, dough nuts, hamburger, chin-chin, cakes e.t.c				

38. In the past one month, how many times have you eaten at a fast food restaurant e.g. Mr Biggs, Tantalizer e.t.c (1) Once (2) 2 times (3) 3 times (4) 4 times (5) 5 times (6) others_____

SECTION C: PHYSICAL ACTIVITIES

39.	Do you have Physical Health Education (P.H.E) in your school?	(1). Yes (2). No
40	In a week day when you are in school, on how many days do you participate in sports activities?	One (2) two (3)three (4) four
41	During P.H.E, how many minutes do you spend exercising or playing sports	Less than 60 minutes (2) more than 60 minutes
42	Do you have inter-house sport in your school?	(1). Yes (2). No
43	How often is it done?	Once a year (2) twice a year.
44	Do you participate in any activity during the inter house sports?	(1). Yes (2). No
45	Which sporting activity do you participate in?	
46	How do you get to school in the morning?	By bus/car (2) Bike (3) Walking
47	If walking, How many minutes do you spend?	Less than 30 minutes (2) more than 30 minutes
48	How do you get home from school?	By bus/car (2) Bike (3) Walking
49	If walking, How many minutes do you spend	Less than 30 minutes (2) more than 30 minutes

Every day, how many minutes do you spend on each of these activities?

		Yes	No	Average minutes
50.	Walking to school?			
51.	Walking from school?			
52.	Participating in sporting activities e.g football, basketball, tennis e.t.c			
53.	Jogging			
54.	Sweeping the floor?			
55.	Fetching water?			
56.	Washing?			
57.	Skipping?			
58.	Riding bicycle?			
59.	Swimming			
60.	Running			
61.	Watching television?			
62.	Playing video games e.g play station			
63.	Others			

Physical activities engaged in in the past 7 days

		Yes	No	Average mins
64	Walking to school?			
65.	Walking from school?			
66.	Participating in sporting activities e.g football, basketball, tennis e.t.c			
67.	Jogging			
68.	Sweeping the floor?			
69.	Fetching water?			
70.	Washing?			
71.	Skipping?			
72.	Riding bicycle?			
73.	Swimming			
74.	Running			
75.	Watching television?			
76.	Playing video games e.g play station			
77.	Others			

78. During weekdays, how many minutes do you spend watching television? (1) less than 2 hours (2) more than 2 hours

79. During weekends how many minutes do you spend watching television? (1) less than 2 hours (2) more than 2 hours

SECTION D: FAMILY HISTORY INFORMATION

80. Have you ever heard of Diabetes? 1. Yes 2. No 3. I don't know
81. If yes, what is the source of information? (1) television (2) parents (3) others _____
82. Has anyone in your immediate family ever been diagnosed of Diabetes? (1) Yes (2) No
83. If yes, who? (1) father (2) mother (brother (4) sister (5) others_____
84. Has anyone other relative or extended family ever been diagnosed of diabetes?
85. If yes, who? (1) uncle (2) aunt (3) cousin (4) grand-parents (5) others_____
86. What was your birth weight when you were born?
87. Did your mother have high blood pressure when she was pregnant? (1). Yes (2). No
88. Has your mum ever had diabetes before? (1). Yes (2). No (3). I don't know
89. Did your mother have elevated blood glucose or diabetes when she was pregnant? (1). Yes (2). No

SECTION E: MEASUREMENTS

90.	Fasting Blood glucose (mg/dl)	
91.	Weight (Kg)	
92.	Height (cm)	
93.	Systolic Blood pressure (mmHg)	
94.	Diastolic Blood pressure (mmHg)	

Thank you.

APPENDIX IV

LIST OF PRIVATE SCHOOLS IN ISWLG

1. Abbey standard college Ososami
2. Access college odutola, Oke ado
3. Adem sec school, liberty rd
4. Apostolic faith sec school
5. Atanda international high school
6. Atanda neigbourhood high school, oluyole
7. Bambo academy Apata ring rd
8. Benatad royal college
9. Bevy high school College crescent
10. Brightest star college
11. Christ Amb intl schl Oluyole est
12. Christ the redeemer sec school oluyole
13. Concord college Ring rd
14. Dominion college
15. ECWA model college challenge
16. Ephraim college
17. Firm foundation college
18. Foremost college Ring rd
19. Genius royal academy Challenge
20. Glorious college
21. Grace private school new Adeoyo
22. Great advocate college
23. Kambridge comprehensive college Oni and sons
24. Kingdom comprehensive college Fodacis
25. Leaders high school
26. Mighty miracle college Oke bola
27. Mount rose high school
28. Muslim model college Oke ado ib
29. New cross college gloruious college
30. Oaks view college Oluyole est
31. Oke ado baptist comprehensive college, Oke ado
32. Olapade agoro L.H.S apata
33. Oluyole private college Oluyole est
34. Omoniyi intl college bembo Apata
35. Oritamefa baptist model Oluyole
36. Pen junior secondary school Iyaganku
37. Pethil comprehensive college apata
38. Praise academy

39. Qiblah high school, aleshinloye
40. Rhema chapel intl college oke ado
41. Rochas intl college oke ado
42. Sacred heart college akinyemi way
43. Sacred heart sec school oke ado
44. St catherine college Aleshinloye
45. St james cathedral college Oke bola
46. Standhope intl college Oke ado
47. Sunshine intl high school Ntc rd
48. The amazing grace high school
49. The front runner college
50. The vale college iyaganku GRA
51. United missionary comp. Coll Molete
52. Victory Christian academy Oluyole

APPENDIX V

LIST OF PUBLIC SCHOOLS IN ISWLG

1. A.U.D Sec Shool Oke Ado
2. A.U.G High Schl Oke Ado
3. Adifase High School Apata
4. African Church Gram Schl Apata
5. Apata Comm grammar Schl
6. Apata Grammar School Logudu
7. Baptist Grammar School Idi-Isin
8. Baptist Sec School Oke Ado
9. Basorun Ogunmola High School Ring Rd
10. Celestial Church High School Oke Ado
11. Comm. Gram. Scl, Elewura, Challenge
12. Community Gram Schl Gbekuba
13. Community Gram School Ring Rd
14. Government College Apata
15. I.M.G Grammar School Sharp Corner
16. Ibadan Boys High School Oke Bola
17. Img High School Apata
18. Odo Ona Girls Grammar School Oke Ayo
19. Oke Ado High School,Oke Ado
20. Oke-Bola Comp High Schl, Oke –Bola
21. Oladipo Alayande Schl Of Sci Oke Bola
22. Oluyole Est Gram Schl Oluyole Est
23. Oluyole Ext. High School. Oluyole Est
24. Oluyole High School Ring Rd
25. Our Lady Of Apostle Odo-Ona (Mary Way)
26. Peoples Girls Grammar School Molete
27. Queens School Apata
28. St Theresas College Oke Ado
29. Urban Day Grammar School Ring Rd

APPENDIX VI

Girls SBP by Age and Height
(Normal SBP is less than the prehypertensive result.)

Age	BP Classification	Systolic BP (mmHg)						
3	Height (cm)	91	92	95	98	100	103	105
	Prehypertension	100	100	102	103	104	106	106
	Stage 1 HTN	104	104	105	107	108	109	110
	Stage 2 HTN	116	116	118	119	120	121	122
4	Height (cm)	97	99	101	104	106	110	112
	Prehypertension	101	102	103	104	106	107	108
	Stage 1 HTN	105	106	107	108	110	111	112
	Stage 2 HTN	117	118	119	120	122	123	124
5	Height (cm)	104	105	108	111	113	118	120
	Prehypertension	103	103	105	106	107	109	108
	Stage 1 HTN	107	107	108	110	111	112	113
	Stage 2 HTN	119	119	121	122	123	125	125
6	Height (cm)	110	112	115	118	122	126	128
	Prehypertension	104	105	106	108	109	110	111
	Stage 1 HTN	108	109	110	113	113	114	115
	Stage 2 HTN	120	121	122	124	125	126	127
7	Height (cm)	116	118	121	125	129	132	135
	Prehypertension	106	107	108	109	111	112	113
	Stage 1 HTN	110	111	112	113	115	116	116
	Stage 2 HTN	122	123	124	125	127	128	129
8	Height (cm)	121	123	127	131	135	139	141
	Prehypertension	108	109	110	111	113	114	114
	Stage 1 HTN	112	112	114	115	116	118	118
	Stage 2 HTN	124	125	126	127	128	130	130
9	Height (cm)	125	128	131	136	140	144	147
	Prehypertension	110	110	112	113	114	116	116
	Stage 1 HTN	114	114	115	117	118	119	120
	Stage 2 HTN	126	126	128	129	130	132	132
10	Height (cm)	130	132	136	141	145	150	153
	Prehypertension	112	112	114	115	116	118	118
	Stage 1 HTN	116	116	117	119	120	121	122
	Stage 2 HTN	128	128	130	131	132	134	134
11	Height (cm)	135	138	143	148	153	157	160
	Prehypertension	114	114	116	117	118	119	120
	Stage 1 HTN	118	118	119	121	122	123	124
	Stage 2 HTN	130	130	131	133	134	135	136
12	Height (cm)	143	146	150	155	160	164	166
	Prehypertension	116	116	117	119	120	120	120
	Stage 1 HTN	119	120	121	123	124	125	126
	Stage 2 HTN	132	132	133	135	136	137	138
13	Height (cm)	148	151	155	159	164	168	170
	Prehypertension	117	118	119	120	120	120	120
	Stage 1 HTN	121	122	123	124	126	127	128
	Stage 2 HTN	133	134	135	137	138	139	140
14	Height (cm)	151	155	157	161	166	170	172
	Prehypertension	119	120	120	120	120	120	120
	Stage 1 HTN	123	123	125	126	127	129	129
	Stage 2 HTN	135	136	137	138	140	141	141
15	Height (cm)	152	156	158	162	167	171	173
	Prehypertension	120	120	120	120	120	120	120
	Stage 1 HTN	124	125	126	127	129	130	131
	Stage 2 HTN	136	137	138	139	141	142	143
16	Height (cm)	152	156	158	163	167	171	173
	Prehypertension	120	120	120	120	120	120	120
	Stage 1 HTN	125	126	127	128	130	131	132
	Stage 2 HTN	137	138	139	140	142	143	144
17	Height (cm)	152	156	159	163	167	171	174
	Prehypertension	120	120	120	120	120	120	120
	Stage 1 HTN	125	126	127	129	130	131	132
	Stage 2 HTN	138	138	139	141	142	143	144

APPENDIX VII

Boys SBP by Age and Height
(Normal SBP is less than the prehypertensive result.)

Age ↓	BP Classification	Systolic BP (mmHg)						
3	Height (cm)	92	94	96	99	102	104	106
	Prehypertension	100	101	103	105	107	108	109
	Stage 1 HTN	104	105	107	109	110	112	113
	Stage 2 HTN	116	117	119	121	123	124	125
4	Height (cm)	99	100	103	106	109	112	113
	Prehypertension	102	103	105	107	108	110	111
	Stage 1 HTN	106	107	109	111	113	114	115
	Stage 2 HTN	118	119	121	123	125	126	127
5	Height (cm)	104	106	108	112	116	119	120
	Prehypertension	104	105	106	108	110	111	112
	Stage 1 HTN	108	109	110	112	114	115	116
	Stage 2 HTN	120	121	123	125	126	128	128
6	Height (cm)	110	112	115	119	122	126	127
	Prehypertension	105	106	108	110	111	113	113
	Stage 1 HTN	109	110	112	114	115	117	117
	Stage 2 HTN	121	122	124	126	128	129	130
7	Height (cm)	116	118	121	125	129	132	134
	Prehypertension	106	107	109	111	113	114	115
	Stage 1 HTN	110	111	113	115	117	118	119
	Stage 2 HTN	122	123	125	127	129	130	131
8	Height (cm)	121	123	127	131	135	139	141
	Prehypertension	107	109	110	112	114	115	116
	Stage 1 HTN	111	112	114	116	118	119	120
	Stage 2 HTN	124	125	127	128	130	132	132
9	Height (cm)	126	128	132	136	141	145	147
	Prehypertension	109	110	112	114	115	117	118
	Stage 1 HTN	113	114	116	118	119	121	121
	Stage 2 HTN	125	126	128	130	132	133	134
10	Height (cm)	130	133	137	141	146	150	153
	Prehypertension	111	112	114	115	117	119	119
	Stage 1 HTN	115	116	117	119	121	122	123
	Stage 2 HTN	127	128	130	132	133	135	135
11	Height (cm)	135	137	142	146	151	156	159
	Prehypertension	113	114	115	117	119	120	120
	Stage 1 HTN	117	118	119	121	123	124	125
	Stage 2 HTN	129	130	132	134	135	137	137
12	Height (cm)	140	143	148	153	158	163	166
	Prehypertension	115	116	118	120	120	120	120
	Stage 1 HTN	119	120	122	123	125	127	127
	Stage 2 HTN	131	132	134	136	138	139	140
13	Height (cm)	147	150	155	160	166	171	173
	Prehypertension	117	118	120	120	120	120	120
	Stage 1 HTN	121	122	124	126	128	129	130
	Stage 2 HTN	133	135	136	138	140	141	142
14	Height (cm)	154	157	162	167	173	177	180
	Prehypertension	120	120	120	120	120	120	120
	Stage 1 HTN	124	125	127	128	130	132	132
	Stage 2 HTN	136	137	139	141	143	144	145
15	Height (cm)	159	162	167	172	177	182	184
	Prehypertension	120	120	120	120	120	120	120
	Stage 1 HTN	126	127	129	131	133	134	135
	Stage 2 HTN	139	140	141	143	145	147	147
16	Height (cm)	162	165	170	175	180	184	186
	Prehypertension	120	120	120	120	120	120	120
	Stage 1 HTN	129	130	132	134	135	137	137
	Stage 2 HTN	141	142	144	146	148	149	150
17	Height (cm)	164	166	171	176	181	185	187
	Prehypertension	120	120	120	120	120	120	120
	Stage 1 HTN	131	132	134	136	138	139	140
	Stage 2 HTN	144	145	146	148	150	151	152

NIH Publication 07-5268
May 2007

APPENDIX VIII

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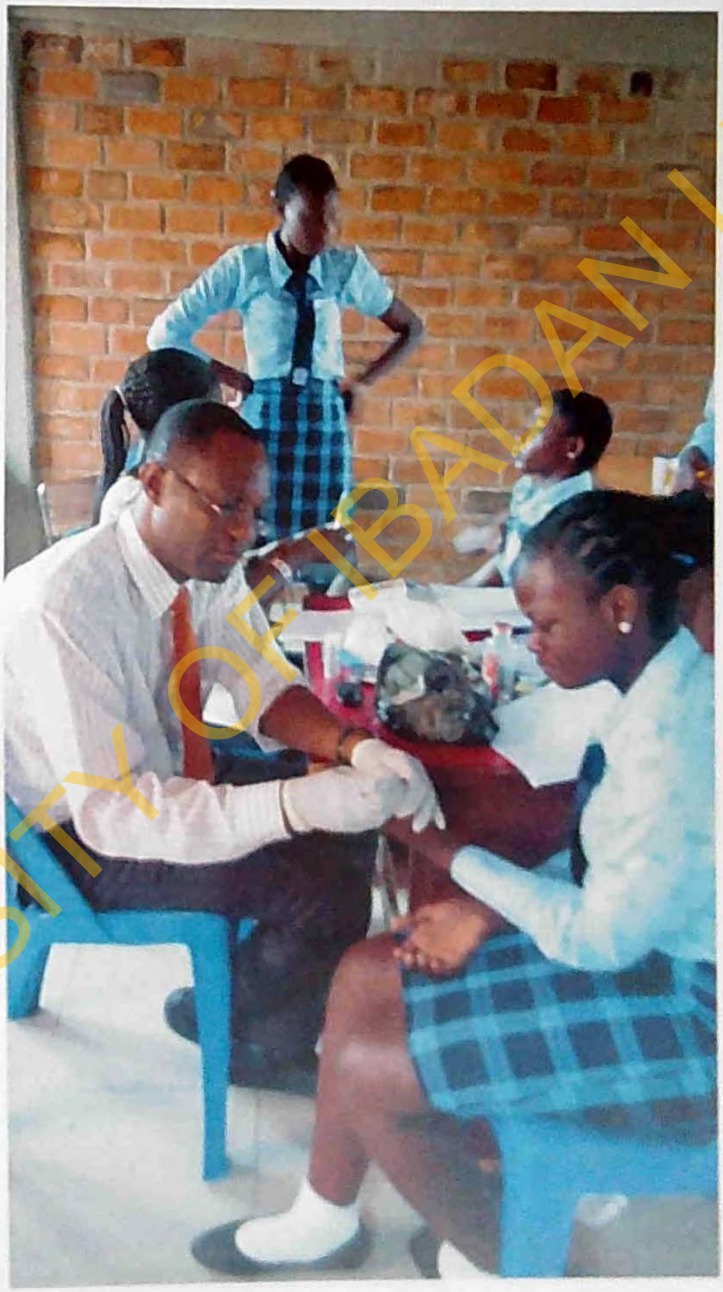
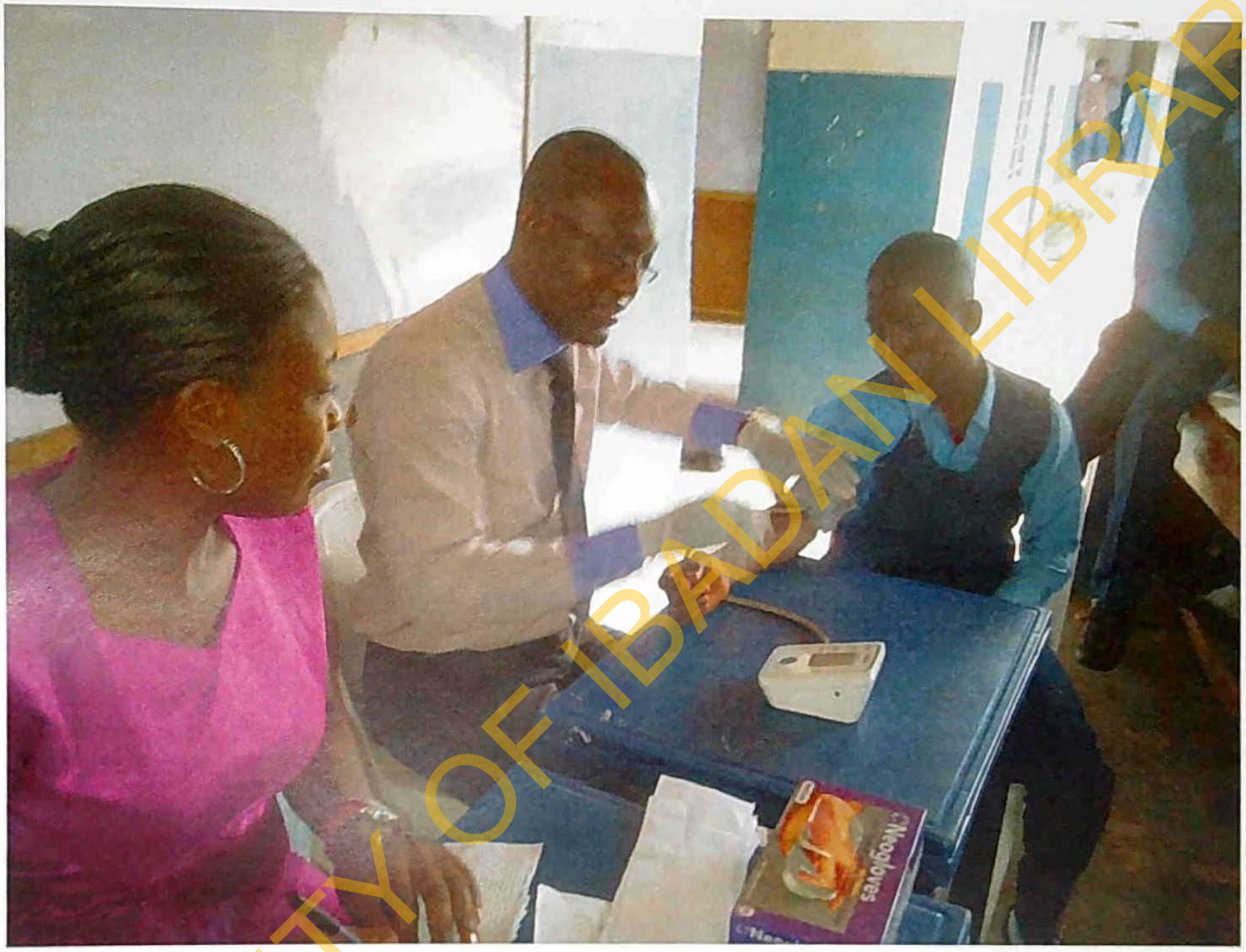


APPENDIX IX

APPENDIX X



APPENDIX X